BASS DROP!

BASS

IN MODERN POPULAR

DANCE MUSIC

Dissertation
submitted in fulfilment of the requirements for the academic degree
Doctor of Philosophy (Dr. phil.)
at the Faculty of Humanities
of Universität Hamburg

SUBMITTED BY

Lars Schmedeke

Hamburg, 2021

First reviewer: Prof. Dr. Rolf Bader
Second reviewer: Prof. Dr. Albrecht Schneider
Third reviewer: Prof. Dr. Martin Pfleiderer

Date of disputation: 1 June 2022

Electronic publication:

This dissertation is published online in the repository of the University of Hamburg.

Persistent Identifier (URN):

urn:nbn:de:gbv:18-ediss-138008

https://nbn-resolving.org/urn:nbn:de:gbv:18-ediss-138008

Abstract (EN)

Popular modern dancing music styles like Hip Hop, House or Techno occupy a large fraction of current western everyday musical practice. In these musical genres the bass is a central element. This dissertation provides a cultural history of popular dancing music with emphasis on its roots in Soul, Funk, Disco & Reggae and a focus on musical, sociocultural and technological developments.

On this foundation valid models of perceptive “bassness” are introduced: The momentary fatness and the integrated fatness. These are based on extensive empirical work encompassing one psychoacoustic listening test as well as two online questionnaires – one of which is conducted among 37 professional DJs. This research employs a well-founded sample of 100 relevant original recordings from dance music history. The quality of the fatness models is demonstrated by two sample applications, one of which is a selforganizing Kohonen-Map, that is able to differentiate similarity between songs from different musical genres.

Abstract (DE)

Die populäre moderne Popmusik nimmt mit Stilen wie Hip Hop, House oder Techno einen großen Teil der aktuellen, westlichen Musikpraxis ein. In ihr ist der Bass ein zentrales Element. Diese Dissertation beschreibt die populäre Tanzmusik und ihren Bass zunächst aus kulturhistorischer Perspektive unter besonderer Berücksichtigung von Soul, Funk, Disco und Reggae. Beschrieben werden insbesondere musikalische, soziokulturelle und technologische Entwicklungen.

Darauf aufbauend werden mittels mehrerer empirischer Erhebungen valide Modelle der perzeptiven Basshaftigkeit von Schallen vorgestellt: Die momentane Fettheit sowie die integerierte Fettheit. Die Erhebung umfasst einen psychoakustischen Hörtest und 2 Online-Befragungen - davon eine unter 37 professionellen DJs. Hierbei kommt ein ausführlich diskutiertes Sample aus 100 relevanten Original Mastern der Tanzmusikgeschichte zum Einsatz. Die Güte dieser Modelle wird unter anderem am Training einer selbst-organisierenden Kohonen-Karte zur Musikdifferenzierung demonstriert.

Figure 1: **Circular projection of the core loop from "A Love I Can Feel" (43)**
From outermost to innermost:
SPL < 200 Hz, momentary fatness, autocorrelation of momentary fatness, predicted rimshot position
Color coding: spectral centroid of the respective band (green indicates low values, red indicates high values)

Acknowledgements

Modern popular dance music can, without doubt, be regarded as the subject of my life's work. Not only in my academic research, but also throughout my twenty years as a professional disc jockey, promoter, and music producer, beats, bass, and groove have been constant companions. I consider the freedom to research this subject in such breadth and depth a great privilege, and I am grateful to many people for making this possible:

My special thanks go to my doctoral supervisor, Professor Rolf Bader, who encouraged me to pursue this path and granted me the academic freedom to develop the topic according to my own expertise. He was always available with valuable advice, critical perspective, and inspiration.

I would also like to thank Professor Albrecht Schneider, my second reviewer, for his thorough and constructive criticism, which helped me sharpen this dissertation. My thanks also go to Michael Blaß for kindly making his excellent Apollon code available to me, and to Dr. Tim Ziemer for his helpful and detailed comments on my research.

I am equally grateful to those who encouraged and motivated me to pursue the empirical study of music as a perceptual phenomenon. This applies in particular to my dedicated music teacher Ille Schulte, as well as to my music psychology lecturers, Professor Martin Pfleiderer and Dr. Klaus Frieler.

I also wish to thank the many participants in the surveys conducted for this research. I am especially grateful to the numerous DJs who accompanied my musical path at different stages and whose expertise formed the basis of the expert survey. This, too, is part of the autobiographical dimension of this dissertation.

I thank my father, Dirk Schmedeke, and my brother, Finn Schmedeke, for their knowledgeable proofreading and for lending me numerous rare records. I also owe my deepest gratitude to my late mother, Susanne Schmedeke; without the generous support of my parents, I would hardly have been able to write this dissertation during the Covid pandemic, a period that was so difficult for us performing artists.

My greatest thanks, however, go to my wife Sisell Schmedeke, who always believed in me. Without her support, motivation, and criticism, I would never have come this far.

This dissertation is dedicated to you, *Habibti*.

Figure 2: **Circular Projection of the Core Loop from "King of My Castle" (96)**

From outside to inside:
SPL < 200 Hz, Momentary Fatness, autocorrelation of Momentary Fatness, predicted rimshot position.

Colour coding: spectral centroid of the respective band, with green corresponding to low and red to high.

Table of Contents

TABLE OF CONTENTS **7**

1. PREFACE **11**

2. POPULAR DANCE MUSIC, 1960–2020 ..... **16**

2.1 EARLY TECHNICAL DEVELOPMENTS 17

2.1.1 The Problem of Pre-Electric Bass Generation *17*

2.1.2 Transducers and early recording/playback techniques *19*

2.2 DANCE MUSIC CULTURE AND NIGHTLIFE BEFORE 1960 21

2.2.1 From West Africa to Rhythm & Blues *21*

2.2.2 Dance Culture under Prohibition and National Socialism *24*

2.3 TECHNOLOGICAL ADVANCES IN THE POSTWAR ERA 26

2.3.1 Advances in Recording and Playback Technology *26*

2.3.2 Pickups and the 1950s Fender Precision Bass *28*

2.4 THE 1960S: SOUL AND THE TWIST 33

2.4.1 The Twist and Solo Dancing *33*

2.4.2 Soul *38*

2.4.3 James Jamerson and the Motor-City-Bass *39*

2.5 DEDICATED BASS MUSIC: THE JAMAICAN SOUND SYSTEM CULTURE 48

2.5.1 Sound Clash – The Development of the Sound System and Toasting Style *48*

2.5.2 Versioning – Ska, Rocksteady and Reggae *52*

2.5.3 Dubwise – The Sound Engineer as Artist *63*

2.6 THE 1970S AND 1980S - FUNK AND DISCO 69

2.6.1 Funk *69*

2.6.2 Electronic Sound Production *73*

2.6.3 Kraftwerk *76*

2.6.4 Disco Culture as an Underground Phenomenon (1968-1975) *76*

2.6.5 Disco Culture as a Mainstream Phenomenon ... *80*
2.6.6 The Digitization of Music Production ... *86*
2.7 Hip Hop ... 89
2.7.1 Hip Hop als Performance-Kultur ... *90*
2.7.2 Hip Hop as a Recording Culture ... *93*
2.7.3 Hip Hop as a Global Youth Culture ... *98*
2.7.4 Miami and the Bass Sound ... *102*
2.7.5 Hip Hop from 1987 to 2020: Further Substyles and Their Significance ... *103*
2.7.6 Dancehall and Bass Music in the Global South ... *109*
2.8 Electronic Dance Music ... 117
2.8.1 Chicago and the Birth of House ... *117*
2.8.2 Detroit and the Birth of Techno ... *123*
2.8.3 Rave as Dance Culture ... *126*
2.8.4 British Divergences ... *129*
2.8.5 Further Electronic Substyles ... *135*
2.9 Modern Popular Dance Music by 2020 ... 142
2.9.1 Modern Popular Dance Music as a Cultural Phenomenon ... *142*
2.9.2 Characteristics of Modern Popular Dance Music ... *145*
1.9.3 Der Bass in der modernen, populären Tanzmusik ... *149*
3. EMPIRICAL APPROACH TO FATNESS ... 156
3.1 Bass in Scholarship ... 157
3.2 Psychoacoustic Perspective ... 163
3.2.1 Critical Bands ... *166*
3.2.2 Sottek's Auditory Model ... *168*
3.2.3 The Parameter of Sharpness as a Working Basis ... *169*
3.2.4 Measures of Loudness ... *172*
3.2.5 Weitere Audio Features ... *174*
3.2.6 Measures for Music and Human Perception ... *180*
3.3 Machine Learning ... 181
3.3.1 Neural Networks and Self-Organizing Maps ... *182*
4. FATNESS AS A PSYCHOACOUSTIC PARAMETER ... 184
4.1 Exploratory Online Survey ... 187
4.1.1 Experimental Procedure ... *187*
4.1.2 Test Sounds in Typical Playing Styles ... *187*

4.1.3 Demographics *188*
4.1.4 Results *189*
4.2 Listening Test 195
4.2.1 Experimental Design *195*
4.2.2 Conduct of the Listening Test *197*
4.2.3 Hypothesen *202*
4.3 Linear Model 203
4.4 Analysis of Contributing Factors 206
4.4.1 Loudness > 200 Hz *207*
4.4.2 Loudness >200Hz *208*
4.4.3 Spectral Centroid < 200 Hz *209*
4.4.4 Signal-to-Noise-Ratio <200Hz *210*
4.5 Non-linear Model 211
4.6 Discussion 214

5. APPLICATION-ORIENTED FATNESS MODEL 215

5.1 Requirements for a Fatness Model for Musical Sounds 216
5.1.1 Considerations Regarding Tonality *216*
5.1.2 Considerations Regarding Temporal Resolution *217*
5.1.3 Considerations Regarding the Data Basis *218*
5.2 A Representative Sample of Popular Dance Music 221
5.2.1 Tracks 1-25 ..... *221*
5.2.2 Tracks 26-50 ..... *230*
5.2.3 Tracks 51–75 ..... *239*
5.2.4 Tracks 76-100 ..... *247*
5.3 Online Survey 258
5.3.1 Experimental Setup *258*
5.3.2 Implementation and Demographics *262*
5.3.3 Analysis of Expertise *265*
5.3.4 Fatness vs. Time *266*
5.4 Momentary Fatness 269
5.4.1 Requirements *269*
5.4.2 Analysis of Contributing Factors *269*
5.4.3 Modelling *284*
5.4.4 Diskussion *287*
5.5 Integrated Fatness of Musical Sounds 293

5.5.1 Requirements ... *293*
5.5.2 Analysis of Contributing Factors ... *293*
5.5.3 Modelling ... *307*
5.5.4 Discussion ... *308*

6. APPLICATION EXAMPLES ... **319**

6.1 SELF-ORGANIZING MAP ... 320
6.1.1 Feature Selection ... *320*
6.1.2 Differential Analysis of the SOM Clusters ... *327*
6.1.3 Analysis Using a Test Sample ... *331*
6.1.4 Discussion of Plausibility within the Clusters ... *336*
6.1.5 Discussion ... *339*
6.1.6 Application Perspective ... *341*
6.2 CONSIDERATIONS ON THE CYCLICALITY OF DANCE MUSIC ... 343

7. OUTLOOK ... **348**

8. CONCLUSION ... **351**

BIBLIOGRAPHY ... **355**

LIST OF NOTATION EXAMPLES ... **395**

LIST OF FIGURES ... **396**

LIST OF TABLES ... **400**

EXPERIMENTAL INSTRUCTIONS: "DJS" ... **401**

DISCOGRAPHY ... **403**

TRAININGSSAMPLE REFERENCE ... **413**

TEST SAMPLE (B) REFERENCE ... **417**

COLOURS AND SYMBOLS ... **420**

STATEMENT ON THE USE OF AI-ASSISTED TOOLS ... **421**

1. Preface

When, after a charged moment of silence, - more present, more powerful than before - when anticipation, wound up by ever-quickening rolls and a rising sonic swell, is driven to the breaking point and culminates at a track's apex, we speak of the bass drop: the instant when music, restored to its full spectral weight and fatness, drives sweat-slicked bodies deeper into collective ecstasy (Solberg, 2014, pp. 70-71,77; Sloan & Harding, 2020, pp. 54-60).

It is a historical irony that, while this thesis was being written, modern popular dance music itself entered such a suspension. SARS-CoV-2 silenced turntables worldwide, and millions across disparate scenes found themselves awaiting the end of the swelling quiet - the post-pandemic bass drop when the global beat would resume on the floor.

Precisely this deepest rupture in the history of dance music offers a frame for looking back at the culture as a bounded phenomenon, a vantage this work seeks to use. No one can say when the pause will end, nor what it will mean for club culture and its music - but the contours of anticipation, suspension, and return provide a powerful lens through which to begin.

When we speak about contemporary popular dance music, "the bass" usually seems to occupy a privileged role. On closer inspection, however, the term proves diffuse. A range of instruments bears "bass" in its name - marking either a register or a supposed instrument class: the contrabass is literally a "bass violin," and the electric bass a "bass guitar." From the 1980s onward, the bass drum increasingly enters this discourse as well. Synthesizers, too, offer "bass" timbres without attempting to emulate any of the above instruments - the "TB" in Roland's famed TB-303, for instance, stands for "Transistor Bass." In parallel, the lowest portions of the audible spectrum are labeled "bass" (depending on the source, <250 Hz or <150 Hz) and even "sub-bass" (<80 Hz).

Yet neither instrument names nor frequency bands define the phenomenon adequately; in modern popular dance music, bass remains, in effect, an abstractum (Font-Navarette, 2015, p. 489). Yet there persists a conception of "bass" in modern popular dance music - clear, though tacit, and collectively held. This book sets out to approach that understanding.

The bass's privileged status is legible even in the marketplace of titles: on the electronic-dance–oriented platform Beatport, more than 111,000 tracks include the word "Bass," whereas fewer than 300 include "Treble."[1]

To clarify what this term "bass" denotes - across its physico-acoustic, musical, and sociocultural dimensions - and how it should be interpreted, we must first examine modern popular dance music.
For the purposes of this book, **"modern popular dance music" is defined as:**

> *Contemporary popular music of African-American lineage that is organized primarily around events in which the audience's dancing - rather than a live stage act - constitutes the principal performance.*

Representative styles include historical forms such as Soul, Funk, Rocksteady, Roots Reggae, and Disco, as well as contemporary genres such as Hip Hop, House, Techno, Dancehall, and Drum & Bass, together with their numerous substyles and derivatives. The term also encompasses regionally specific idioms from Africa, the Caribbean, and Latin America that have been strongly shaped by these traditions. Part I of this book situates these styles within their respective musical lineages and explains their development.

---

[1] As of 15 January 2019, www.beatport.com returned 111,305 results for the search term "Bass" and just 274 for "Treble."

Some core elements of this bass concept also surface, in part, within strands of Western pop and rock that are less directly shaped by the African diaspora. They are not treated further here, however, because the bass paradigm advanced in this study cannot be applied to those repertoires in a consistent way. In the more live-performance-oriented strains of hard rock, for example, the term "bass" is largely synonymous with the instrument designation "electric bass (guitar)."

A look at the German year-end singles chart for 2018, compiled by the Bundesverband Musikindustrie e.V., underscores the prominence of modern popular dance music: of the 100 listed tracks, only six can be classified unambiguously as outside this category, with a further five borderline cases - most of them rock ballads featuring guest vocals from hip-hop artists (Bundeverband Musikindustrie e.V., 2019 A similar picture emerges from Billboard's 2018 year-end Hot 100: Although fourteen tracks are not dance music and six are borderline cases - attesting to the relatively greater popularity of rock and country in the United States - it is nevertheless difficult to deny the stylistic influence of dubstep and EDM within these genres. (Billboard Magazine, 2019). It follows that modern popular dance music constitutes a substantial share of everyday musical practice in contemporary Western cultures.

Despite this music's cultural centrality, the scholarly record remains frustratingly limited - both in scope and depth. On one side stand studies that parse discrete sub-scenes without situating them in a wider frame; on the other, capacious surveys - above all the standard work by Brewster & Broughton (Brewster, 2006)) - that recount the field largely as the personal history of a participating cohort (here, DJs), leaving comparatively little analytical space for the music itself. This mirrors a broader tendency in hip-hop and techno studies to privilege sociological over music-analytical inquiry. For example, in Forman's Hip-Hop Studies Reader (Forman, 2004) , the section on "Music" occupies roughly the same extent as the section on "Gender and Hip Hop," one sociological topic among many. Without denying the importance of such concerns, this book seeks to help establish a holistic - and explicitly musical - perspective on modern, popular dance music. Accordingly, substantial portions of what follows weave together musical, technological, and sociocultural perspectives in order, ultimately, to analyze "bass" within a clearly delineated frame.

Because musical styles and dance cultures are cumulative cultural techniques, I place particular emphasis on how bass-relevant properties emerge, evolve, and are carried across into other styles and substyles. While genre labels are, in the end, diffuse linguistic conventions for clusters of musical and cultural traits, the continuities - for example, between soul, funk, and disco, or between ska, rocksteady, and reggae - are unmistakable. Personnel and place-based continuities only reinforce the point. (It is customary to narrate this as a linear process, but that should be understood strictly as a heuristic simplification of an essentially non-linear development.) In this sense, many contemporary dance-music idioms are structured by features that first arose from earlier technological and sociocultural constraints, as well as from human needs and strategies of meeting them - features that, once unbound from their original contexts, nevertheless persist. One needs only think of dancing to recorded music: in eras of repression, records were easier to conceal than orchestras, and yet in liberal societies they remain the norm.

This raises, in turn, a set of questions central to the present book: what, precisely, do we mean by "bass"; how did its musical functions take shape; and how have interactions among music, society, and technological change come to define bass within modern popular dance music?

Building on this cultural account, the abstract category of "bass" can now be described empirically. As a property of sound, one might argue that bass belongs to the domain of acoustics. For listeners, however, it is a phenomenon of sensation - what Malcolm James, in relation to sound-system culture, even terms a form of "acoustic intimacy" (James, 2020, p. 20). Questions that link physically measurable stimuli to psychologically reportable experience fall within the field of psychophysics and its measures of sensation. Accordingly, in this dissertation the perceived bassness of sounds must be understood and specified as a psychoacoustic phenomenon.

In both scene vernaculars and specialist discourse, the perceived bassness of a sound is routinely glossed as its "fatness." The reputable German electronic-music magazine Groove, for example, observes that without the 12-inch single the "punchy bass lines of club music would not sound as fat as they do today" (Ditze, 2012, p. 34), Musicological writing likewise speaks of "fat basslines" (Budde, 2000, p. 61) The term is

equally established in English usage: Detroit techno historian Dan Sicko characterizes a “generally rich and full” bass as “fat” (Sicko, 2010, p. 72).

Accordingly, beyond clarifying the meaning and historical development of “bass,” this book asks which acoustic attributes make a bass *sound fat* to listeners - regardless of instrument label, instrument class, or nominal frequency band. To answer this, the present work undertakes a comprehensive empirical program comprising qualitative and quantitative surveys of DJs and scene participants, two psychoacoustic listening tests, and an expert elicitation with DJs applied to a meticulously curated corpus of dance-music recordings from 1960–2019. The corpus is assembled, with reference to the cultural history of dance music, from relevant original masters and analyzed in detail. From these data, the book derives psychoacoustic measures of fatness perception that can provide reliable predictions of perceived fatness from physically measurable parameters.

To demonstrate the musicological utility of these measures, this book presents two applications. First, it introduces a machine-learning–derived similarity map of the aforementioned compact, carefully curated corpus, grounded primarily in perceptual fatness. Second, it evaluates the suitability of an instantaneous fatness metric for enhancing the validity of rhythmic analyses across dance-music repertoires.

This book adopts an interdisciplinary approach, integrating perspectives from musicology, cultural history, sociology, acoustics, psychology, and inferential statistics/machine learning. Its aim is to provide a comprehensive account of bass as a central phenomenon of contemporary popular dance music, with particular attention to its emergence, relevance, and modes of operation.

2. Popular Dance Music, 1960–2020

To understand the role that bass assumes in contemporary, electronically produced dance music, a cultural-historical perspective is indispensable. Equally decisive are technical advances in the generation and reproduction of low-frequency energy and a series of cultural and sociocultural developments across youth culture, music culture, and nightlife.

On the technical side, three domains are paramount: instrument design, synthesizer technology, and sound reinforcement. Especially salient are the emergence of electrically amplified bass instruments; high-excursion, large-format loudspeaker drivers; the rise of synthesizers and drum machines (notably Roland's TR-808 *Transistor Rhythm*); and, later, sophisticated software synthesizers such as Native Instruments' Massive.

Culturally, the discussion follows the development of styles within the African-diasporic tradition - Reggae, Funk, Disco, Hip Hop - and within electronic dance music - House, Techno, Dubstep. Equally important are transformations in the culture of dance events and music scenes that lead to contemporary forms of nocturnal musical life.

The entanglement of culture, technology, and society in relation to popular music and bass is exemplified by Julian Henriques's reflections on Jamaican sound-system culture. As D'Errico notes, Henriques's notion of "bass/base" culture enables an integrated analysis of sound, culture, and social life. In *Sonic Bodies: Reggae Sound Systems, Performance Techniques, and Ways of Knowing*, Henriques characterizes "bass" culture as at once sonic and sociocultural: "it is the high volume, low frequencies -

rather than mid or top - and distinctive rhythmic patterning that make Reggae's auditory vibrations memorable, quickly becoming culturally laden" (D'Errico, 2015, p. 3) The discussion that follows proceeds largely chronologically in order to clarify causal relationships and the diffusion of stylistic features..

2.1 Early Technical Developments

Numerous pioneering inventions relating to dance and nightlife culture, as well as to the recording and reproduction of music, were developed in the second half of the nineteenth century. In the following, I will discuss the development of the gramophone record, the loudspeaker, and the microphone.

> "Since 1877, sounds could be properly - preserved - saved for eternity. With that date the history of the DJ begins." (Poschardt, 1997, p. 224)

2.1.1 The Problem of Pre-Electric Bass Generation

Before electrically amplified instruments, producing loud low-frequency tones was intrinsically difficult. Owing to the ear's reduced sensitivity at low frequencies, tones of equal sound-pressure register as markedly softer in the bass than in higher registers. (Schneider A. , Psychophysics / Psychoacoustics, 2018, p. 578) . To generate deep tones at comparable loudness, builders therefore relied on large resonant bodies capable of sustaining high sound pressure - hence the imposing size and weight of instruments in the contrabass family. A double bass, with a scale length of roughly 110 cm, reaches the sub-bass down to about 41 Hz; because such frequencies are perceived as relatively quiet, a symphony orchestra typically fields up to eight double basses. Palace and church organs, developed between the ninth and sixteenth centuries, push still lower - audibly approaching the infrasonic range around 16 Hz - by means of pipes up to 11 m in length and an external wind supply once provided by as many as twelve calcants (bellows treaders) (Dickreiter M. , 1993, pp. 165-170, 191-192).

While low tones can of course be produced with percussion, this avenue brings its own constraints. A wide diffusion of drum types (membranophones) is documented across Africa from the sixteenth century onward; yet most designs, for reasons of scale, did not project convincingly into the bass. (Blades, 1992, p. 51) Drums and timpani enter

European art music in the eighteenth century, but truly deep and loud sonorities still demanded bulky, impractical constructions. Moreover, in contrast to aerophones and chordophones, idiophones (e.g., gongs, bells) characteristically yield far more complex overtone spectra when used for low sonorities

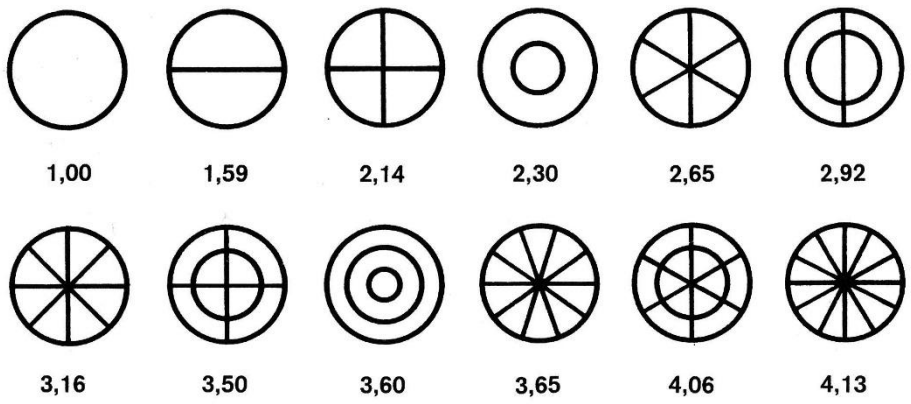


Figure 3: The first nodal points of a circular membrane and the frequencies as multiples of the fundamental frequency / Source: Dickreiter (1993), p. 158

Consequently, most drums are perceived as percussive rather than pitched. The European orchestral timpani mitigate this effect through a complementary secondary cavity resonance of the kettle. Beyond a few exceptions, however, drums possess an effective range of only a single pitch (Dickreiter M. , 1993, pp. 157,158).

The acoustic limitations of pitched instruments were not overcome until the 1950s with mature electric pickups and instrument amplifiers (see §2.3.2). In the percussion family the problem persisted even after the large military bass drum was incorporated into the modern drum set: because no electromechanical counterpart became standard, the bass drum remained effectively capped at roughly 20 W of acoustic power. (Morrison, 2018, p. 159) Close-miking was likewise problematic given the source's high sound-pressure levels and transient attack. More reliable control over overtone behavior and output level arrived only with the advent of drum synthesizers in the 1970s, a development that, in turn, elevated the "bass drum" as a primary component of the low-frequency spectrum. (see 2.6.2).

2.1.2 Transducers and early recording/playback techniques

The first direct precursor to modern sound recording was Édouard-Léon Scott de Martinville's phonautograph (1857). Crucially, Scott's device was not intended to reproduce recorded sound, but to render it visible as a graphic trace. Acoustic energy, collected by a horn, was transmitted mechanically to a stylus that inscribed the vibrations onto a soot-blackened rotating drum. Only in 2008 did the American scholar Patrick Feaster develop a procedure to render Scott's drawings audible, effectively "playing back" the nineteenth-century traces for the first time (Wile, 1982, pp 8-9; Théberge, Sound Recording Technologies, 2003, pp 259-260).

The first device to record and reproduce sound was Thomas A. Edison's phonograph, devised in 1876 and patented in 1877. Replacing Scott's soot drum with a metal-foil–wrapped cylinder, Edison's machine advanced the foil beneath a stylus by means of a hand crank so that acoustic vibrations could be incised and later replayed (Gironow, 2003, p 517; Millars, 2003, p 508).

Despite its public impact, the system suffered from poor durability of the foil medium and limited sonic fidelity - shortcomings that quickly became apparent in practice (Wile, 1982, pp. 19-20).

The development of electro-acoustic transducers - devices that convert fluctuations in air pressure into corresponding variations in electrical voltage - emerged as a byproduct of nineteenth-century telephony. Their application to musical recording came only later, as mechanical methods long predominated. The first microphone, devised in the United States in 1860 by Antonio Meucci as part of his telephone experiments, went unpatented; consequently, credit is often accorded to Alexander Graham Bell, who filed his telephone patent in 1876. While Thomas Edison's laboratory concentrated on the incandescent lamp toward the century's end, it was Bell who pursued improvements over Edison's prototype in the key dimensions of durability and sonic fidelity (Théberge, Microphone, 2003, p. 246).

Bell's team offered Edison a share in the commercial exploitation of their apparatus; he declined and, in 1887, brought his own phonograph to market. Incorporating only

incremental refinements on Bell's design, it became the first integrated recording-and-playback system used for the commercial distribution of music (Millars, 2003, p. 509). The first disc-shaped sound carriers were developed by Emile Berliner. Unlike Edison and Bell, Berliner revived the phonautograph's principle of lateral (rather than vertical) stylus motion. After extensive experimentation with materials to ensure groove durability, he arrived at a process for pressing celluloid discs from zinc matrices - the earliest gramophone records. One disadvantage of this approach, relative to the Bell/Edison systems, was the requirement for separate machines for recording and playback. Berliner was granted the first gramophone patent in 1887 (Théberge, Sound Recording Technologies, 2003, p. 260).

Berliner's model proved successful and quickly spawned numerous imitations - among them Pathé discs and Edison's Diamond Disc. None of these early formats were mutually compatible; they employed different playback speeds and even directions of rotation. Only the shellac disc, introduced in 1898, would coalesce into a broadly accepted standard by the end of the first decade of the twentieth century. Typically 10–12 inches in diameter, shellac records offered about 3 to 3½ minutes per side at 78 rpm and prevailed chiefly because of their superior durability (Bohrwick, Shellac, 2003, pp 520-521; Bohrwick, Record, 2003, p 519).

The shellac disc remained the dominant medium for commercial music distribution well into the 1950s (Tschmuck, 2009, p 141; Unger, 2001; Bohrwick, Shellac, 2003, p 521).

Without the development of electroacoustic transducers and recording media, modern popular dance music would be unimaginable. Both electrically amplified and electronic music depend on the fundamental transduction of acoustic pressure waves into electrical voltage. Likewise, the contemporary dance-music culture - one that centers the dancer's experience rather than the live performer's - could not have emerged in its present form without phonographic recording media.

2.2 Dance Music Culture and Nightlife before 1960

Although the stylistic forms of modern dance music only began to emerge in the 1970s, and although most of its direct precursors did not take shape until after World War II, it remains essential to examine the dance music culture of the early 20th century. Particularly relevant here are, on the one hand, the musicological examination of the fusion between African and European musical traditions that ultimately gave rise to Rhythm & Blues, and, on the other, the sociocultural constraints of repressive societies, which led subcultural groups to engage with dance music primarily through recorded sound rather than live performance.

2.2.1 From West Africa to Rhythm & Blues

At the root of virtually all modern popular dance music lies African American music - a syncretic tradition shaped by the merging of African and European musical elements. Although few sources document the earliest phases of this process, it is generally understood to have begun around 1740 with the Great Awakening, which marked the onset of systematic Christianization of enslaved people brought from West Africa to the United States via the transatlantic slave trade. In contact with European church music, African American communities developed a distinct body of religious song known as spirituals - repertoire that diverged significantly from the musical practices of the white majority (Burnim, Spiritual, African-American, 2012, p. 454).

In addition to elements drawn from Christian hymns, spirituals incorporate numerous features of West African musical practice: a steady fundamental pulse, general heterophony, and a characteristic call-and-response dynamic between a lead singer and the choir. Instrumentation also reflects African traditions - spirituals are largely vocal

music, accompanied only by body percussion such as clapping and stomping [2] (Burnim, Spiritual, African-American, 2012, pp 455-456; Watkins T. D., 2016, p 222; Peretti, 2009, pp 13, 17-18).

In contrast, the harmonic framework of spirituals is distinctly European, shaped by the adoption of tonal systems and harmonic progressions derived from Western music. As tonal instruments gradually became more accessible to African American communities during the 19th century, the blues pentatonic scale emerged - an African musical logic adapted to European tuning systems (Stanbridge, 2012, p 286; Peretti, 2009, pp 17-18 A more urbanized, religiously oriented offshoot of the spiritual is gospel music (Burnim, Gospel, African-American, 2012, p 233; Peretti, 2009, pp 126-127).

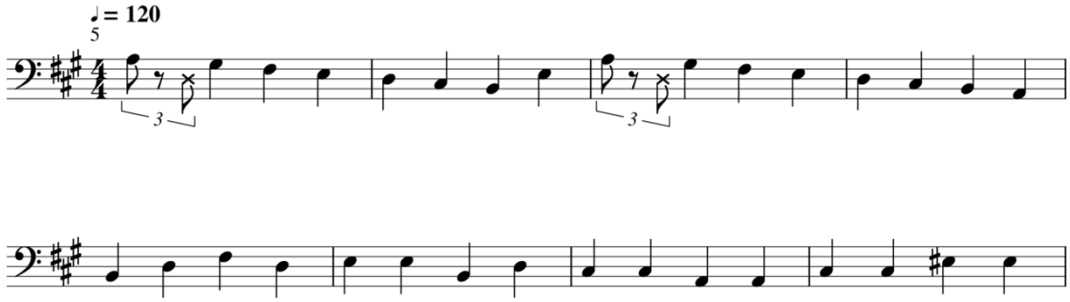
By the end of the 19th century, the blues had emerged in the American South as the first distinct form of African American popular music. It drew on a condensed, 12-bar adaptation of the European ballad, elements of Scottish folk song, and musical idioms inherited from spirituals. The so-called 12-bar blues scheme would go on to dominate the harmonic language of African American music up to the mid-1960s, and exert a formative influence on emerging genres such as beat and rock music (Olliver, 2012, pp 65-66; Peretti, 2009, p 68).

The 1920s saw the development of both early jazz and boogie woogie - two rhythmically dynamic, dance-oriented African American genres that benefited from the now-widespread availability of large instruments such as piano and drums. Jazz musicians pioneered a complex harmonic language and established improvisation as a defining feature of popular music. Perhaps their most enduring legacy to modern dance music, however, is swing - the rhythmic articulation of binary material with ternary micro-timing (Stanbridge, 2012, pp. 293-294).

---

[2] Even though large instruments - especially drums - were prohibited on most plantations, the inherently percussive nature of the music endured, which plausibly explains its distinctive reliance on non-instrumental sound sources.

Boogie woogie, by contrast, is a more straightforward, danceable form of the blues, often performed either by solo pianists or in dance orchestra and big band formats. Its hallmark is a distinctive bass pattern: the so-called walking bass, played by the pianist's left hand, the double bass, or both in unison. This bass line outlines the harmonic structure of the blues scheme through a regular, isochronous pulse, typically rising and falling in alternating motion. Frequently, it is enriched with passing tones. These tonal embellishments, directional shifts, and rhythmic regularity are clearly audible, for instance, in Nina Simone's "My Baby Just Cares for Me" (see score excerpt 1).



Notation 1: Nina Simone "My Baby just cares for me" Walking Bass (excerpt) / Scource: author's transcription

Boogie Woogie was the dominant form of dance music during the Juke Joint era (see. 2.2.3) and the first African American musical style to be positively received by the white mainstream. However, its popularity declined with the onset of World War II (Poloney, 2012, pp. 87-90) The walking bass not only defined the role of the bass in the African American musical tradition as a link between harmony and rhythm; it also overcame the issue of insufficient sonic projection that had plagued bowed playing, by utilizing the clearer and more penetrating tone of plucked strings. The convention that something could function as a "bass" line without being played on a dedicated bass instrument also begins to emerge during this period.

Following the economic transformations of the postwar United States, there was a massive migration of African Americans from the South to the Northeast and to California. The musical expression of these sociocultural shifts was the development of Rhythm & Blues. This genre serves as an umbrella term for a range of styles combining elements of jazz, blues, and boogie woogie. Its harmonic foundation typically remains tied to the 12-bar blues form (occasionally the 16-bar variant), regardless of whether

the piece is a blues-inflected doo-wop ballad or a fast-paced shout song in the tradition of boogie woogie and Kansas City jazz. The walking bass of boogie and the swing feel of jazz are central stylistic features of Rhythm & Blues (Bowman, Rhythm & Blues, 2012, pp 392-395; Peretti, 2009, p 138-139). Rhythm & Blues may be regarded as the last common ancestor of nearly all modern popular music. The genealogical line of rock music, for instance, begins with rock 'n' roll - a hybrid of Rhythm & Blues and country music (Peretti, 2009, p. 139). Likewise, the lineage of soul music - which ultimately forms the basis of all modern popular dance music as understood in the context of this study - can also be traced back to Rhythm & Blues.

2.2.2 Dance Culture under Prohibition and National Socialism

The development of popular dance music - that is, music that foregrounds the performative act of the listener rather than that of the performer - was significantly shaped by two repressive historical moments in the first third of the 20th century: Prohibition in the United States and National Socialism in Germany and France.

Between 1922 and 1933, a nationwide alcohol ban was enforced in the United States. Estimates suggest that around 30,000 illegal bars - known as speakeasies or juke joints - operated during this time, attempting to evade detection by the mere 2,300 Prohibition agents. The use of jukeboxes - coin-operated machines that played shellac singles - was far less conspicuous than hiring jazz bands and offered audiences, for the first time, the opportunity to dance to popular music without the need for live performance. The repeal of Prohibition led to a resurgence in the popularity and perceived value of live music in the United States (Disco: A complete history, 2012; Laing, 2003, pp 513-514).

he first documented venues to offer recorded music specifically for dancing, as an alternative to live performance, were located in occupied Paris in the early 1940s. The most prominent of these was the eponymous La Discothèque, which opened in 1942. (Shapiro, 2007, pp. 22-23).

During the German occupation, live jazz performances were banned as "degenerate art." Audiences began to seek out new ways to access the now-prohibited music. They found refuge in inconspicuous, unofficial basement venues on the Left Bank. Since a

record player was far easier to conceal than a full jazz band, music began to be selected and played from shellac records - marking the first documented precursor to the modern disc jockey (Poschardt, 1997, p. 103).

In Germany, the 1937 ban on swing dancing prohibited public performances of swing, jazz, and bebop. Afro-American music was deemed culturally degenerate by the regime's racial ideology and was also associated with wartime enemies such as the United States and Great Britain. The "Swing Youth," a countercultural movement opposed to both the Hitler Youth and Nazi conformity, was increasingly targeted by state repression. These measures intensified with Germany's entry into the war in 1939, the "Immediate Action against the Swing Youth" in 1941, and a complete ban on dancing following the defeat at Stalingrad in 1943. Punishments ranged from forced haircuts to deportation to concentration camps.

To avoid persecution, gatherings of the self-identified Swing Kids moved from public dance halls - such as Hamburg's Alsterpavillon and Berlin's Tanzpalast Moka Efti - into private spaces, where dancing took place to the sounds of shellac records. Many Hamburg-based swing enthusiasts were very young and came from wealthy, bourgeois households. In the well-equipped basements of these patrician homes, they felt comparatively safe from the Gestapo and the Hitler Youth. Beginning in 1941, they distributed underground flyers to invite trusted guests to clandestine dance events featuring music played on gramophones

(Kater, 1992, p. 155; Shapiro, 2007, pp. 19-21).

The success of *La Discothèque* inspired numerous imitators, particularly in Paris, where basement bars featuring recorded music flourished even after the end of the war. One of the most notable was Whiskey à Go-Go, founded in 1947, which hosted the first documented event in 1953 where music was played continuously using two turntables. The first public appearance of a disc jockey, however, is generally credited to Jimmy Savile, who later became a radio and television presenter (*Top of the Pops*), performing in 1943 in Otley, England. In the United States, similar events known as platter parties did not become widespread until the early 1950s (Brewster & Broughton 2000: pp 44-46; Shapiro, 2007, pp 24, 30-31).

2.3 Technological Advances in the Post-war Era

While a form of music - and with it, a culture - had emerged that was specifically designed for dancing and placed significant emphasis on the bass register, the technical means to reproduce such music effectively remained limited. On the one hand, instruments capable of producing low-frequency sounds tended to suffer from poor ergonomics, inadequate acoustic projection, and high cost. On the other hand, substantial challenges remained in the recording, storage, and playback of low-frequency signal conten (George, Sample This, 2004, p. 438). These limitations were eventually overcome by groundbreaking technological developments in the postwar years - developments that would also shape the sound and production of modern dance music.

2.3.1 Advances in Recording and Playback Technology

During World War II, shellac became increasingly scarce due to its use in the arms industry, making it largely unavailable for record production. This shortage paved the way for the adoption of polyvinyl chloride (PVC) as a material for phonograph records. As early as 1931, the electronics company RCA had introduced a vinyl-based record - marketed as *Victrolac* - for professional use in radio broadcasting. The U.S. Army later relied on this medium to produce training and entertainment records for troops stationed in Europe and Asia (Barton, 1934, pp. 179,182).

After the war, the more affordable, lightweight, and durable vinyl material became increasingly available to consumers. In 1948, the 12-inch LP (33 RPM) was standardized, followed by the 7-inch single (45 RPM) in 1949. Stereo channels were added to the standards in 1958. The 45/45 stereo groove format allowed for full mechanical compatibility between mono and stereo playback systems, with the left and right channels encoded on opposing 45-degree groove walls. Additional advantages of vinyl over shellac included significantly longer playing times - made possible by the smaller groove size (*microgrooves*) - as well as the ability to reproduce the entire audible

frequency spectrum. This was especially relevant in the accurate rendering of frequencies below 500 Hz, which had previously been subject to significant low-frequency roll-off in prior formats. The modern vinyl record can thus be regarded as a crucial step in the development of bass-oriented dance music as a recorded medium (Bohrwick, Vinyl, 2003, S. 524; Bohrwick, Record, 2003, S. 519).

The special significance of the vinyl record for modern popular dance music lies in the fact that it provided the foundation for the practice of the disc jockey. DJs were initially responsible for selecting music for dance events without live performance; beginning in the 1970s, they increasingly took on the task of blending sound material in real time. Moreover, they played a central role in shaping a variety of musical styles. In this context, the tactile and mechanical manipulability of vinyl proved so effective that it remained the dominant medium for DJ performance well into the 21st century (Pfleiderer, Live-Veranstaltungen von populärer Musik und ihre Rezeption, 2008, p. 93).

The challenge of full-range audio recording found its counterpart in the challenge of full-range playback. In the early days of audio technology, it was not yet possible to reproduce the entire range of human hearing. Engineers struggled in particular with achieving a linear frequency response and the generation of low frequencies.

One key breakthrough came in the early 1950s with the development of the non-developable diaphragm. Unlike flat diaphragms, this conical shape could not be flattened onto a two-dimensional surface. This design significantly reduced the unwanted non-linearities in the frequency response of conventional loudspeakers (Buchmann, 1954, pp 64-65; Möser, 2012, p 375).

The issue of rendering low frequencies audible was addressed in 1961 by A. Neville Thiele and Richard H. Small, who established the mathematical foundation for calculating loudspeaker enclosures - now known as the Thiele/Small parameters. These principles, especially the discovery of the bass reflex (or vented-box) design, enabled much louder and more accurate reproduction in the low-frequency range, thus facilitating a frequency response more attuned to human hearing (Hartmann, 2013, pp 201, 205; Borwick, 2003, p 516).

2.3.2 Pickups and the 1950s Fender Precision Bass

The induction pickup developed in 1931 by George Beauchamp and Adolph Rickenbacher (later Americanized to Rickenbacker) marked the point at which the electric amplification of string instruments became commercially viable. Initially, however, this technology was primarily applied to guitars, which - more than the double bass - struggled to compete sonically with the brass sections and increasingly standardized drum kits of the 1920s and 1930s.

The instrument that would ultimately exert the most significant influence on the shaping of the low-frequency spectrum in contemporary popular music was the electric bass. While various instrument makers had sought to address the audibility issues of bass instruments since the invention of the electromagnetic pickup, it was guitar builder Leo Fender who, in the 1950s, succeeded in creating an entirely new instrument concept that proved both commercially and artistically successful. (George, Sample This, 2004, p. 438)

The double bass continued to serve as the standard low-end instrument well into the early years of Rhythm & Blues and Rock'n'Roll. Yet, numerous practical and acoustic drawbacks created a clear need for innovation in this domain. First and foremost was the instrument's sheer size: even a ¾-sized upright bass was difficult to transport from one performance to the next. It would not fit in a car trunk or backseat and often had to be precariously mounted on the roof of a vehicle, exposed to the elements.

In addition, although pizzicato playing offered greater sonic projection than bowing, the instrument still struggled to assert itself in ensembles where drum kits had become the accepted rhythmic standard, brass sections were increasingly loud, and guitars were electrically amplified. As a result, the acoustic double bass increasingly faded into the background.

Initial attempts at solving this problem date back to the 1920s and typically involved electric versions of cellos or upright basses, reduced to strings (and their necessary supports) and a pickup. Notable examples include the electric cello developed by Lloyd Loar for Gibson, whose pickup converted bridge vibrations into voltage, and George Beauchamp's Rickenbacker bass, which featured a more efficient string-based

pickup system. This instrument used metal-wound gut strings that interacted directly with the pickup's magnetic field, minimizing energy loss in signal transmission.
At just 145 cm long and 15 cm wide, the Rickenbacker bass was significantly more compact and portable than its purely acoustic counterparts, though it required external amplification. The basic concept was further explored by manufacturers such as Vega and Regal in the late 1930s and throughout the 1940s. In many cases, the amplifier doubled as a stand for the instrument, or was even integrated directly into the instrument's body
(Smith R. R., 2005, pp. 100-101).

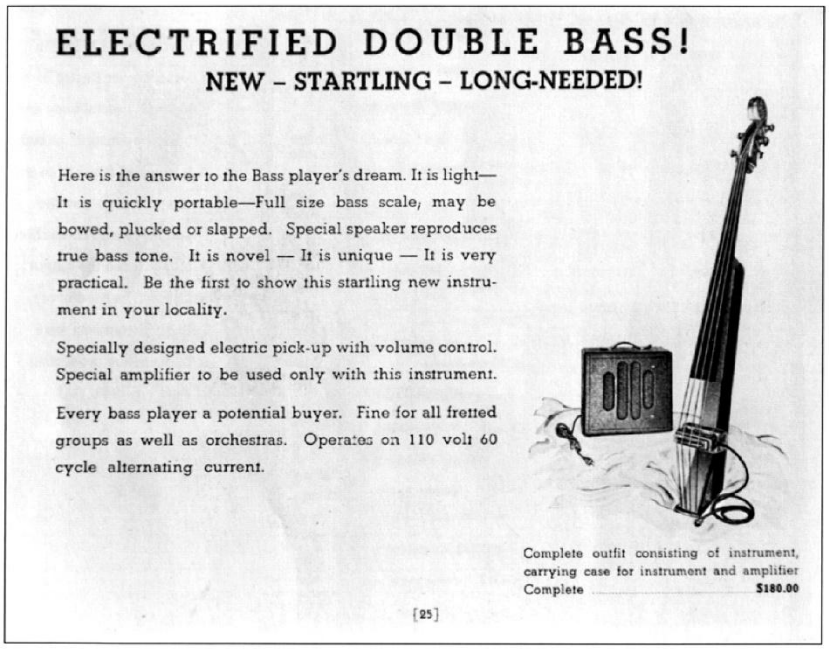


Figure 4: advertisement for the "Electrified Double Bass" /
Source: Regal Musical Instrument Company, 1936. Rights holder not identified; original publisher/manufacturer defunct.
Image quotation pursuant to § 51 of the German Copyright Act (UrhG); not covered by the Creative Commons license of this dissertation.

Another precondition for the development of the Precision Bass was the surplus of guitarists on the American music market. As many dance orchestras were downsized in the late 1940s, guitarists who were not also capable of playing bass often lost their jobs. This created a demand for bass instruments that could be played like guitars - for instance, with frets. Acoustic solutions to this problem had existed for some time. In the 1910s and 1920s, for example, Gibson had developed the Mando-Bass, a large-

bodied, fretted upright instrument that was smaller and lighter than a double bass and relatively easy for guitarists to learn. However, the Mando-Bass suffered from a critical lack of sustain: long tones could only be extended through continuous tremolo.

Other early fretted bass instruments included the Dobro resonator bass, designed for the country music market in the 1930s, and the Regal bass guitar of 1937 - neither of which successfully addressed the core issues of volume and sustain (Smith R. R., 2005, p. 101ff)

Inspired both by early electric bass prototypes and by bass instruments designed to be played in ways similar to guitars - such as those featuring frets - Leo Fender began developing a new type of bass guitar in the early 1950s. As the foundation for his design, he used the Telecaster (originally introduced in 1950 as the Broadcaster), an electric guitar he had previously developed (Bacon & Day, 1999). n shaping the instrument, Fender sought advice from several prominent musicians in jazz and country music, including Oscar Moore of the Nat King Cole Trio.

Due to technical requirements, the Precision Bass featured a larger body than the Telecaster and a scale length of 86 cm (34 inches). In order to improve access to the upper register and reduce the instrument's weight, Fender incorporated deep cutaways into the body design - a feature he would later adopt for his iconic Stratocaster guitar (see Figure 5)

The instrument was equipped with a four-pole single-coil pickup, designed to capture the vibration of the steel strings. While early prototypes of the Precision Bass used piano strings, Fender commissioned custom strings for serial production from V. C. Spier & Kluson. Sonically, the Precision Bass was initially conceived to emulate the tonal character of a double bass. This was achieved through the use of flatwound strings and a rubber string mute. However, it soon became common practice to remove the mute and eventually to use roundwound strings in order to achieve a brighter, more defined, and stylistically independent tone.

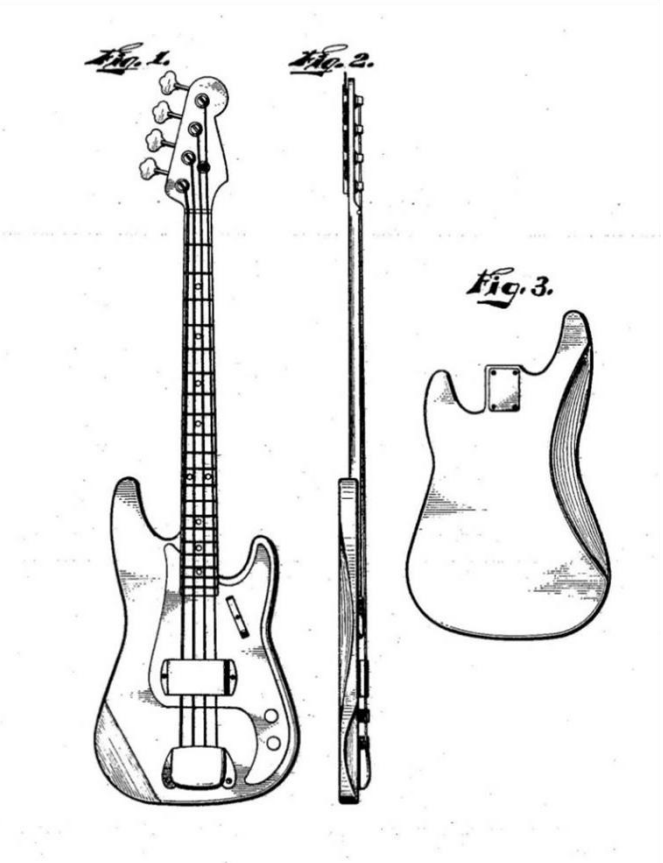


Figure 5: Clarence L. Fender, patent drawing for "Bass Guitar," U.S. Design Patent No. D187,001, U.S. Patent Office, January 5, 1960. Public domain.

The name *Precision Bass* primarily refers to the instrument's fretted fingerboard, which - unlike the fretless fingerboards of violin-family instruments - allowed for precise intonation even when finger placement was slightly inaccurate. In addition, the use of state-of-the-art machinery from Race & Olmsted in its manufacture enabled a highly consistent construction and a harmonically rich overtone spectrum, which had not been achievable with its acoustic predecessors. As with all of his instrument designs, Leo Fender placed great emphasis on ensuring that the instrument could be manufactured industrially at high quality. The result was the first mass-produced electric bass guitar, which rolled off the production line in October 1951.

However, the electric bass guitar was only one half of a dual system. As of 1951, there was still no suitable amplifier available to meet the instrument's requirements. Earlier bass amplifiers had been significantly underpowered: for instance, the model offered by Vega produced only 18 watts. Moreover, prewar bass amplifiers had a reputation for delivering poor sound quality.

Fender responded to this gap by designing the Bassman amplifier, model 5B6, as a dedicated counterpart to the Precision Bass. It featured a 15-inch speaker capable of reproducing low frequencies with accuracy. With 26 watts of output power, the Bassman was still modest by today's standards, but represented a 45% increase over the Vega model (Smith R. R., 2005, p. 103 ff).

A technical innovation of the Bassman was the positioning of its circuitry on the bottom panel of the enclosure. This design reduced the risk of damage from low-frequency vibration and minimized unwanted mechanical noise, thereby improving the amplifier's durability and sonic performance.

Prior to the launch of the Precision Bass and Bassman amplifier, Fender had mainly catered to the country music scene of the American West Coast and Midwest, producing guitars and slide guitars with a matching cowboy image. With these new products, however, the company gained traction on the East Coast and entered the markets for jazz and popular entertainment music. The electric bass quickly became the standard low-end instrument for nearly all rock and Rhythm & Blues bands, as well as for the numerous genres that would evolve from them - at least until the digital revolution.

In the years that followed, a wide range of manufacturers - including Gibson, Höfner, and Rickenbacker - adapted Fender's concept, producing their own electric bass guitars whose specifications closely followed the template established by the Precision Bass. Bassists such as Paul McCartney would go on to achieve global fame playing instruments directly inspired by Leo Fender's design.

What Fender achieved was nothing less than a solution to the long-standing challenges of bass instruments: size and portability, audibility in ensemble contexts, and sustain. He did so by inventing an entirely new instrument - one that would go on to shape the sound and structure of popular music for decades to come

(Smith R. R., 2005).

2.4 The 1960s: Soul and the Twist

Fueled by technological, musical, and cultural progress, African American musical culture finally broke through into the international mainstream in the 1960s. While Rhythm & Blues had still been categorized as *race music* by record labels such as Chess in 1950s America, its subsequent developments - leading up to the broader umbrella term *Soul* - rose to become the *Sound of Young America*, particularly under Barry Gordy's Motown and Tamla labels, and to a lesser extent through Stax/ATCO. Of particular importance in this transformation were two developments: the abandonment of rigid partner dances in favor of fashion-driven solo dances such as the Twist, and the introduction of prominent, more progressive basslines in mainstream hits by James Jamerson, bassist of the Funk Brothers.

2.4.1 The Twist and Solo Dancing

Derived from the "wringin' and twistin'" dances documented as early as the 1890s on Southern U.S. plantations (Welsh-Asante, 1998, p. 106), the **Twist** emerged in the early 1960s as part of a wave of fashion-driven dances that, unlike earlier partner dances such as the Lindy Hop, required no fixed choreography, rehearsed steps, or designated partner.

> "The Twist caused a revolution because of its simplicity. It required no partner, no routine, no ritual, no training. All it needed was a record and a set of loose limbs. […] Because it wasn't couples dance […] it unified a group of dancers. Dancing the twist, you were no longer focused on your partner, you were partying with a whole room full of people."
> (Brewster, 2006, p. 66)

This shift allowed dancers - especially women - to dance individually, replacing the intimacy of couple-based dancing with a collective experience of individuals sharing the floor. No longer were women expected to wait for an invitation from a male partner or for a designated "ladies' choice"; instead, the Twist allowed them to dance freely, on their own terms (Brewster, 2006, p. 66).

Whereas the classic Rock'n'Roll era had focused heavily on the stage presence of performers such as Elvis Presley, Chuck Berry, or Jerry Lee Lewis, the rise of the Twist marked a shift in focus toward the performance of the dancing audience itself (Sam Houston State University, p. 1).

The Twist originated informally among African American teenagers and was first observed in 1959 by Rhythm & Blues singer Hank Ballard, who was inspired to record and release the song *"The Twist"* as the B-side of a single. Ballard's original version became a local hit in Philadelphia and entered the Billboard Hot R&B charts for three weeks in April 1959 (Billboard Magazine, 1959). Dick Clark, host of the widely influential music program *American Bandstand*, recognized the commercial potential of both the song and the dance and initiated a re-recording of the track in 1960 with Chubby Checker as the performer. The new version was released on the Cameo Parkway label, in which Clark held a financial stake.

The song, the dance, and the figure of Chubby Checker were all optimized for mainstream success and prominently promoted on *American Bandstand*. Although both Ballard and Checker were Black, Checker's significantly lighter skin tone made him more marketable to white American audiences at the time. Moreover, his humorous and dance-heavy stage performances - his name itself a playful spoof of *Fats Domino*, the highly successful Rhythm & Blues singer and pianist of the 1950s - made him a more commercially viable figure. On *American Bandstand*, Checker even taught the Twist to the U.S. public using white dancers as demonstrators.

Clark's marketing strategy paid off: a first Twist craze swept the country in 1960. Checker's single entered the Billboard Hot 100 (the main chart, not just the R&B chart) and reached No. 1 in September 1960 (Billboard Magazine, 1960). However, public interest in the dance began to wane again in early 1961 (Brewster, 2006, p. 67).

The Twist quickly evolved into an international phenomenon. As early as 1961, local twist productions began to appear in France and West Germany. In 1962, French rock'n'roll star Dick Rogers released *"Twist à Saint-Tropez"*, while in the same year, Caterina Valente and Silvio Francesco adapted *"Peppermint Twist"* into German for the West German market. One year later, Manfred Krug recorded *"Twist in der Nacht"* for the East German state-run label AMIGA.

In the United Kingdom, the dance initially struggled to gain traction due to its perceived indecency. When future DJ and producer Jeff Dexter, then only fourteen years old, performed the twist on stage at London's Lyceum - having learned the moves from a record sleeve - he was expelled from the venue and banned. Just weeks later, however, as the twist caught on as a widespread trend, Dexter was not only reinstated but hired as a house dancer. He went on to demonstrate the dance in a Pathé newsreel, helping to introduce the Twist to British audiences. Even the BBC aired a sanitized version of the dance on its ballroom-inspired television show *Television Dancing Club*, set to Gershwin's *Fascinating Rhythm* (Brewster, 2006, p. 68) Across Europe, the twist rapidly became the favored dance in emerging discotheques (Poschardt, 1997, p. 106).

The Twist craze truly took off at the once-seedy Peppermint Lounge in New York City - formerly disreputable New York nightclub with a clientele of sailors, street hustlers, and greaser types. In 1961, the house band Dee & The Starlighters was booked for what was intended to be a short engagement - but by chance, the group became an insider tip among members of New York's high society. Over time, the 179-capacity venue became the epicenter of the Twist craze, attracting the rich and famous to its dance floor. Among those who twisted at the Peppermint Lounge were Greta Garbo, Judy Garland, Tennessee Williams (Poschardt, 1997, p. 106), Marilyn Monroe, and Jacqueline Kennedy, the latter of whom even advocated for creating a similar space within the White House itself (Brewster, 2006, p. 67).

At the latest, with the chart-topping success of *"Peppermint Twist"* by Dee & The Starlighters in early 1962 (Billboard Magazine, 1962) the Peppermint Lounge had achieved national fame. The song helped ignite a second wave of Twist mania, even more widespread than the first. That same year, Chubby Checker's original version of *"The Twist"* re-entered the Billboard Hot 100 and reached No. 1 for a second time - something no other song had ever accomplished. While the Twist had initially been a youth-driven phenomenon in 1960, by 1962 it had been embraced by the wider public. *"The Twist"* remains the top-ranking title in the all-time Billboard Hot 100 chart (Trust, 2018).

Although the Peppermint Lounge was still a live-music venue, it laid the groundwork for the emerging discotheque and club culture in New York City. By 1965, it was succeeded by Arthur, which became the city's most popular dance venue and relied primarily on recorded music rather than live performance. In the years that followed, Terry Noel began to develop the foundational techniques of modern DJing at Arthur, becoming one of the first to blend records seamlessly during a continuous dance set. "The first generation of American discotheques - such as Shepherd's, L'Interdit, or Hippopotamus - would have been inconceivable without the Peppermint Lounge." (Poschardt, 1997, p. 106; Shapiro, 2007, p. 31) .

Other notable dance trends of this period included The Jerk, The Monkey, The Mashed Potato, and The Watusi (Hazzard-Gordon, 1990, p. 170).

The particular significance of the Twist as a mainstream phenomenon lies in its role as a cultural rupture in dance practice - marking a generational shift between those who came of age before 1960 and those who came of age after. During the 1960s, both in the United States and in Europe, the foundations were laid for nightlife and dance behavior as we still know them today. While similar forms of social dance had long existed within subcultures of the African diaspora - for instance in the United States, France, and Jamaica - the defining innovation of the Twist was its wide-reaching impact across national, generational, and class boundaries (Brewster, 2006, p. 66).

In Germany, this cultural transformation is particularly well documented in Jürgen Zinnecker's meta-study on postwar youth culture in the Federal Republic. There, he traces the shift *"from social dancing to freestyle"* (Zinnecker, 1987, p. 207). Until the 1950s, youth dance practices in Germany remained largely embedded within the formalized traditions of their parents. In 1954 and 1955, the preferred styles among young people were still the waltz and the tango, with little generational difference in taste (Zinnecker, 1987, pp. 208-209). By 1960, however, a generational divergence began to emerge. Whereas in 1955 over 60% of surveyed youth had reported a preference for classical ballroom dances, only 40% said the same five years later. In contrast, 34% now favored *fad damces* - a newly introduced category referring to contemporary popular trend dances. This moment also marks the beginning of intra-generational differentiation, as young adults (ages 25–30) largely continued to prefer traditional social

dances, while younger cohorts were moving away from them (Zinnecker, 1987, p. 212). By 1965, the trend was clear: among 17- to 21-year-olds, Twist (46%) and other solo or fad dances (52%) dominated, while only a third of respondents still reported dancing the waltz (Zinnecker, 1987, p. 214).

A follow-up study conducted by Zinnecker in 1984 showed that this shift had become permanent. The youth of 1965 did not return to waltz and ballroom traditions in adulthood; instead, they maintained the *new* approach to dance, which had since been adopted by even younger generations. As Zinnecker concluded:

"Discotheques have created new types of dance venues in which informal rules prevail. […] Where the formal codes of ballroom dancing no longer apply, anyone can participate in dance - 'somehow,' in their own way." (Zinnecker, 1987, p. 9).

In the early 1960s, the Twist served as a catalyst for the fusion of American and European nightlife cultures. East of the Atlantic, it encountered a burgeoning discotheque scene and unlocked its social and spatial freedoms in new, exciting, and creatively expressive ways. West of the Atlantic, African American dance culture found in the discotheque a fertile framework within which it could further evolve and expand.

2.4.2 Soul

Alongside the Twist and Rock'n'Roll, Soul represents the most significant stylistic evolution to emerge from Rhythm & Blues. Originating in the late 1950s and early 1960s, it would become one of the most influential genres in the history of popular music. As Rhythm & Blues gained increasing commercial success, a growing number of gospel singers - including James Brown, Sam Cooke, and Ray Charles - transitioned into the genre. They infused it with the expressive, emotionally charged vocal style of gospel, thus giving rise to what would come to be known as soul music (Bowman, Soul, 2012, p 440; Peretti, 2009, pp 141-142).

Of the many local soul scenes, each with its own stylistic characteristics, those in Memphis and Detroit proved especially influential (Peretti, 2009, p. 155).

In Memphis, Southern Soul began to take shape from 1957 onwards, centered around Stax Records and a handful of other independent labels. Southern Soul remained closely tied to its musical roots in Rhythm & Blues and gospel for much of its development. Many of its songs were secularized versions of gospel music. For instance, Sam & Dave's *"You don't know what that woman has done for me"* is a direct adaptation of the gospel original *"You don't know what the Lord has done for me"* (Bowman, Soul, 2012, pp. 440-442).

A more forward-looking northern counterpart to the Memphis sound was Motown, founded by Berry Gordy in Detroit. Gordy's aim was to shape soul music into a sound palatable to the American mainstream - one that would appeal not only to Black audiences but also to white listeners. To that end, he assembled a team of groundbreaking musicians who would go on to redefine African American popular music: the songwriting trio Holland–Dozier–Holland, lyricist and producer Smokey Robinson, the legendary studio band The Funk Brothers, and a roster of extraordinary vocalists including Michael Jackson, Diana Ross, Stevie Wonder, and Marvin Gaye.

Whereas Rhythm & Blues and Southern Soul often emphasized the downbeat, the Motown sound introduced a prominent backbeat, which would later form the rhythmic basis for funk's breakbeat (Bowman, Soul, 2012, p 444; Fitzgeralt, 2012, pp 339-340; Peretti, 2009, pp 153-154).

“Motown Song elevated Rhythm to a place of prominence and infused pop songs with elements borrowed from gospel music - such as short sing-along choruses, call-response vocals, simple personalized lyrics, vocal melismas, backbeats, tambourines, handclaps, pentatonic scales, and repeated riffs.” (Fitzgeralt, 2012, p. 339)

Berry Gordy’s strategy proved immensely successful: Motown became the most successful independent label in music history, and African American music became firmly established within the American mainstream charts (Fitzgeralt, 2012, p. 340).

One of Motown’s most enduring contributions to the repertoire of modern dance music, however, was the redefinition of the role of the bass, pioneered by James Jamerson, bassist of the Funk Brothers.

2.4.3 James Jamerson and the Motor-City-Bass

Although Leo Fender’s Precision Bass had introduced the instrument that would go on to define the form and function of the bass in popular dance music, it took several years before the electric bass was recognized as an instrument in its own right rather than merely a more practical substitute for the upright bass. Rhythm & Blues and Rock’n’Roll of the 1950s and early 1960s were still largely shaped by the walking bass lines and other patterns borrowed from boogie woogie piano. It was not until the early 1960s that James Jamerson, bassist of the Motown house band in Detroit, developed a distinct and highly influential approach to bass playing - one that would not only redefine African American dance music but also exert lasting influence on the development of rock (Zarbo, 2014, p. 43).

Jamerson was a musically gifted child and was already accompanying the gospel choir of his church by the age of ten (Slutsky, 1989, p. 4). He benefited greatly from the strong music education program at Northwestern High School in Detroit, where he learned the fundamentals of double bass playing (Slutsky, 1989, p. 5). Like many future members of the Funk Brothers, he honed his skills in Detroit’s vibrant jazz club scene of the 1950s, where he performed with artists such as Dizzy Gillespie and gained exposure to both the virtuosic and avant-garde techniques of modern jazz. In the late 1950s, he also joined the band of local blues figure Washboard Willie (Slutsky, 1989, pp. 9-10). Because blues held greater cultural relevance and popularity for Detroit’s

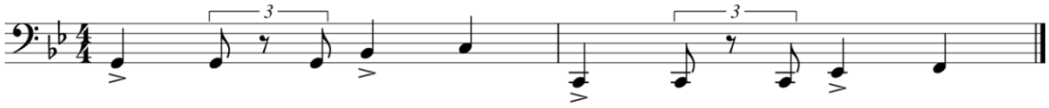
African American communities at the time, Jamerson gained not only broader performance opportunities but also important connections within the city's musical networks. The blues repertoire also familiarized him with the harmonic structures that would later form the basis of soul music. Thus, Jamerson's musical foundation uniquely combined virtuosity and complexity with a strong sense of accessibility and popular appeal (Zarbo, 2014, pp. 24-25).

His work with Washboard Willie eventually made Jamerson one of the most sought-after session bassists in Detroit's small but interconnected studio scene. This brought him to the attention of Berry Gordy, who began hiring him in 1957 for sessions with his then-nascent Motown label. At that time, the Funk Brothers were not yet exclusive to Motown and continued to take on live and studio work for other clients. As a result, Jamerson can be heard on a wide range of recordings beyond Motown, such as John Lee Hooker's blues hit *"Boom Boom Boom"* (Vee-Jay Records) and Jackie Wilson's *"(Your Love Keeps Lifting Me) Higher and Higher"* (Brunswick Records) (Slutsky, 1989, pp. 9-10, 174).

The early Motown soul sound remained heavily influenced by simpler Rhythm & Blues styles such as Twist and Doo Wop, which were gradually gaining traction among white mainstream audiences as well (see section 2.4.1). At this point, Jamerson was still recording his session parts on the double bass, but the essential elements of what would later become his distinctive electric bass style were already clearly taking shape. This becomes particularly apparent when we compare his bass playing to that of his contemporaries. *Do You Love Me* (Notation 3) , performed by the Motown act The Contours, alternated at the top of the Billboard Hot R&B charts in the autumn of 1962 with *Green Onions* (Notation 2) by Booker T. & The M.G.'s (Billboard Magazine, 1962). . Notably, Booker T. & The M.G.'s served as the studio band for Stax, Motown's principal competitor, and thus represented the grounded Southern Soul counterpart to the innovative Northern Soul of Detroit's Funk Brothers , with Jamerson as one of its most central and influential members.

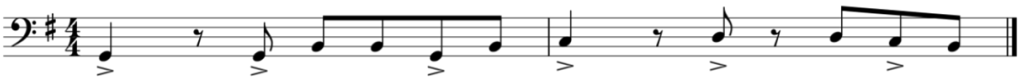
n the A-section of each piece, the respective bassists are faced with a similar problem: accompanying two alternating harmonies through harmonic outlining in the bass. M.G.'s bassist Lewis Steinberg solves this in the conventional Southern Soul manner:

a blues-style harmonic outlining that remains strictly anchored to the downbeat, breaking away from the rigid pattern only with a lightly swung pickup note before the heavy third beat.



Notation 2: Booker T. & The M.G.s "Green Onions" Bass Riff / Source: Author's own transcription

Jamerson, by contrast, prevailed in the studio against songwriter and producer Berry Gordy - who likewise demanded a rigid downbeat - by syncopating the harmonic outlining in the manner of a *clave*. The bass thus interlocks with the drum's backbeat to produce a simple yet effective polyrhythm. Moreover, Jamerson markedly varies the density of his line, omitting the traditionally accented third beat entirely in the second bar.



Notation 3: The Contours "Do You Love Me" Bass Riff / Source: Author's own transcription

Gordy recounts in his autobiography how, in this session, both Jamerson's unorthodox bass style and his equally unorthodox personality came to the fore. Gordy had requested a "straight" bass part, firmly grounded on the downbeat. Jamerson repeatedly defied this instruction, syncopating the line and embellishing it with numerous ornaments and variations. Gordy halted the live session multiple times - which, in the constraints of a two-track studio, meant the entire ensemble had to restart from the beginning. Jamerson stood his ground until Gordy recognised that the part added genuine value to the track:: „He knew I loved what I just heard and everybody else knew it, too. They also knew, he had gotten me." (Gordy, 1994, p. 158)

In 1963, Jamerson transitioned from double bass to a 1962 Fender Precision Bass, which he christened *The Funk Machine* (siehe Figure 6) The photograph reproduced in Figure 6 is used here not merely for visual identification, but as a historical document of Jamerson's early electric-bass practice: it situates him in a Detroit performance context shortly after this transition and visually anchors the instrument that became

central to his Motown sound. As was standard practice at the time, he strung it with flatwound strings, producing a sound rich in fundamental but low in overtones. According to accounts, Jamerson possessed exceptionally large and strong hands, enabling him to set his strings at an unusually high action (i.e., with the strings set higher above the fretboard than is typical) - an integral part of his distinctive tone, but physically challenging for most other bassists to play (Slutsky, 1989, p. 85).

Figure 6: James Jamerson with Precision Bass „Funk Machine“ /
Source: James Jamerson at the Blues Unlimited club, Detroit, 1964. Photographer unknown. Source: *The Post and Courier* / Wikipedia file page, *James Jamerson - Detroit - 1964.jpg*.

Motown and Jamerson biographer Alan Slutsky distills the electric bass style Jamerson developed in the mid-1960s into three core principles:

1) Harmonic and rhythmic ambiguity

   a. Creating expectations for downbeats that never arrive

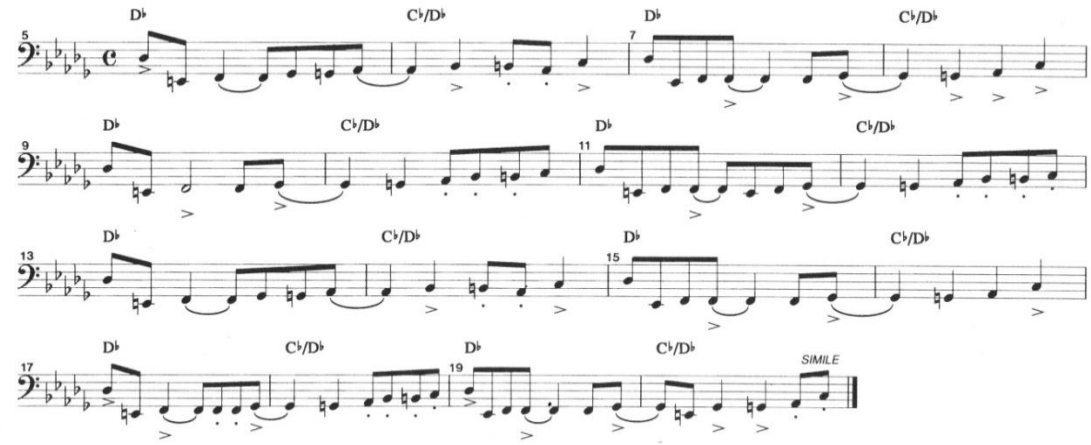
In *Uptight* (Notation 4), this occurs through the tied 4+ in the first measure and the absence of a beat 1 in the second measure of the bass motif.

   b. Shaping the groove through dynamic variation

In the same track, the F on beat 2 of the first measure is struck with noticeably greater force than the Db on the downbeat.

   c. Using passing tones to reinterpret harmonic structure

For example, the G sustained from measure 7 resolves to Ab only on beat 3 of measure 8 after passing through Gb. This technique becomes even more pronounced in measure 20, where the resolution is delayed until the fourth beat (Slutsky, 1989, p. 93).



Notation 4: Stevie Wonder "Uptight (Everything's Alright)" Bass / Source: Slutsky, 1989, p 93

2) Use of contrast in phrasing for motivic development

a. Sudden contrasts between dense, dynamic passages and sustained, inactive ones:

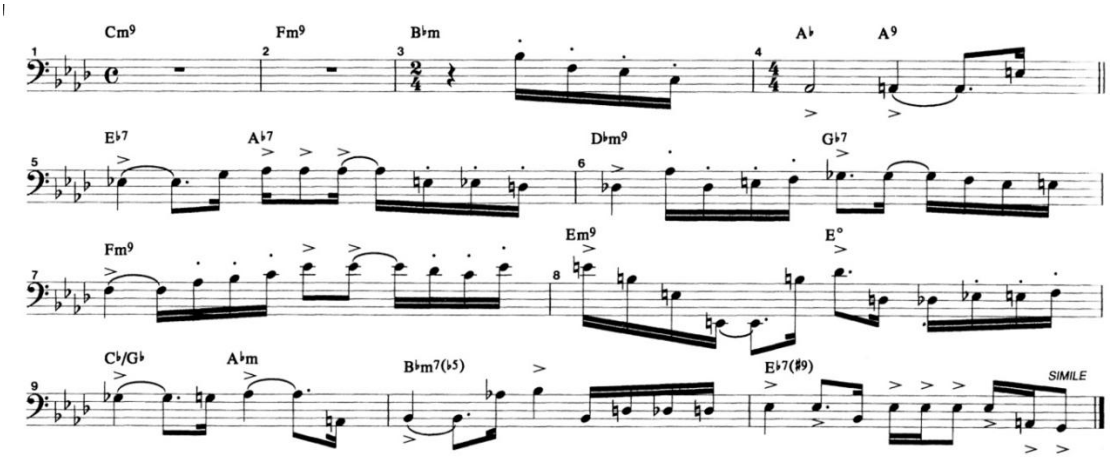
In *I'd Be a Fool* (Notation 5), the bass line alternates continuously, between measures 3 and 7, from rapid runs to isolated sustained half and quarter notes.

b. Abrupt changes between horizontal and vertical motion:

In measures 5 through 7, Jamerson primarily employs linear scalar movement (a vertical approach). In measure 8, however, he shifts to horizontal motion, executing a two-octave sixteenth-note arpeggio that culminates in an almost two-octave leap from low E to high D.

c. Frequent, unexpected changes in melodic direction:

Between measures 5 and 7, the contour of the bass line changes direction six times (Slutsky, 1989, p. 94).



Notation 5: Stevie Wonder "I'd be a Fool right now" (1969) Bass / Source: Slutsky, 1989, S. 94

Selective use of dissonance as an effect:

a. Employing harmonically and melodically unstable connecting phrase

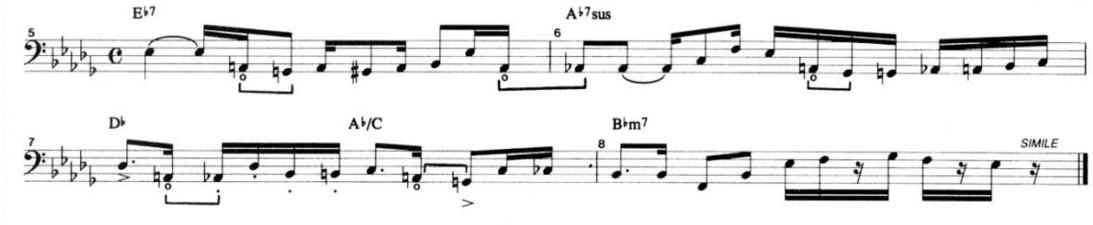
For instance, in *How Long Has That Evening Train Been Gone* (Notation 6), Jamerson frequently incorporates the tritone (A in the key of Eb) in measure 5.

b. T*he use of 'lazy' open strings*:

He often introduced non-diatonic open-string tones as part of rakes (an arpeggio-like electric bass technique) in keys such as Ab, Gb, Eb, or Db. This can be observed, for example, in the transition from measure 1 to measure 2.

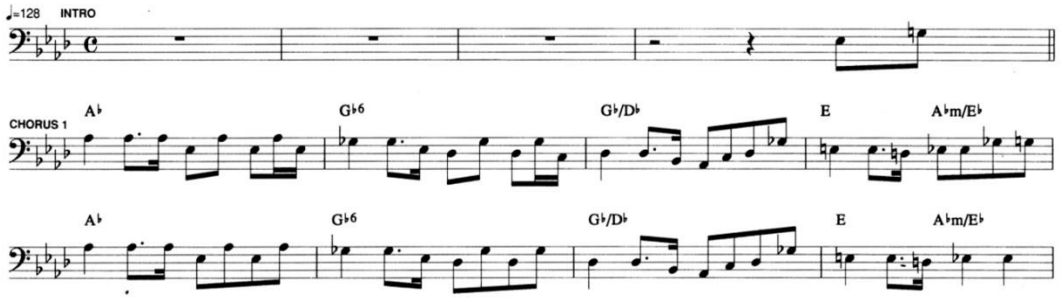
d. Approaching root notes through non-diatonic chromatic steps:

As in the previously mentioned lead-in to measure 6, but also in examples without rakes, such as the chromatic descent from Cb to Bb between measures 7 and 8 (Slutsky, 1989, p. 95).



Notation 6: The Supremes "How long has that Evening Train been gone" (1968) Bass / Source: Skutsky, 1989, p 95

While Slutsky's three chosen examples - viewed from the standpoint of an instrumentalist - are indeed illustrative of Jamerson's technical vocabulary, two of them, *I'd Be a Fool Right Now* and *How Long Has That Evening Train Been Gone*, stand out for their unusual complexity. These works serve well in tracing stylistic development, but they are less representative when assessing Jamerson's enduring influence on modern popular dance music.



Notation 7: The Supremes "You keep me hanging on" (excerpt) (1966) Bass / Quelle: Slustky, 1989, p 131

A more fitting example of this influence can be found in the Supremes' 1966 No. 1 hit *You Keep Me Hangin' On* (Notation 7) The track is built on the repetition of a four-bar pattern in which Jamerson weaves syncopated counter-rhythms - uncommon in popular music at the time - against the drummer's straight beat, enriched by melodic figures that move through diatonic passing tones. Equally striking is the organic ease with which the bass line integrates into the soul arrangement, never violating the listener's expectations so blatantly as to draw undue attention, yet subtly reshaping the rhythmic and harmonic fabric.

In the early 1960s, Jamerson still earned his living as a touring bassist with Jackie Wilson and on the Motown Revue circuit. However, his singular style quickly made him indispensable in the Motown studios. By 1964 he had ceased touring altogether, as no recording was undertaken without his presence (Slutsky, 1989, pp 19-21; Gordy, 1994, p 125). Even the label's record-setting songwriting team, Holland–Dozier–Holland, eventually abandoned the practice of supplying fully notated bass parts, instead providing only chord charts - outlining the harmonic framework of their compositions

and leaving Jamerson complete creative freedom within it - acknowledging that they could not produce bass lines superior to those he would conceive himself (Slutsky, 1989, pp. 34-35).

By 1971, Jamerson had further refined his style to a high degree of complexity. His musical achievements reached a peak with his work on Marvin Gaye's landmark album *What's Going On* and his contributions to the Jackson Five. In these recordings, he fused soloistic and improvisatory elements with an unwavering sense of his role within the rhythm section and harmonic structure (Slutsky, 1989, pp. 103, 113). While this later style did not command the same immediate influence he had exerted in the mid-1960s, it provided a blueprint for the intricate soul, soul-jazz, and funk compositions of the 1970s. The influential work of artists such as Isaac Hayes, Curtis Mayfield, and Roy Ayers would be inconceivable without his example.

Jamerson's core oeuvre marries the accessibility of rhythm and blues with the harmonic richness and complexity of jazz, without diminishing the listener's sense of immediacy. The result is an increased vitality, density, and groove - qualities eagerly adopted by many of his contemporaries. An array of prominent bassists across genres have acknowledged Jamerson's decisive influence: British beat and rock icons such as Paul McCartney of the Beatles (Slutsky, 1989, p. 103) and John Entwistle of The Who (Slutsky, 1989, p. 111) stand in agreement with later pioneers of African American music such as George Clinton (Slutsky, 1989, p. 184) as well as highly influential session players like Stanley Clarke (Slutsky, 1989, p. 185) and Anthony Jackson (Slutsky, 1989, p. 179).

Ed Friedland encapsulates Jamerson's impact in *The Way They Play: R&B Bass Masters*:

> *"James Jamerson is the man who started it all. Before him, the electric bass was an untapped reservoir of potential. Often poorly recorded and played without flair, it had not yet become a force in music. All that changed when Jamerson picked up the instrument in 1960."* (Friedland, 2005, p. 7).

2.5 Dedicated Bass Music: The Jamaican Sound System Culture

The early history of Jamaican reggae forms an important cultural and technological parallel to the transition from rhythm and blues to soul in the expansion of the bass register within dance music. Reggae stands as the first genre to be fundamentally shaped by the bass, and the first to assign greater importance to recorded sound than to live performance. Beyond this, reggae also served as the point of origin for a number of cultural techniques that have since become firmly embedded in the vocabulary of modern dance music:

- The dub mix, a precursor to both the remix and purely instrumental EDM.
- Toasting, the forerunner of modern vocal delivery styles such as rap and ragga.
- The version, an early form of the instrumental culture later embraced by hip hop.
- The sound clash, the direct ancestor of the DJ battle (Brewster, 2006, p. 116).

2.5.1 Sound Clash – The Development of the Sound System and Toasting Style

In the late 1940s, when local listening habits were dominated by mento - a Jamaican variant of calypso - and, above all, rhythm and blues records brought in by merchant seamen, a new form of mobile open-air dancehall emerged: the *sound system* (Bradley, 2003, p 33; Regis, 2014, p 104; Huss, 2003, p 263; Moskowitz D. V., 2006, p 205). One of the first to operate such a system was Tom Wong, who performed under the name *Tom the Great Sebastian*. Wong owned a hardware store selling not only tools and household goods but also electrical equipment. Seeking a more lucrative use of his inventory, he began, on weekends, to deploy his store's sound gear for public lawn parties, earning additional income through the sale of drinks (Stolzoff, 2000, p. 43). Wong was the first to make this form of musical entertainment truly popular in Jamaica, aided in part by the work of former Royal Air Force technician Hedley Jones,

who built for him one of the island's first full-range amplifiers. To describe it, Wong coined the term *sound system*. The 100-watt unit Jones constructed drew attention not least for its loud yet exceptionally clear bass reproduction (Stolzoff, 2000, p. 44). As Jones later recalled in an interview with the *Jamaican Observer*::

"The public address system prior to World War II was designed to electronically respond to a limited range of audio frequencies, covering voice and general purposes. As against such limitation, a Jamaican sound system was designed to respond with low surface noise, low distortion and high fidelity, over the complete audio range of frequencies from 15Hz to 20kHz: a huge technological difference. The Jones model High-Fidelity audio amplifier of 1947 was designed to perform the function of reproduction of the full audio spectrum; and that was the model Tom Wong acquired and named a Sound System. Before that era noisy PA systems were the norm." (Wignall, 2013)

Sound systems were, and remain, nothing less than "huge, mobile assemblies of amplifiers and loudspeakers, designed for the sole purpose of playing music outdoors as loudly as possible" (Brewster, 2006, p. 118). Until the mid-1950s, *Tom the Great Sebastian* reigned unchallenged as the king of the Jamaican music scene (Stolzoff, 2000, p. 44) His dominance, however, came to an end when two of the most influential figures in the history of the sound system - Clement "Coxsone" Dodd and Duke "The Trojan" Reid - entered the business of staging open-air dance parties.
Both men were proprietors of licensed bars and liquor stores, and each quickly grasped the economic synergy of combining music with alcohol sales. Duke Reid famously advertised with the slogan: *"For the best in sound and the finest in high spirits, come to Reid's Sound System and Liquor Store"*
(Bradley, 2003, p. 42 ff)
By the late 1950s, the rapid proliferation of sound systems in Kingston's townships meant that it was not uncommon for two or more dances to take place within earshot of each other. Out of this emerged the *sound clash* - a competitive showdown between rival sound systems and their DJs.

Since lawn parties charged no admission and attendees were free to spend their money wherever the music most appealed to them, competition for the audience's favor became fierce
(Stolzoff, 2000, pp. 52-53).

Because these events took place outdoors, sheer volume and the far-reaching power of long-wavelength bass frequencies became the decisive factors in drawing a crowd (Stolzoff, 2000, p. 50), This set off an arms race for the largest and most powerful rigs. Indeed, Duke Reid's *Trojan* Sound System took its name from the type of truck used to haul its massive speaker cabinets (Bradley, 2003, p. 44).

Early Jamaican DJs also sought to outshine their rivals by securing exclusive tracks unavailable to competing sound systems. In the earliest days of the scene, most records were brought to the island by merchant seamen. But as the more successful *soundmen* began generating substantial profits, they reinvested their earnings into trips to the United States specifically to purchase records. To protect their finds, it became common practice to remove the paper labels from singles, making it nearly impossible for competitors to identify and source the same tracks[3] (Bradley, 2003, p. 34). As a result, Coxsone Dodd's signature tune - Willis Jackson's jazz number *Later 'Gator* - was known in Jamaica only as the "Coxsone Hop" (Brewster, 2006, p. 122). It would take Duke Reid a full seven years to track down his rival's secret weapon (Bradley, 2003, p 51, Stolzoff, 2000, p 50, Huss, 2003, p 263).

Performance style soon became another crucial competitive factor, extending far beyond the passive act of spinning records. Duke Reid, for example, was known to appear wearing a crown and ermine robe, theatrically firing live gunshots into the air

[3] The deliberate removal of a record's paper label to conceal its title was a widespread strategy in the pre-digital DJ era, later resurfacing among the DJs of hip hop's first decade (see Section 2.7.1).

(Bradley, 2003, p. 45). The creative use of sound effects - particularly spring reverb and tape echo - further transformed the experience from simple record-playing into a fully fledged DJ performance.

The most significant innovation in performance practice, however, was the moment when Jamaican disc jockeys began to take the microphone - not merely to announce the next record, but to embellish, comment on, and interact with the music in real time. Out of a fusion of their own idiom (Jamaican Pidgin English, or Patois), British nursery rhymes, and the jive talk of American radio DJs emerged *toasting*: a melodious, rhythmically inflected chant that constitutes the direct precursor to all modern forms of rhythmic spoken delivery. This lineage is reflected in Jamaican terminology, where the performer of such vocal styles is still referred to as a *DJ*, rather than an MC or rapper as in other contexts. By contrast, the Jamaican term for a traditional disc jockey - one who selects and plays records - is *selector*. The earliest vocalists in this idiom were, from 1956, its originator Count Manchuki, and from 1957, King Stitt, who would go on to enjoy success during the ska and rocksteady eras (Witmer, 2014, p 288; Huss, 2003, p 263).

These four core techniques of the early Jamaican *sound clash* - through which pioneering DJs competed for the loyalty of a paying audience - remain relevant to this day, both in DJ performance practice more broadly and in competitive formats specifically. The flamboyant stage personas once cultivated by sound system operators find their echoes in the extravagant headgear of hip hop pioneer Afrika Bambaataa, or in the theatrical antics of 21st-century American EDM festivals, where superstar DJs are known to crowd-surf atop inflatable rafts (Krook, 2016). he *sound clash* itself has evolved into a codified form of DJ competition, no longer fought for the passing foot traffic of the dance, but for prestige and cultural capital. While it retains a particular prominence within contemporary dancehall, its competitive ethos periodically resurfaces in other musical contexts as well - for instance, in Red Bull's internationally staged *Culture Clash* series, which pits major figures from diverse dance music traditions against one another "in the best Jamaican sound clash tradition" (Red Bull Deutschland GmbH, 2018) (Kühne, 2018; Huss, 2003, pp 263-264).

The cultivation of exclusivity through bespoke acetate pressings (*dubplates*) and limited-run vinyl records for select artistic circles (V.I.P. editions) has likewise persisted across multiple strands of modern dance music (Schmidt, 1998, p. 43). Although the advent of CD-R technology - and, more decisively, the near-universal adoption of digital file formats - has made access to music technically ubiquitous, this very ubiquity has paradoxically heightened the symbolic value of true exclusivity (Théberge, Acetate, 2003, p. 505).

Finally, the union of dance music and rhythmic vocal delivery - first crystallized in the toasting tradition - has become inescapable since the 1980s, a development whose most globally influential manifestation, American hip hop, will be examined in greater detail in section 2.7.

2.5.2 Versioning – Ska, Rocksteady and Reggae

By the late 1950s, the sound of American rhythm and blues was evolving toward doo-wop, the twist, and eventually soul. The Jamaican market, however, did not yet follow this stylistic shift. As a result, sound system operators increasingly struggled to source new and exclusive tracks with which to outpace their competitors.

In 1957, Clement “Coxsone” Dodd and Duke “The Trojan” Reid became the first to record rhythm-and-blues-style instrumentals with local musicians in Kingston’s rental studios, pressing these performances onto acetate discs (*dubplates*) for exclusive use at their own dances. At this point, they had no intention of selling the recordings (Stolzoff, 2000, p 58; Witmer, 2014, p 286). Both were therefore taken aback by the enthusiastic audience response. These instrumentals afforded toasting DJs even greater latitude for extemporized verbal interplay than the occasional vocal breaks in imported R&B singles.

It is worth noting that the musicians sought to imitate the distinctive shuffle feel of southern R&B production, particularly from the music hubs of New Orleans and Memphis - but in doing so, they often accentuated its rhythmic idiosyncrasies to an exaggerated degree. To ensure these tracks could hold their own in the acoustically competitive environment of the lawn parties, the bass frequencies were deliberately and prominently boosted at the recording stage.

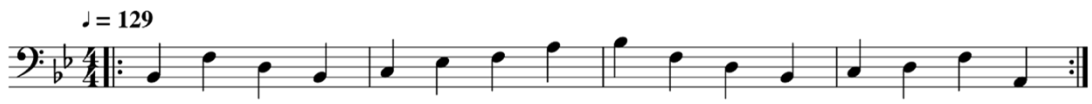
When Dodd began issuing the first small commercial pressings in 1959, the few hundred unlabeled copies sold out almost immediately (Stolzoff, 2000, p. 59), Seizing the momentum, he quickly established his first two labels, Worldisc and All Stars. Duke Reid soon followed, launching his own imprint, Treasure Isle, named after his liquor store. This early Jamaican R&B laid the foundation for ska - and, by extension, for the entirety of Jamaica's popular music tradition (Brewster, 2006, p 125-126; Bradley, 2003, pp. 54-55).

Ska was the first truly original form of popular music created by Jamaica's Black population. Although by 1960 Kingston hosted a handful of record labels claiming to have their own in-house studio bands, these ensembles were all drawn from the same pool of roughly thirty musicians. Trained jazz players such as Don Drummond, "Baba" Brooks, and Ernest Ranglin appeared in only slightly different line-ups under various names. Beginning in 1959, this close-knit group sought a sound that would reflect the growing spirit of national independence. The progression from Derrick Harriott's 1958 rhythm-and-blues track *Lollipop Girl* to Theophilus Beckford's 1959 *Easy Snapping*, and ultimately to the Folkes Brothers' *Oh Carolina*, [4] reveals a gradual departure from American stylistic models toward an autonomous sound - one that both referenced the musicians' African heritage and introduced a new rhythmic sensibility. On *Oh Carolina*, for instance, the harmony vocals evoke West African palm-wine music, while the track also features early Rasta percussionist Count Ossie (Bradley, 2003, p 69; Collins, 2019, pp. 466-467). For *Easy Snapping*, producer Coxsone Dodd instructed guitarist and arranger Ernest Ranglin to adapt the typical shuffle of Jamaican boogie but to shift the emphasis onto a triplet-delayed syncopation. This technique became the basis of

[4] While the three titles were composed and recorded in different years, their earliest documented releases all date from 1960.

the rhythmic figure often referred to as the "offbeat," a defining element of the reggae sound (Bradley, 2003, pp. 61-65).

In the national mood following Jamaica's formal independence from the British Empire in 1962, performers increasingly favored their own local idiom over the previously preferred American English, and demanded an equally distinctive musical voice (Stolzoff, 2000, p. 65). The tight circle of established studio musicians was soon joined by younger instrumentalists eager to shape the emerging style. Out of these collaborations, and with new talents such as saxophonist Tommy McCook and pianist Jackie Mittoo, the Skatalites formed in 1962, giving ska its definitive form. Even the island's formerly conservative radio stations began to incorporate the once-dismissed "ghetto music" into their programming, prompting a renewed focus on vocal performance. Retaining a trace of African American influence, many new vocal duos and trios modeled themselves after doo-wop ensembles. These predominantly young township residents now began to introduce local subject matter beyond the conventional love song. Increasingly, the lyrics addressed the everyday realities of "youths" in the townships, with one particularly popular theme being the gangsterism and rebelliousness of the so-called Rudeboys. (Stolzoff, 2000, p. 80). A striking example of all these elements coalescing in ska is *Simmer Down*, recorded by the then-unknown vocal trio The Wailers (Bradley, 2003, pp. 99-101). Although the bass in ska plays a more prominent role than in earlier Jamaican R&B, it still closely follows the American blues model - particularly the walking bass line. *Simmer Down* offers a particularly clear illustration of this continuity:



Notation 8: The Wailers "Simmer Down" (Walking Bass Pattern) / Source: Author's own transcription

Equally significant for the development of Afro-Caribbean music was Clement Dodd's establishment of his own recording facility in 1963. Studio One was the first studio on the island to be owned by a Black Jamaican, and consequently the first to focus primarily on producing Afro-Jamaican music. This independence freed Dodd from the

high costs of renting studio time and allowed him to employ the Skatalites on a permanent - though not exclusive - basis. He granted the gifted arranger Don Drummond, along with Roland Alphonso, Jackie Mittoo, and Tommy McCook, wide creative latitude in shaping the music, resulting in a prolific output of stylistically defining ska recordings.

The influence of Studio One on Jamaican music in the years to come cannot be overstated:

"To call Studio One of the late '60s the 'Motown of Jamaica' would probably flatter Berry Gordy's label more than the other way around. […] Whereas Motown represented merely one facet in the evolution of soul, Studio One, during the formative years of the style, embodied the very development of reggae itself." (Bradley, 2003, p. 197)

Dodd's most formidable competitors, Prince Buster and Duke Reid, soon followed suit by opening their own successful studios. The genre's commercial potential proved so great that Chris Blackwell's Island label began marketing ska in the United Kingdom (Bradley, 2003, p. 103). There, records were sold primarily to the *Windrush Generation* - some 300,000 first-generation Caribbean immigrants who had used the final years of colonial rule as an opportunity to settle in a prosperous Europe. These West Indian immigrants and their music would leave a lasting imprint on British popular music over the following decades (see section 2.8.4) (Bradley, 2003, p. 115).

The next step in reggae's stylistic evolution was rocksteady. Whereas ska's bass lines still drew heavily on the boogie-inflected upright bass figures of 1950s rhythm and blues, by the mid-1960s the electric bass - and with it the rhythmic sensibility of Motown - had entered Jamaican popular music (Bradley, 2003, p. 102).

"Leo Fender's invention rewrote the rules of rhythm the world over - but in no country was the transformation as profound as it was on the island." (Bradley, 2003, pp. 151-152)

The adoption of the slower, more spacious *one drop* beat - omitting the downbeat on the one - opened new possibilities for bassists to develop more elaborate and independent lines. Players such as Lloyd Brevett and Leroy Sibbles drew deep inspiration

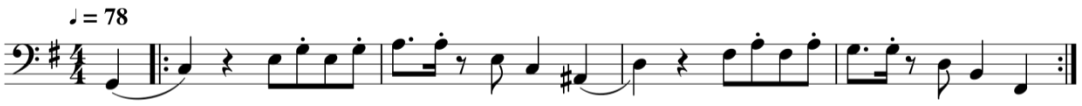
from American counterparts like James Jamerson, forging a rocksteady idiom in which the electric bass emerged as the lead instrument.

At Studio One, Leroy Sibbles was not only the lead singer of the vocal trio The Heptones but also served as arranger, A&R, and the ensemble's defining bassist during the rocksteady years (Bradley, 2003, p. 99). Widely regarded as one of the most influential reggae musicians of all time, Sibbles was instrumental in cementing both the elevated role of the bass in the genre and its stylistic synthesis of Afro-Jamaican and African American musical elements (Davis, 1982, pp. 53, 105-106). I had the good fortune to meet him during a studio session in 2011, and he later kindly shared with me several insights into the emergence of the rocksteady and reggae bass:

„My baselines contributed greatly to the evolution of reggae music and still are to this day. […] There were a lot of influences. Groups like The Four Tops, Temptations[5], Impressions… We redid some of the American tunes and they were a great hit for us. Sometimes Coxsone would bring back records from America for us to redo as well." (Sibbles, 2017)

An exemplary song from this era is *"Mama, Let Me Go"* - often simply referred to as *"Mama"* - by the Heptones. It encapsulates all the defining characteristics of the rocksteady period. At 78 BPM, its tempo sits far below that of the brisk ska tunes, which typically fall between 105 and 130 BPM (for instance, *"Simmer Down"* clocks in at 127 BPM) (Bradley, 2003, p. 155). The track features a bass line by Leroy Sibbles that is as intricate as it is melodic, serving as the song's primary driving force (see Notation 9), subtly doubled by ghost notes on the guitar.

[5] Both the Temptations and the Four Tops were under contract with Motown, and the corresponding bass lines came from the pen of James Jamerson.



Notation 9: The Heptones – "Mama, let me go" (Bass Pattern) / Source: Author's own transcription

Beneath this foundation, Sibbles delivers a simple yet soulful vocal melody in the style of Smokey Robinson or early Curtis Mayfield (Bradley, 2003, p. 160). The harmony vocals of Barry Llewellyn and Earl Morgan unfold in the characteristic Afro-Jamaican falsetto, while the brass section - dominant in ska - now merely punctuates the down-beat. Especially when contrasted with the calm, sustained vocal passages, the electric bass in rocksteady here emerges, for the first time, as a true lead instrument (Bradley, 2003, p. 157).

"Mama" also serves as an illustration of versioning and riddim culture in Jamaican popular music. In reggae parlance, a *version* refers not merely to the instrumental take of a song, but to an instrumental track conceived for the express purpose of reuse in the creation of other recordings. While in the 1950s such versions were primarily produced for live use by toasting DJs, it soon became common practice to recycle them for subsequent studio releases (Brewster, 2006, pp. 126-127; Witmer, 2014, p. 287). Such an instrumental track is called a *riddim* (Patois for *rhythm*). Accordingly, the instrumental version of *"Mama, Let Me Go"* is known as the *Mama Riddim*. At Studio One, this riddim was later repurposed for titles including *"Good Girl Gone Bad"* by Jo Jo Mac, *"Dance Tonight"* by Barry Brown, *"Hug and Kiss"* by The Jays, and *"One More Time"* by the Blackstones.[6]

---

[6] A selection of such *riddim* compilations was curated by myself together with the DJ collective King Kong Disko in 2011 and 2012 for the radio station Byte.fm.
The broadcasts, entitled *Studio 1 Riddimwise* Pt. 1 and Pt. 2, are available for streaming on Mixcloud.

Because copyright law in Jamaica was, in practice, not applied to music until the 1990s, successful riddims were often re-used by producers from other labels for their own recordings. For the "Mama Riddim," the archive *Riddimguide.com* (Riddimguide.com, n.d.) lists 62 songs from 1967–2005, while *Riddimbase.org* (Riddimbase.org, n.d.) lists 65. Notable examples include Errol Dunkley's *Love in the House* (Midnight Rock, 1982) and Tony Rebel & Swade's *Just Friends* (Techniques, 2001). Owing to the popularity of these hits, the "Mama Riddim" is also widely referred to as the *Love in the House Riddim* or the *Just Friends Riddim*. This practice - known as versioning - remains a defining feature of reggae and dancehall to this day (Stolzoff, 2000, p. 91).

"If ska was the birth of Jamaica's modern pop music, and rocksteady its somewhat wayward adolescence, then with reggae it came of age." (Bradley, 2003, p. 186).

A decisive factor in shaping the reggae sound was the introduction of the electric organ into Jamaican studios in the late 1960s. This altered the feel of the offbeat groove once again. Where the shuffle had previously underpinned the rhythm, keyboardists such as Jackie Mittoo and Winston Wright began employing a clipped, staccato organ figure known as the *John-Crow skank* (Bradley, 2003, p. 188). The reggae rhythmic framework evolved roughly as follows: the "one" remained empty; beats two and four featured staccato chords from organ and/or guitar, often ornamented by eighth notes on either side; and beat three carried the heavy downbeat of the one-drop drum pattern.

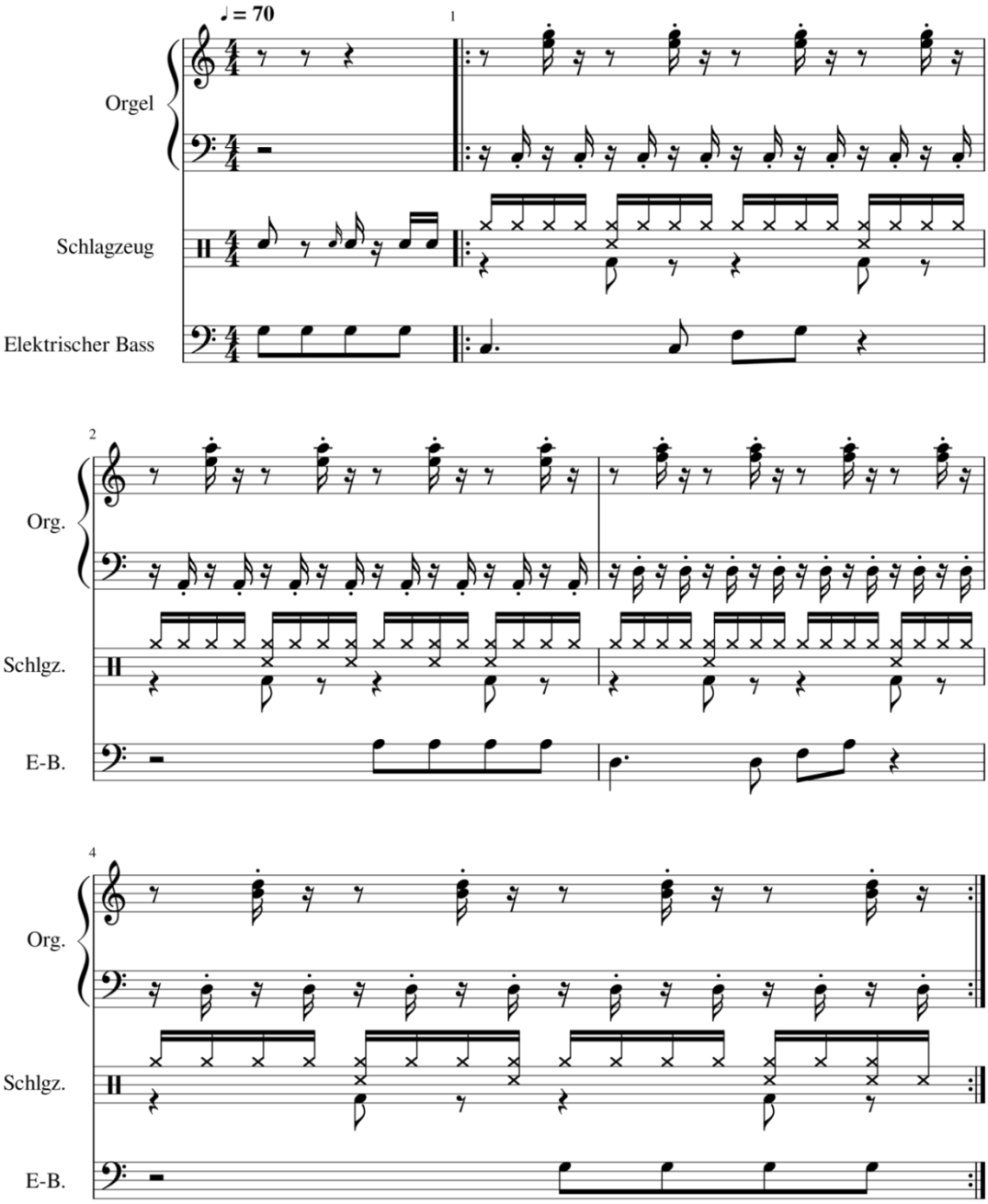
Melodic duties, which in rocksteady had been carried prominently by the bass, were partially shifted back to the horn section and, in some cases, the organ. Nevertheless, bass and drums were brought even more to the fore in the overall texture (Bradley, 2003, p. 190). . The expression *drum & bass* was already part of Jamaican musical parlance three decades before British electronic producers appropriated it as a genre

---

https://www.mixcloud.com/KingKongDisko/studio-1-riddimwise/

https://www.mixcloud.com/KingKongDisko/studio-1-riddim-wise-pt2/

label (see section 2.8.4). More broadly, reggae was characterised by a looser approach to form than its predecessors: these elements were emblematic of the style, but none was obligatory. John Holt's *I Need a Love I Can Feel* (Notation 10), recorded only three years after *Mama, Let Me Go* by many of the same musicians, illustrates all of these developments - particularly Leroy Sibbles's restrained yet highly effective bass line and Jackie Mittoo's organ work. As striking as these formal changes were, reggae ultimately represented a greater freedom for musicians in their handling of musical structures, making it difficult to define a single blueprint for the style (Bradley, 2003, p. 186).



Notation 10: John Holt "A Love I can feel" (Love I can feel Riddim) / Source: Author's own transcription

In the decade that followed, the now fully formed style diversified under a new generation of producers such as Joe Gibbs and Lee "Scratch" Perry.

A mainstream reggae emerged that addressed familiar themes of love, sexuality, youth culture, and nightlife. Sonically and in performance style it often drew on the aesthetics of the rising disco scene, and it catered in part to the Jamaican middle class of uptown Kingston (Stolzoff, 2000, p. 70). A representative example is Althea & Donna's hit Uptown Top Ranking, which reworks the riddim of Alton Ellis's I'm Still in Love, augmenting it with toasting and disco-inflected effects. This strain would later develop into dancehall.

Among Caribbean immigrants in the United Kingdom, lovers rock gained particular popularity. This middle-class–oriented reggae avoided controversial sonorities and topics, offering a gentler sound for listeners culturally removed from the Jamaican tenements. For the British market, Jamaican tracks were often adapted with additional horn or string arrangements in the style of Philly soul. A case in point is Ken Boothe's Cover of Bread's "Everything I Own", which spent three weeks at No. 1 on the UK charts in 1974 (UK Official Charts Company, 1974; Brathfisch, 2003, p. 289).

While the Rastafari movement had occupied a marginalized - and often mutually antagonistic - position within Jamaican society from the 1940s through the 1960s (Lee, 2000, S. 163 ff; Stolzoff, 2000, S. 80 this began to change in the early 1970s, buoyed by a rising current of Black self-consciousness (Brewster, 2006, p. 119). The young, innovative producer Lee "Scratch" Perry, working with the still little-known Wailers - Peter Tosh, Bunny Wailer, and Bob Marley - developed on his Upsetter label a new sound that combined Rasta spirituality with socially critical "reality" lyrics. Musically, this manifested in a more austere timbre and in influences from Kumina and Burru percussion of African tradition - the actual music of Rastafarianism, before Reggae (Ryman, Kumina, 2014, pp. 420, 422; Ryman, Burro, 2014, p. 95). However, the Wailers fell out with Perry before this creative process could be brought to completion. Tracks such as *Duppy Conqueror* remained deeply rooted in rocksteady (Bradley, 2003, p. 294ff). In 1971 the Wailers founded their own label, Tuff Gong, and released titles such as *Trenchtown Rock* that would define the now fully articulated Roots Reggae style; in the same year, the single became Jamaica's best-selling record (Moskowitz D. , 2007; Bradley, 2003, p. 305). The immense success of this strain of reggae quickly led other artists and labels to market roots as well - for example, Studio

One with singers Burning Spear and Horace Andy, and Joe Gibbs with the group Culture. As a voice for oppressed and economically disadvantaged people of color, roots reggae developed during the 1970s and 1980s into the most important and influential musical movement of the so-called “Third World” (Stolzoff, 2000, p. 66; Dagnini, 2019, p. 478).
Rastafarianism remains highly significant across much of the reggae scene today. Other genres - including hip hop, Afrobeats, and UK electronic music - also periodically draw on it.

Dub anticipated contemporary remix practice and was the first musical idiom to center the creative reworking of pre-existing recordings. A detailed examination follows in the next section.

2.5.3 Dubwise – The Sound Engineer as Artist

One of the most important cultural techniques that reggae contributed to the canon of modern dance music is the dub mix. This was the earliest manifestation of what would later be known as the remix, which has since become an essential component of virtually all electronically produced dance-music styles (Brewster, 2006, p. 126). The crucial difference from the American disco-era dance mix is, as Bradley observes, that "a song departs from the composer's original intention - musically as well as sociologically - yet remains recognizable" (Bradley, 2003, p. 276). In other words, it is not merely extended or re-edited in its formal sequence; rather, the source material is transformed into a new artifact, not a mere derivative.

Like the reuse of riddims, reinterpretation as dub was an expression of Jamaica's culture of recycling, grounded in the efficient management of scarcity in a poor Caribbean nation (Bradley, 2003, p. 277). As studio owners competed with the expanding tourism industry for musicians, and as record prices were fixed by government policy, profit margins for conventional production plummeted. Reggae producers and sound system operators therefore sought more efficient ways to supply their audiences with new sounds (Bradley, 2003, p. 295).

Duke Reid had already begun in the 1960s to press instrumental versions on the B-sides of his singles. The same practice was common among many American soul artists: James Brown, for instance, frequently released a flip side labeled "Pt. 2," presenting an instrumental cut of the A-side. During the rocksteady era, however, such versions were still dominated by instrumental solos - initially horn features by Tommy McCook and, after the electric organ had become established, numerous instrumental takes by Jackie Mittoo (Bradley, 2003, p. 279).

From the early 1970s onward, producers and recording engineers became more adventurous. Even before then, faulty test pressings without vocals had turned into surprise favorites at sound system dances; gradually, practitioners began to cultivate a deliberate aesthetics of omission and reduction. The first commercially released dub mix is generally held to be "Voo-Doo," the B-side to Little Roy's sound-clash anthem "Hard Fighter" (1971). Although many details later deemed essential - such as the heavy use of effects - are absent, the track presents a markedly stripped instrumental mix: the

intro remains unchanged; after the distinctive organ figure, however, instead of a solo the track continues as a bare instrumental that is progressively reduced to nothing but bass and drums (Bradley, 2003, p. 276).

The most decisive contribution to defining the genre of dub - and the techniques associated with it - came from Osbourne Ruddock, better known as King Tubby. A trained electrical engineer with an early reputation for brilliance, Tubby, like Hedley Jones before him, designed and built sound reinforcement systems for sound systems; in the 1960s he first worked as a selector for Duke Reid and, in 1968, founded his own highly successful rig, Hometown Hi-Fi. Three attributes made Ruddock one of the key pioneers of modern dance music:

- Self-built tools and an engineer's imagination. Tubby constructed his own equipment for both DJ and studio use, giving him technical capabilities that outstripped those of his competitors. Especially noteworthy were his creative deployments of reverb, delay, and filters. More importantly, he grasped - more than any of his contemporaries - the creative potential of audio engineering itself.
- In performance with Hometown Hi-Fi, he used this equipment in ways that made his sound an unmistakable hallmark - a defining differentiator. This applied both to the rig's sheer power and fidelity and to his creative, live use of studio processing during the DJ set.
- Hands-on mixcraft at the mastering stage. As a studio engineer, Tubby translated this experience into real-time processing of the mixdown during mastering. Given that most Jamaican studios of the early 1970s (and into the 1980s) still operated on two- and four-track machines, many refinements were otherwise impossible. In the early 1970s, Tubby achieved wonders - committing inventive, virtuosic mixdowns either to master tape or direct-to-disc lacquer masters (acetates).

Before long, other producers - among them Augustus Pablo and Lee "Scratch" Perry - sought out Ruddock's skills, hiring him to cut versions for their B-sides at his own

two-track studio. The resulting income enabled a rapid expansion: he built his own four-track console and acquired marquee effects units such as an

Echolette Echoplex and a Roland Space Echo. In this environment, working with Perry, owner of the Upsetter label, he created the genre-defining milestone Blackboard Jungle, issued in 1973 initially as Upsetters 14 Dub. Perry - already a stylistic trail-blazer through his work with the Wailers - now contributed the conceptual leap of producing recordings whose primary purpose was to serve as raw material for dub mixing. Since Ruddock did not function as a producer in the strict sense, but rather as a DJ and recording engineer, his collaboration with Perry significantly amplified the impact of his work.

Blackboard Jungle is widely regarded as the first dub LP to present the style in fully articulated form. Instrumentals tracked by the elite Upsetter studio band were taken apart and reassembled by Ruddock with consummate finesse. Over a foundation of drum and bass, organ figures and horn stabs alternate with silence, repeatedly collapsing into cascades of echo. Dotted-note delay times generate dynamically shifting syncopations, especially on snare rimshots. The album is almost entirely devoid of singing; instead, sparse, reverberant vocal fragments and onomatopoetic sounds are deployed - e.g., the rhythmic “plop” and hiss on “Sensemilla Dub”, or Dillinger’s toasting on “Moving Forward.” At Perry’s insistence, sirens - introduced here for the first time in dub - also appear as sonic effects (Witmer, 2014, p. 289).

Ruddock shared his knowledge generously with his partners, and the techniques of dub spread rapidly as a result. Among his most important protégés were the radio host and electrical engineer Michael Campbell (Mikey Dread) - who later founded the DATC (Dread at the Controls) label - and Lee “Scratch” Perry, for whom Ruddock in 1974 designed the legendary Black Ark studio, then among the most advanced in Jamaica (see figure). In the ensuing years it became almost de rigueur for reggae producers to have their B-side versions mixed by Ruddock. Around 1975, the credit “King Tubby Meets [name of studio band or artist]” supplanted the generic label Version - a special distinction not afforded to his competitors, who were typically also the producers of their own imprints (Bradley, 2003, p. 287).

The new dub culture also rekindled versioning, prompting many producers to have master tapes of earlier hits - reaching back to the rocksteady era - reworked. Rupie Edwards, proprietor of the Success label, recounts how he acquired the tracks to *"My Conversation"* from Martin Riley, the Uniques' backing vocalist. The rocksteady classic had originally appeared in 1968 on Bunny "Striker" Lee's label:

"Martin came to me - because, I suppose, he needed money - and offered to sell me the backing track of a song with which he'd had a hit ages ago. That was quite normal at the time. People were always saying, we'll make a version of this, a dub of that; so anyone who had a strong rhythm track would sell it to someone who could bring it up to date. Producers were constantly buying and selling riddims.".

From these tracks he commissioned eleven dubs and additional vocal cuts by other performers, issuing them - together with the original - on the album *Yamaha Skank* (titled after Shorty the President's toast/dub interpretation). It was, at the same time, the first one-riddim album. Since then, it has become standard practice in reggae for producers to create a version, "voice" it with multiple singers, and release the results as a dedicated album alongside the individual singles (Bradley, 2003, p. 289). A prominent later example is Steven "Lenky" Marsden's Diwali Riddim (2002), which includes the international hits Sean Paul's "Get Busy" and Wayne Wonder's "No Letting Go."

While reggae's cultural techniques most directly shaped the development of hip hop and UK electronic styles (see Section 2.8.4), the techniques of dub constitute a prototype of electronic dance music (Brewster, 2006, pp. 130-131). With King Tubby, the figure of the „recording engineer as artist emerges" (Bradley, 2003, p. 287) - already in both forms familiar today: the DJ who transforms live playback in real time, nd the DJ-producer who crafts original remixes in the home studio for use in their sets. (see Section 2.6.6). Dub also pioneered the sample-like deployment of vocal fragments and effects, as well as the use of extended ostinato passages built largely from beat and bass, where musical progression is achieved primarily through the application and parameter modulation of effects - a practice transmitted from dub to virtually all branches of EDM (Pfleiderer, Riddim & Sound, 2001, pp. 109-110). „Dub Techniken werden heute in praktisch allen Bereichen der Popmusik eingesetzt" (Brewster, 2006, p. 128)

und übertragen damit die herausragende Rolle des Basses auf all jene anderen Stile: „A Dub mix is essentially the bare bones of a track with the bass turned up“ (Brewster, 2006, p. 128).

By the end of the 1960s, the schism in popular music had fully crystallized. Out of Rhythm & Blues emerged, on the one hand, Rock'n'Roll and, on the other, Soul. Over time, rock and African American dance music became distinct formations - even as points of contact persisted: the imprint of Jamerson's bass techniques on 1960s rock (see 2.4.3), the influence of progressive rock on P-Funk (see 2.6.1), or the absorption of stadium-rock habitus into American EDM culture (see 2.8.5).

As a development of Rhythm & Blues - marked by a stronger engagement with African-diasporic aesthetics than mainstream soul and by tight integration with the U.S. record market - Afro-Jamaican music may be understood as a substyle within African American popular music. Much confusion around this classification stems from the widespread familiarity with Bob Marley's later output for Island Records (Chris Blackwell), produced with progressive-rock sensibilities to reach a white international mainstream. From the standpoint of Afro-Jamaican practice, however, tracks such as "Could You Be Loved" or "Buffalo Soldier" are hardly representative (Bradley, 2003, p. 362). The contribution of this comparatively small island to the evolution of modern, popular, bass-driven dance music is not to be underestimated: without the culture techniques forged there, none of today's major styles would exist in their current form.

Figure 7 Lee “Scratch” Perry & King Tubby
AI-generated placeholder illustration replacing an unlicensed historical image of Lee “Scratch” Perry and King Tubby in a studio context. The image is not a historical photograph and is not intended as documentary evidence. Created by the author with AI assistance..

By the early 1970s, African American dance music had differentiated itself, set itself apart from rock, and established the bass as the linchpin between rhythm, harmony, and melody - accorded a central role in composition, arrangement, and mixdown alike. None of this would have been possible without the concurrent overcoming of technical hurdles in the recording and reproduction of low frequencies.

2.6 The 1970s and 1980s - Funk and Disco

The decisive developments in African American music during the 1970s were, first, funk's re-centering of rhythmic primacy, and second, the emergence - and subsequent mainstream breakthrough - of modern popular dance culture in the disco era.

In addition, the widespread adoption of electronic sound production - synthesizers and electric keyboards, drum machines, and studio processing - dramatically expanded the cultural possibility space of modern popular dance music, particularly in the domain of the bass.

2.6.1 Funk

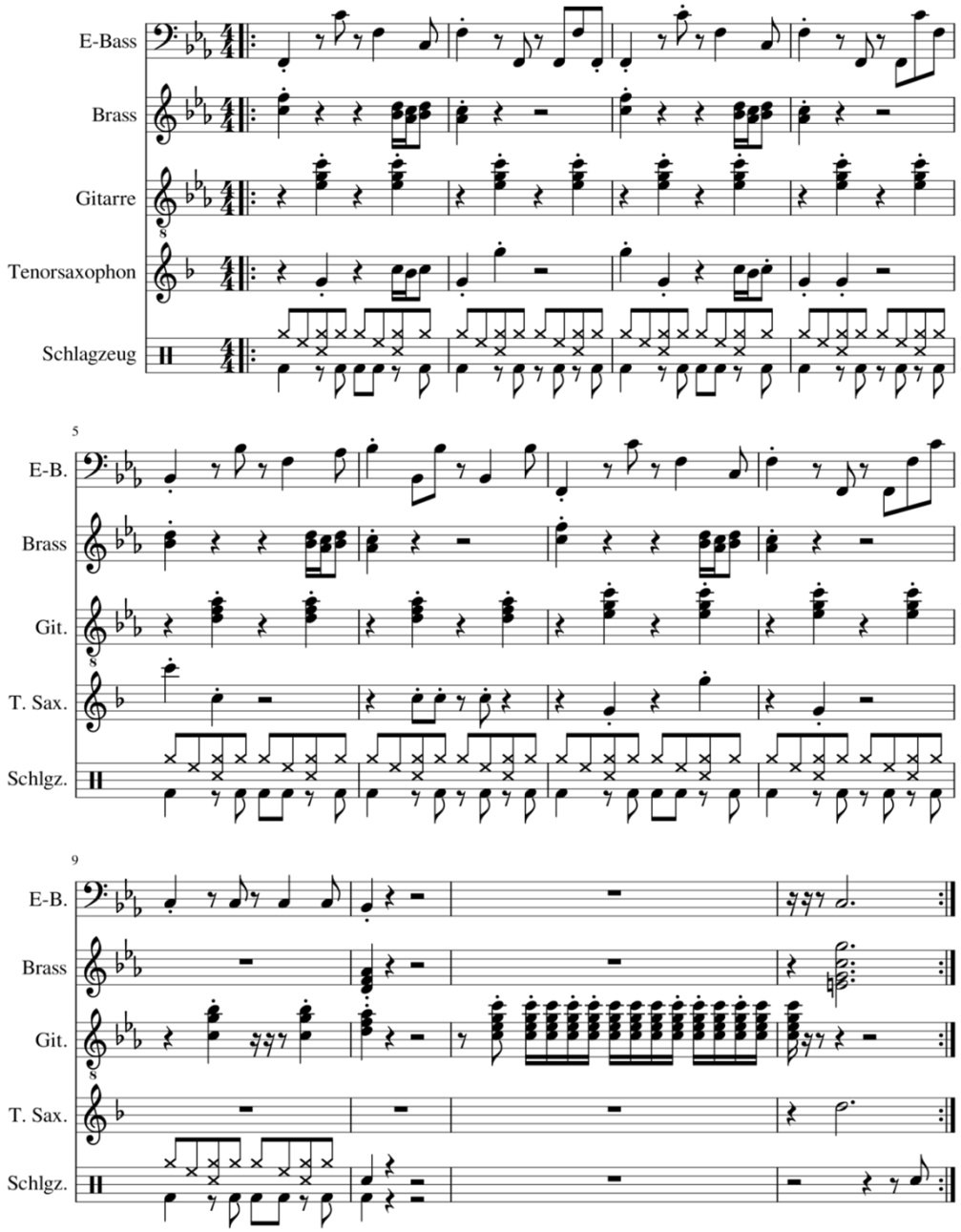
In the late 1960s, funk emerged from soul as a new branch of African American music - one that drew on elements of jazz and, in turn, decisively shaped disco, hip hop, and house. Hallmark features of early funk include a repetitive foundational groove that weaves the soul-derived backbeat together with emphatic phrase-initial downbeats, strongly syncopated bass lines, and sharply accented horn charts and rhythm guitar into a polyrhythmic lattice. Vocal techniques inherited from soul are often recast percussively. Funk first achieved broad popularity through the music of James Brown and Sly Stone.

With its intensified focus on the rhythm section and the interlocking of drum and bass grooves - a renewal of African timeline (key-pattern) traditions - funk imposed new demands on electric-bass technique. Percussive approaches such as striking the string against the fingerboard and snapping it with the fingers gained currency, collectively known as the slap technique.

The history of funk begins with James Brown. In the 1950s and early 1960s Brown had already achieved great success as a gospel, R&B, and soul singer with his band, the Famous Flames (Strong, 2001, pp. 121-126). Building on new currents in African American music - above all the work of Motown's house band, the Funk Brothers, with James Jamerson as a central member (Slutsky, 1989, p. 184) - Brown released *"Papa's Got a Brand New Bag"* in 1964, the blueprint for a new style whose impact

on subsequent dance-music genres would be immense. Funk breaks with harmony-driven songwriting: interlocking rhythmic layers come to the fore. With this interlock, the rhythm section gains new prominence: “the arrangements were more bass-heavy; the kick drum and the bass guitar pushed to the foreground” (Poschardt, 1997, p. 119). Funk’s temporal organization departs in part from blues schemata and a strictly back-beat-centered feel. In tandem with a growing engagement within African American communities with an African-derived identity, funk explicitly draws on elements of “off-beat phrasing” (Kubik, 2004, p. 76), cyclicity (Kubik, 2004, p. 79; Pfleiderer, 2006, p. 293) and pattern-based structure (Kubik, 2004, p. 86; Pfleiderer, 2006, p. 293) characteristic of traditional African musics. Especially emblematic is the construction of songs from such patterns, themselves built from sequences of rhythmic - often closely related - 2–16-bar cycles, a procedure that has become typical across virtually all styles of modern dance music.

This Africanization of soul is already audible in “Papa’s Got a Brand New Bag” (Notation 11). Schematically, the track consists of a 12-bar cycle formed by the sequenced repetition of a 4-bar pattern. The only departure from this cycle is the break: a two-bar closing turnaround at the end of the cycle. The pattern in “Papa’s Got a Brand New Bag” is driven less by melody than by a polyrhythmic interplay among instrumental groups. Around the elementary pulsation (Kubik, 2004, p. 71), - supplied primarily by the hi-hat - the downbeat of the bass and the offbeat of the rhythm guitar interlock as a binary interlock (Zweierverzahnung) (Kubik, 2004, pp. 82-84). Within the timbrally dominant horn section, the tenor saxophone assumes a special role: at times it aligns with the other horns (bar 1, beat 4), while at other moments it moves contrary to them (bar 1, beat 2). As a result, the horn writing remains rhythmically ambivalent, exhibiting elements of both binary and ternary interlocks - internally within the section and in relation to the other instrumental groups.



Notation 11: James Brown "Papa's got a brand new Bag" / Source: Author's own transcription

Even though the harmonic structure of *"Papa's Got a Brand New Bag"* can still be parsed as a simple twelve-bar blues, this is no longer constitutive for the execution of funk, nor does it remain a necessary feature in the style's subsequent development (Pfleiderer, 2006, p. 294). Because Brown's vocal delivery anticipates the spoken styles of the 1970s and 1980s - issuing rhythmically articulated dance cues that

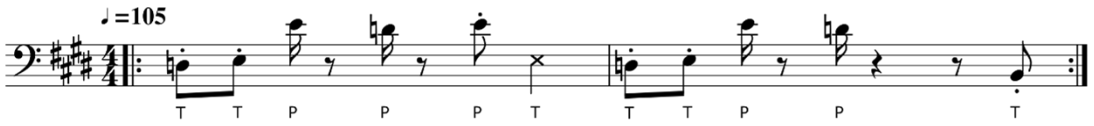
function more as emcee-like patter than as sung melody - the tonal materials serve chiefly to locate events within the cycle and to generate tension and subsequent closure at the break. In the absence of a melodic lead voice, no elaborate harmonic framework is required to support one.

What becomes decisive instead is the priority of rhythm: the production of musical context through repeated, interlocking patterns and the organization of form into 12- or 16-bar schemata punctuated by a break. These are innovations of funk that persist across virtually all styles of modern dance musi. (Adams, 2015, p. 118)

How swiftly Brown's invention was taken up by other musicians - and how gradually funk could be woven into adjacent musical frameworks - is evident in the soul classic *"You Keep Me Hangin' On"* (Notation 7). Only two years after *"Papa's Got a Brand New Bag,"* Jamerson's bass techniques interlock with Brown's compositional priorities, together sketching a blueprint for African American popular music in the decade to follow.

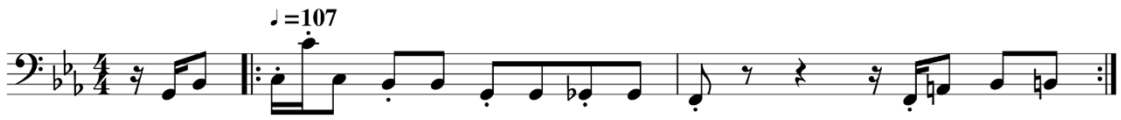
In the 1970s, artists such as Sly and the Family Stone and George Clinton drove funk's development forward. Brown's "hard rhythms" (Vincent & Davis, 2012, p. 218) ere retained but enriched with elements drawn from psychedelic rock. Several leading figures of the soul era adapted the new idiom as well - Curtis Mayfield in "Move On Up," and The Temptations in "Papa Was a Rollin' Stone" (Vincent & Davis, 2012, pp. 216-218).

A key techniques of Funk music was the set of bass-playing techniques developed by Larry Graham, Sly Stone's bassist. In slap bass, the strings are not plucked in the usual manner: instead, the thumb percussively thumps the string against the end of the fingerboard (thumb "slap"), while the other fingers "pop" the string away from the fingerboard. This expands the instrument's percussive vocabulary and marks an early step toward dissolving the traditional bass/bass-drum dichotomy. The effect is emblematic in "Thank You (Falettinme Be Mice Elf Agin)" (Notation 12): in the notation, T denotes the thumb stroke and P the popped note. The percussive articulation underscores the riff's migrating accents across a short ostinato that repeats for the duration of the track. (Vincent & Davis, 2012, p. 218; Pfleiderer, 2006, p. 296) .



Notation 12: Sly & The Family Stone "Thank You (Fallentinme Be Mice Elf Agin)" Bass Riff / Source: Author's own transcription

Clinton's disco-oriented P-Funk extended funk's palette from the late 1970s onward by foregrounding synthesizer bass, feeding directly into late-disco/post-disco and, later, G-funk. A canonical example is the synth-bass riff in Parliament's "Flash Light" (Notation 13). The sound persists in contemporary pop: Mark Ronson's productions for Bruno Mars - *"Uptown Funk"* and *"24K Magic"* - explicitly revive this timbre and groove (see Section 2.6.2).



Notation 13: Parliament "Flashlight" Synth Bass / Source: Author's own transcription

2.6.2 Electronic Sound Production

The rising availability of electronic sound-generation tools - beginning in the 1960s, gaining a foothold in the 1970s, and becoming standard practice by the 1980s - profoundly reshaped both the form of dance music and the role of the bass within it. Those technological shifts remain decisive for both to this day.

Precursors to the synthesizer bass include the pedal-operated bass registers of church organs, emulated first in electromechanical organs (from 1935) and later in electronic organs (from ca. 1960). The electromechanical Rhodes pianos likewise offered a dedicated low-register model in the Piano Bass (1960). All of these instruments took their cues either from classical organ traditions or from conventional bass timbres (Brockhaus, 2017, p. 367).

The gradual spread of the subtractive synthesizer in the 1960s and early 1970s massively expanded the design space for low-frequency sound. In addition to providing voltage-controlled oscillators (VCOs) with multiple waveforms, these instruments

offered voltage-controlled filters (VCFs) with resonance a diverse set of filter characteristics (Stange-Elbe & Bronner, 2008, p. 361). The initially modular nature of these systems - exemplified by the standard-setting Moog Modular - limited their accessibility and thus their early diffusion. Nevertheless, as Brockhaus observes, "on his early albums […] Stevie Wonder relied almost exclusively on the Moog Modular for bass, thereby establishing - [from 1972 onward] - the synthesizer bass" (Brockhaus, 2017, p. 367; George, Sample This, 2004, p. 438). It is noteworthy that these albums appeared on Motown: the same institution that had incubated modern electric-bass idioms also became a crucible for the synth-bass tradition.

With the introduction of simpler, affordable, stage-ready semi-modular instruments such as the Minimoog, other musicians followed his lead (Humid, 2005, p. 51; Stange-Elbe & Bronner, 2008, p. 317 Most of these adopters also came from the African American musical milieu, so that from 1975 onward synthesizer bass appears on productions by Michael Jackson, Donna Summer, Funkadelic, and Herbie Hancock (Brockhaus, 2017, pp. 367-368).

Electronic sound generation reshaped not only the bass but also the production of percussive timbres. It gave producers far greater control over the kick drum's sound and helped solve the problems of projection and mix presence outlined in Section2.1.1. Consequently, with the advent of drum machines and advances in studio technology, the kick drum gained prominence in the mixes of popular dance music and became a legitimate object of bass research. An examination of typical drum patterns and kick-drum timbres in recent styles is therefore warranted.

Although the 1960s already saw programmable sequencers for modular synthesizers (e.g., Moog's 960/Q960) and simple rhythm accompaniments for home organs (e.g., the Ace Tone Rhythm Ace series), it was the Roland CR-78 (1978) - which combined these concepts - that effectively inaugurated the successful category of programmable drum machines (Humid, 2005, p. 51). Its successors, the TR-808 (see Fig. 8) and TR-909, would shape the sound of hip hop and EDM for years to come (Budde, 2000, p. 60)

Figure 8: Roland TR-808 Rhythm Composer / Quelle: Brandon Daniel / Clusternote

Particularly decisive was the tunable, parametric, sine-derived kick drum that Roland's machines made available - a defining element of styles such as Miami bass, trap, and baile funk. Bridging categories, the Roland TB-303 combined a monophonic bass synthesizer (with a resonant filter) and a programmable step sequencer in a single unit, and proved pivotal to the evolution of electronic dance music - especially acid house (Humid, 2005, p. 51-53; Budde, 2000, p. 61; Kirby, Acid House, 2017, p. 13; Théberge, Drum Machine, 2003, pp. 236-237).

With the introduction of the MIDI sequencing standard in 1982 (see 2.6.6), these standalone devices quickly became obsolete - not least because they were ill-suited to their original role as accompaniment automata for performers. (Stange-Elbe & Bronner, 2008, p. 317) Nevertheless, their signature timbres entered the canon of classic samples and colors across virtually all styles of modern dance music. Unsurprisingly, the late-1990s trend toward virtual emulations began in 1997 with Propellerheads' software ReBirth-338, a recreation of the three iconic unit. (Stange-Elbe & Bronner, 2008, p. 321)

2.6.3 Kraftwerk

Among the most influential catalysts in the emergence of electronically inflected dance music were the German pop avant-gardists Kraftwerk. The work of art-school graduates Ralf Hütter and Florian Schneider initially extended Krautrock while increasingly incorporating electronic–experimental ideas indebted to Stockhausen and musique concrète. (Brewster, 2006, pp. 343-344) In form, however, Kraftwerk - and their predecessor project Organisation - still resembled a classic band lineup, with guitar, bass, and drums.

With the landmark albums *Autobahn* (1974) and *Trans-Europe Express* (1977), Kraftwerk brought near–fully electronic sonics to promin ence, even as the results are better understood as artful sound collage than straightforward dance music. Telling titles such as "Tanzmusik" from *Ralf & Florian* (1973) are likely tongue-in-cheek. Nevertheless, the 22-minute *Autobahn* - with passages of electronically generated percussion - was received favorably in the disco scene and in early hip hop. And although Kraftwerk strove to craft a distinctly European sound set apart from American and British pop, their drum-machine parts increasingly moved into dialogue with African American popular forms. As Hoffmann notes, "Kraftwerk seem to fit naturally into the African American musical tradition" (Hoffmann H. , 2009)

The connection became undeniable when hip hop pioneer Afrika Bambaataa used *Trans-Europe Express* as a primary sample source for "Planet Rock" (see §2.7.2). Early Detroit techno producers likewise cited these Kraftwerk productions; Hütter has referred to them as "brothers in spirit" (Hoffmann H. , 2009) While Kraftwerk's own output is not, in the narrow sense, popular dance music, their impact on today's predominantly electronic modes of music production is difficult to overstate.

2.6.4 Disco Culture as an Underground Phenomenon (1968-1975)

In hindsight, disco is often conflated with its later mass-market icons - Saturday Night Fever, ABBA, the Village People. Yet its origins lie elsewhere: as an egalitarian revolution incubated in the underground of New York's nightlife. By the late 1960s, the United States was pulled between mounting crises - the Vietnam War and the oil crisis

- and a widening ethos of personal and collective liberation. On one front, African Americans pressed their civil rights with growing urgency; on another, gay communities were only beginning to claim public space and visibility. Equally consequential was the widespread adoption of the contraceptive pill, which catalyzed a transformation in sexual mores (Brewster, 2006, p. 136) In this volatile mix, disco provided not mere entertainment but a social technology of inclusion. As Poschardt puts it, "Disco, as minority music, created a social niche in an otherwise hostile environment" (Poschardt, 1997, p. 114).

The transformations that disco wrought in the (African)American music market are, in many respects, comparable to those pioneered in Jamaica over the preceding fifteen years (see chapter 2.5). They reshaped the architecture of nightlife and the nightclub, redefined the role of the disc jockey, and altered studio working practices. The adoption of the 12-inch maxi-single format likewise arose in direct response to the needs of the disco scene (Brewster, 2006, p. 137).

Francis Grosso embodied this professional shift. He began his career in 1968 as an impromptu stand-in for Terry Noel, who was unable to work due to drug use, and immediately assumed Noel's position at the New York discotheque Salvation. What most distinguished Grosso from his contemporaries was his reconception of the DJ's task: he linked records into what has since been called a DJ set. Previously, the basic unit of reference in a DJ's performance had been the individual song. Grosso was the first to string tracks into arcs of mood and energy that followed a dramaturgy of his own design (Shapiro, 2007, p. 39; Brewster, 2006, p. 141).

> *„Before him people played records as if they were discrete little performances, Francis treated them like movements in a symphony; continuous elements in a grand whole."* (Brewster, 2006, p. 141)

A feedback loop with the floor certainly emerged: he adjusted his plan in real time in response to audience reactions. Yet the new type of nightclub DJ was no longer there primarily to satisfy individual requests. Rather, he wove many records into a continuous Gesamtkunstwerk - a holistic arc designed to intuit and serve the crowd's collective musical needs. This self-conception has decisively shaped DJ performance practice to this day (Brewster, 2006, p. 139).

Although Grosso was likely not the first DJ capable of seamless equal-tempo transitions, he helped establish what has become the craft's most essential technique: beatmatching. Here, the tempos of two records are aligned via a pitch control, and the tracks are then blended on the mixer so that the underlying pulse continues unbroken despite the change of tune. Pitch controls originally served to fine-tune platter speed - verified with a stroboscope - to ensure correct playback. Later, turntables built explicitly for DJ use, such as the Technics SL-1200, combined quartz lock stability with a user-friendly pitch slider. A further application of the method is the layering and fusing of passages from different records using equalizers to sculpt frequency overlap. (Brewster, 2006, p. 145).

Musically, this was a turn away from the lightweight soul–pop crossover epitomized, on the one hand, by the Beatles and, on the other, by Motown. By the late 1960s, the sound of New York's nightclubs was expanding in multiple directions beyond the mainstream. On one front, funk brought a cohort of more emphatically Black performers into DJs' selections; on another, African American popular music had begun to evolve outside the United States, prompting feedback effects from boogaloo and the Latin rock of Carlos Santana and Tito Puente, as well as from the West African Afrofunk of Fela Kuti and Osibisa (Brewster, 2006, p. 141). Disco was thus the first music style - outside Jamaica - to be defined at the DJ booth. Fittingly, the site of performance supplied the genre's very name. When producers later began to make disco records, they followed the established practices of the dance floor. (Poschardt, 1997, pp. 110-111)

Although Francis Grosso laid the groundwork for the emerging disco culture, he was not himself among its leading protagonists. That role fell to his protégés, Michael Capello and Steve D'Aquisto, whom he trained at the DJ booths of Sanctuary and Haven. (Brewster, 2006, p. 148)

What Grosso was for disco's early musical history, David Mancuso - founder of The Loft - was for its nightlife culture. In 1970, in the industrial loft where he lived, Mancuso began hosting semi-public, invite-only parties. He pursued a meticulously curated vision of party culture: décor, who got in, what was played, and - above all - how it sounded.

He began with an overbuilt home stereo; after meeting Alex Rosner, the two engineered The Loft's sound system, setting a new benchmark for clubs. Rosner - an audiophile - persuaded Mancuso to finance the first true hi-fi PA, which he then designed. Compared with nearby 1960s venues such as Le Club and The Arthur, The Loft's rig represented a generational leap and quickly drew the attention of Grosso, Capello, and D'Aquisto, who introduced Mancuso to the craft's fundamentals (Brewster, 2006, pp. 152-153). By the mid-1970s, a new cohort of New York DJs had emerged - cooperative in ethos and excited by danceable music across styles, especially with African American, Latin American, or African inflections. For the first time, DJs were powerful enough to lift a track from local club favorite to national or international hit. A classic case is "Soul Makossa" by Cameroonian saxophonist Manu Dibango: released in 1972 on the small French label Fiesta, it became a Loft anthem and was later taken to a wider audience by Atlantic Records. (Brewster, 2006, p. 159; Lawrence, 2014, pp. 180-181; Shapiro, 2007, pp. 44-47)

Mancuso's clientele was socially, ethnically, and economically diverse - highly unusual for the period. Precisely for that reason, an atmosphere of equality prevailed. The freedom enjoyed by gay and other queer communities in this setting is striking for the Nixon era, when the American mainstream - and the sexual criminal code with it - remained deeply prudish (Brewster, 2006, p. 157). This spirit became emblematic of the disco movement. In Foucauldian terms, disco may thus be read as a struggle for liberation waged on the terrain of the body (Poschardt, 1997, p. 116). A further legacy of the era is the prevalence of chemical stimulants across nearly all branches of electronic dance music (Brewster, 2006, pp. 143, 163).

The first commercial counterpart to The Loft was The Gallery, a public discotheque opened in 1973 by the young DJ Nicky Siano. Strongly influenced by David Mancuso, it occupied a (much larger) loft and was fitted with a similar Alex Rosner system. Siano, however, placed special emphasis on sub-bass: "He loved that deep, deep bass and had Alex Rosner design him a sound system with forbiddingly dark, bowel-quaking bass reproduction […]" (Shapiro, 2007, pp. 51-52), - an influential innovation outside Jamaica's sound-system culture. The Gallery's technical setup also enabled precise coordination of light and sound. (Brewster, 2006, pp. 162-163) In the wake of

The Loft's cultural impact and The Gallery's commercial success, an estimated 150–200 discotheques opened in New York by 1975. A new nightlife culture had taken root (Brewster, 2006, p. 164).

2.6.5 Disco Culture as a Mainstream Phenomenon

As the 1960s gave way to the 1970s, the American record industry confronted a widening gap. Rock - so lucrative only a few years earlier - was losing momentum. The Beatles disbanded in 1970; Janis Joplin and Jimi Hendrix died that same year, and Jim Morrison followed in 1971. With the zeitgeist shifting, the majors labels entered the new decade in search of a fresh, bankable sound.

In disco's formative phase, audiences and DJs together distilled a common denominator from diverse dance styles. From the plethora of influences championed by pioneers like Grosso, Mancuso, and Siano, there emerged a compact toolkit of musical elements that spoke to a strikingly broad demographic. (Brewster, 2006, pp. 176-177) By then, the impact of club play on sales - clear at the latest since *"Soul Makossa"* - was undeniable, and labels began to systematically harness it. Young marketing figures such as Billy Smith of 20th Century Promotions recognized that clubs now complemented, and at times rivaled, radio as the primary engine of music promotion. Hits like Carl Douglas's *"Kung Fu Fighting"* and Average White Band's *"Pick Up the Pieces"* were catalyzed precisely through this club-centered promotional ecology. (Brewster, 2006, p. 179-180; Lawrence, 2014, p. 181)

When airplay still governed promotion, labels favored compact pop, rock, and soul singles that rarely exceeded two or three minutes. On the dance floor, by contrast, what mattered was the ecstatic insistence on the beat. Listening habits for non-dance music were shifting as well under the sway of late-1960s progressive-rock epics: pieces like Iron Butterfly's In-A-Gadda-Da-Vida filled entire LP sides and featured multi-minute drum solos. Within a few years, African American artists adopted this long-form approach, extending tracks well beyond the three-minute mark. (Brewster, 2006, p. 182). James Brown's Sex Machine and The Temptations' Papa Was a Rollin' Stone exemplify the trend among marquee acts, running to nearly six and nearly seven minutes, respectively.

As Rolling Stone journalist Vince Aletti observed in 1973:

> *„The best Disco music is full of changes and breaks, which allow for several changes of mood or pace and open up for long instrumental passages. If the break works, it becomes the pivot and anticipated peak of the song."*
> (Brewster, 2006, p. 182)

A large share of early disco-era music met dancers' needs musically yet remained formally bound to radio pop. As a result, just when a track reached its peak, it was effectively over. These climactic moments were usually the drum breaks in the funk records being played. The problem, then, was how to extend precisely those sections that most animated the floor.

While King Tubby in Jamaica developed the side of the remix concerned with the simultaneity of elements and their alteration, it was in New York that Tom Moulton invented the remix in terms of sequentiality - the ordering of form.

Moulton observed, at a discotheque on Fire Island, which parts of a song sent dancers off the floor and which provoked the most exuberant response. He first assembled a 45-minute cassette side made exclusively of those crowd-pleasing sections - repeating them as needed - by cutting tape with millimetric precision and splicing it back together. His first commercial release using this method was, in August 1974, an edit of B.T. Express's funk single "Do It ('Til You're Satisfied)." The nearly twice-as-long version displaced the original in airplay - and thus in public perception - almost entirely; in November it reached No. 2 on the Billboard Hot 100. (Bilboard Magazine, 1974). That same year, several labels emerged specializing in promoting commercial releases by circulating their disco mixes, a substantial number crafted by Moulton. With his reworking of Gloria Gaynor's "Never Can Say Goodbye," he delivered the first chart hit that was not only music of the disco scene but explicitly in the style of disco. In the wake of this shift, DJs - now functioning as remix artists and producers attuned to the needs of the dance floor - became central to the record industry, and they remain so to this day (Brewster, 2006, p. 181-185; Lawrence, 2014, p. 181).

The established 7-inch single was no longer optimal for the extended running times required in disco. The longer the track, the tighter and shallower the groove pitch had

to be, which reduced dynamic range - most audibly in the bass. Once again, Tom Moulton found the solution.

When no 7-inch lacquers were available for a test pressing of one of his mixes, the cut was made at 45 RPM onto a 12-inch blank - at the time used exclusively for albums at 33⅓ RPM. To compensate, the grooves were cut extra wide, so that the seven-minute mix filled an entire side. This prototype of the 12-inch maxi-single proved compelling, offering DJs a format with clear advantages:

1. Greater headroom and bass than a 7” single or LP, thanks to wider grooves.
2. Longer playing time than the 7” single.
3. Higher dynamics than an LP, owing to the higher rotational speed (45 RPM).
4. Improved tactile handling for DJs compared with a 7-inch single, thanks to the larger surface area and small spindle hole.

Although Moulton initially dismissed the procedure as excessive, by 1975 it had become the de facto standard for DJ promotional pressings. Early industry uptake remained selective - labels tended to reserve the format for titles thought to require a marketing boost - so much club-relevant repertoire was not yet available on 12-inch, prompting understandable skepticism among DJs. The turning point came with Double Exposure’s “Ten Percent (Special 12″ Disco Mix)” on the then-nascent Salsoul imprint: whereas the commercial single ran roughly three minutes, the promo featured a ten-minute reworking with orchestral overdubs and extended percussion solos, and quickly eclipsed the radio edit in popularity. In response to public demand, Salsoul issued “Ten Percent” as the first commercially released 12-inch maxi-single. The format would remain the gold standard of DJ practice well into the early twenty-first century. From the standpoint of bass culture and sound design, the 12-inch amounted to a material redefinition of the medium: it enabled sustained, high-fidelity low-frequency reproduction far beyond the three-minute constraint of the 7-inch single on a widely distributed commercial carrier (Brewster, 2006, S. 185-187; Hoffmann, Tom Moulton - Der Erfinder der Maxi-Single, 2016, S. 51-54).

Another influential cultural technique of the era - crucial for the later rise of hip hop - was the mixtape. With the ascendancy of the compact cassette, which by the late 1960s had outcompeted other tape-based music carriers, audiences and collectors first began to value complete documentations of DJ performances. DJs sold under-the-counter recordings of their sets, with no royalties paid - owing in part to the record industry's explicit refusal to legitimate the format. Licensing music to disc jockeys for this purpose was categorically excluded. Within the industry, practice was less rigid: a few short-form DJ sets appeared on vinyl by special arrangement. A representative example is Spring Records' sampler *Disco Pa-r-r-ty*, which licensed material from James Brown, Mandrill, and Lyn Collins (Brewster, 2006, pp. 180-181; Shapiro, 2007, p. 56) By the close of the 1970s, disco had undergone a stark inversion. What began as an exuberant, egalitarian culture - nurtured by connoisseurs and collectors of obscure musical gems and sustained by marginalized communities - had become an exuberant spectacle of the prominent establishment, dancing to a thematically thinned blend of soul, funk, and pop. Ecstatic individualism had displaced ecstatic collectivism. (Brewster, 2006, pp. 193, 200) Emblematic of this turn were, on the one hand, the elite nightclub Studio 54, and on the other, the Hollywood codification of disco in Saturday Night Fever.

Studio 54 in New York is commonly regarded as the most famous discotheque of its era - indeed, perhaps the most famous ever. It opened on April 26, 1977, in a 54th Street venue that had previously served as a music theatre and television studio. Outfitted with the most lavish sound and lighting systems of its day, Studio 54 became the stage for the excesses of the rich and beautiful - a kind of Peppermint Lounge after the Fall. Beyond its rigorously enforced door policy unfolded a world of sex and money, driven by cocaine. The roster of regulars reads like a roll call of the period's cultural elite: Andy Warhol, Truman Capote, Grace Jones, Bianca Jagger, Woody Allen, and Sylvester Stallone, among many others. At the centre of the Studio 54 phenomenon was spectacle and surface, no longer the music. "Studio 54 was consciously the antithesis of the original disco clubs […]," and it thus epitomised the tendencies of the late disco era (Brewster, 2006, pp. 193-194, 196).

Just as Studio 54 embodied this shift, so too did the film Saturday Night Fever. Whereas the emblematic protagonist of early disco culture was a gay African American man, the film substitutes him with Tony Manero, a heterosexual Italian American portrayed by John Travolta. Its blockbuster soundtrack - by the Australian Bee Gees, repositioned by RSO after their move from Atco as the "white Temptations" (Brewster, 2006, p. 198) - cemented the transformation. With the tandem success of film and soundtrack, the Bee Gees assumed for disco the role that Elvis Presley had played for rock 'n' roll and Dave Brubeck for jazz: they domesticated an African American cultural practice into a sanitized product for the white mainstream, largely stripped of its transgressive, subcultural charge. (Brewster, 2006, pp. 197-198)

One of the most formative producers of this late phase was the Munich-based Italian Giorgio Moroder. European producers such as Moroder adopted the formal template of earlier Black disco while paring back many African American idioms, substituting the increasingly available resources of electronic production. (Brewster, 2006, p. 200)

Moroder's collaborations with Donna Summer proved especially decisive. Their first, "Love to Love You Baby" (1975), still follows a funk-derived formal grammar yet extends it to seventeen minutes, filling an entire LP side. Summer's lascivious vocal repeats the title line in mantra-like, sample-style loops, anticipating the vocal-sampling aesthetics of later house - which frequently acknowledges Moroder's precedent. Love to Love You Baby became one of the first international commercial breakthroughs of Disco (Brewster, 2006, p. 200; Lawrence, 2014, p. 182; Shapiro, 2007, pp. 129-130).

Musically more consequential was Moroder and Summer's second hit, released in 1977. On the album I Remember Yesterday, each track was conceived to represent a distinct style or era; Moroder was tasked with composing the "future" - which yielded the almost entirely electronic "I Feel Love." (Raffeiner, 2013, p. 30; Pfleiderer, 2006, p. 311)

Moroder: "Moroder: "You can't know the future, but I knew there was an instrument that was the future. I knew it from the day I first saw a Moog synthesizer." (Raffeiner, 2013, p. 32)

The track is anchored by a synthetic bass that Moroder generated with delay in lieu of a sequencer. (Brockhaus, 2017, p. 368) Apart from the kick drum and Summer's vocal,

the entire production derives from the synthesizer. The kick articulates every quarter-note beat throughout - a pattern later codified across all forms of techno and house as four-to-the-floor.

Moroder: “I think we found a style that was European. Apart from Donna as the singer - who was Black and had that special voice - there was nothing of R&B in the music. “ (Raffeiner, 2013, p. 33)

With “I Feel Love,” Moroder furnished one of the two crucial connective tissues between the Rhythm & Blues tradition and electronic dance music (EDM). He effectively inaugurated Hi-NRG, a style intelligible as the hinge between disco and 1980s house, and one that has been described as both the genre’s “commercial apex” and its “musical nadir.” (Brewster, 2006, S. 200-201; Lawrence, 2014, S. 181; Shapiro, 2007, 139-140)

Disco recast soul and funk into a dance culture that was simultaneously subcultural and mass-oriented, and its imprint runs through virtually every style that followed. It institutionalized a new priority: the loud, precise articulation of the low end as a core aesthetic norm of modern popular dance music. From Moroder onward, the kick drum - alongside the electric bass and synth bass - steps forward as a defining, foreground element of the bass register.

In this regime, bass is not merely a sound but an embodied force. As Poschardt observes, “the hard bass line of the disco beat is not merely heard but felt throughout the body. Each beat hits the gut, presses on the ribs, and renders a (physical) response to the music unavoidable: either dance or leave the club” (Poschardt, 1997, p. 118)

2.6.6 The Digitization of Music Production

With the onset of the 1980s, music-production practice underwent another profound transformation. (Théberge, Computers in Music, 2003, p. 234) As the cost of microprocessors and computer memory fell continuously, the digitization of the creative process - and, ultimately, its democratization - accelerated.

Although digital storage media had been used since the introduction of the PCM standard in the late 1960s to produce stereo masters, the 1980s saw these techniques migrate to multitrack recording. Chief among the advantages in the early era of harddisk recording was the ability to copy and consolidate tracks without generation loss - i.e., without the additional noise that bouncing incurred on analog tape (Théberge, Digital Recording, 2003, p. 217).

In parallel, the introduction of the MIDI standard removed long-standing barriers to digital communication between electronic instruments and hardware sequencers, making MIDI an integral part of studio workflow (Théberge, Computers in Music, 2003, pp. 234-235; Théberge, MIDI, 2003, p. 247).

As affordable personal computers became widely available, they first assumed - by about 1986 - the role of dedicated hardware sequencers. Software sequencers not only replaced their hardware predecessors but also expanded the scope and complexity of controlling external devices (Théberge, Computers in Music, 2003, p. 235).

By the early 1990s, gains in personal-computer performance enabled digital audio recording to be integrated directly into software sequencers (Théberge, Digital Recording, 2003, p. 217; Théberge, Computers in Music, 2003, p. 235). his convergence yielded a step change in editability and workflow flexibility (Jones, 2003, p. 227). Cy the decade's end, the compulsory reliance on external sound generators diminished with the advent of software synthesizers and effects, typically implemented as plug-ins within the sequencer environment. Consequently, the centrality of large commercial studios declined: substantial portions of production - and, in many cases, entire projects - could now be realized in home or project studios (Jones, 2003, p. 227). This was particularly consequential for modern popular dance music, which is not

predicated on the labor-intensive multitrack capture of (electro-)acoustic ensembles; simply substituting electronically generated drums for a recorded kit renders a considerable burden of track counts, microphone deployment, and acoustic isolation unnecessary (Théberge, Sound Editing, 2003, p. 228; Théberge, Music Software (Professional & Amateur), 2003, p. 251).

Another key vector of digitization was sampling, introduced in 1979 with the Fairlight CMI (Fig. 9) and rendered more affordable in 1980 with the E-mu Emulator (Théberge, Computers in Music, 2003, p. 235). Here, acoustic information is digitized and stored in RAM, from which it can be retrieved, transformed, and recontextualized within new musical works. This made it possible to fold pre-existing sounds into fresh productions - for example, to lift drum timbres from commercial recordings and deploy them, drum-machine–style, to articulate an original beat. As RAM prices fell, longer samples became practical; from the late 1980s onward, short passages such as drum breaks or bass riffs could be captured and looped. It also became standard practice to process the source material timbrally and, crucially, to chop and recombine it ("slicing"), thereby further expanding the canon of contemporary production techniques (Théberge, Sound Editing, 2003, p. 228; George, Sample This, 2004, pp. 438-439).

All of this lowered the barriers to entry for professional music production and blurred the boundaries between musician, producer, and engineer (Jones, 2003, p. 227). The stylistic developments of the 1980s - and even more so the 1990s and 2000s - were shaped by producers working in small, informal (often ad hoc) studios, who became decisive agents of aesthetic change. At the same time, musicians without formal training gained easier access to production, opening new perspectives on musical design and practice. (Théberge, Sampler, 2003, pp. 257-258).

With the disco era's codification of dance-floor and nightlife conventions - and with the progressive availability of electronic and, soon, digital instruments - the aesthetic, social, and technological preconditions for modern popular dance music were firmly in place. As the 1970s gave way to the 1980s, young producers in New York, Chicago, and Detroit began to elaborate idioms that would crystallize into distinct traditions. The next two sections trace the genre's twin lineages - hip hop and electronic dance

music (EDM) - which unfolded in parallel rather than in sequence, each comprising a wide constellation of substyles.

Figure 9: Fairlight CMI / Quelle: Peter Wielk

2.7 Hip Hop

As a counterpoint to the glittering elitism of late-era disco, hip hop emerged in the latter half of the 1970s in New York's "ghettos" - above all the Bronx. At first it functioned as a strictly local festal culture for African American minorities in socially marginalized neighborhoods: a dance event format with roots in reggae sound-system practice and disco DJing, capable of sonically animating the community rooms of housing projects, parish and recreation halls, schoolyards, and parks.

Like reggae, early hip hop was fundamentally DJ-driven. With the success of individual acts in the 1980s, the originally accompanying spoken-word vocalists moved to the foreground, catalyzing the music's expansion - first beyond the city, then internationally.

By the 1990s, hip hop had consolidated itself as one of the world's largest youth cultures and most commercially consequential musical formations. Today, alongside electronic dance music (EDM), it constitutes one of the two principal categories of modern popular dance music - remaining highly significant as both musical style and youth culture.

Hip hop - with its proliferation of substyles - played a decisive role in establishing the low-frequency register as a foregrounded value in the mainstream. It also helped define the formal logics of modern dance music through several key cultural techniques:

- Recontextualization of existing recordings: the use of passages from other artists' records to create new works - initially via manual manipulation of vinyl (cueing, backspins, breaks), later via digital sampling (Poschardt, 1997, p. 166).
- Vocal innovation: the refinement of jive-talk and dub toasting into the modern form of rap (Poschardt, 1997, p. 156).
- A new production paradigm: hip hop was the first major popular style in which the predominant production practice did not center on playing instruments in the classical sense. A workflow that foregrounds the turntable, synthesizers, and samplers has, since then, underpinned a substantial share of modern dance music (Schloss, 2004, pp. 2-4, 25-27).

Accordingly, any robust account of the bass in modern dance music requires a close examination of hip hop's evolution.

2.7.1 Hip Hop als Performance-Kultur

The earliest phase of New York's hip-hop scene is poorly documented, not least because it emerged as a predominantly street-based culture in the economically disinvested and socially abandoned South Bronx. Much of what we know derives from participants' testimony. Most sources, however, concur that a decisive early milestone was Clive Campbell's (Kool DJ Herc's) dance events in the community room of a public-housing project (Poschardt, 1997, p. 163). Herc effectively translated the Jamaican sound-system ethos and performance practice to an American funk and disco repertoire, combining toasting-derived spoken delivery with the use of two turntables and a mixer to blend/crossfade between records - thereby articulating a new, as yet unnamed style. (Brewster, 2006, p. 230, 232; Poschart, 1997, pp. 164-165)
Brewster succinctly puts it:

> „Hip Hop owes Reggae an enormous debt. Kool Herc, hip hop's founder was Jamaican and what he did in the Bronx was largely to build a New York Version of the Kingston Soundsystems of his youth, toasting deejays included."
> (Brewster, 2006, p. 130)

Beginning in 1973, Kool DJ Herc became the first DJ to extend the drum break of a funk, soul, or disco side by alternating between two copies of the same record on twin turntables, rather than playing the track straight through - a procedure later termed beat juggling, and effectively the earliest form of the drum loop. A signal example was the Incredible Bongo Band's cover of "Apache" - a percussion-driven funk instrumental that became both Herc's signature and one of the foundational sound sources of early hip hop, a kind of "national anthem" of the South Bronx (George, Hip-Hop's Founding Fathers speak the Truth, 2004, p. 47) Herc's block parties also provided a first regular home for B-boys and their competitive dance style, breakdancing. Previously they had appeared as outliers within the disco scene, known as "Good Foot" dancers - after James Brown's 1972 track "Get on the Good Foot" - and would dance exclusively to

the breaks (Poschart, 1997, S. 170; Hoffmann M. , 2004, S. 34 In the Bronx, the breaks - and with them the breakers - moved to center stage. The term breakbeat, coined in this period and still in use, refers precisely to this practice of isolating and repeating the drum break in lieu of the full track (Brewster, 2006, p. 228-231; George, 2004, p. 47):

In 1973, Campbell was still performing - under parental supervision - in a housing-project community room for fellow teenagers. By the following year, his new approach had drawn sufficient attention that, in 1974, he held regular residencies in four discotheques. Within the tightly circumscribed Uptown corridor of the Bronx and Harlem, he achieved, in remarkably short order, a level of renown comparable to the superstar stature of the era and became a powerful crowd magnet. This success enabled him to retain two MCs[7], Coke La Rock and Clark Kent, widely regarded as the first rappers of the hip-hop scene. Their delivery drew on both Jamaican toasting and the jive patter of African American radio DJs, yet fundamentally emancipated itself from either precedent (Brewster, 2006, pp. 233-234; George, Hip-Hop's Founding Fathers speak the Truth, 2004, p. 52).

Another Jamaican bequest to hip hop was its bass-forward aesthetic (Poschardt, 1997, p. 166). As Campbell himself put it:

> *„A lot of my music is about the bass" (Brewster, 2006, p. 233)*

The core of his Herculords sound system comprised two McIntosh 2300 power amplifiers, each delivering 600 watts, driving two large Shure loudspeaker towers. (Poschardt, 1997, p. 166) Eyewitnesses - including many later hip-hop protagonists influenced by him - consistently attest to its unusually powerful low-frequency reproduction. The premium placed on bass was surely due in part to the fact that many block parties were held outdoors - in parks and on schoolyards - where, as with Kingston's

[7] MC stands for "Master of Ceremonies" (often spelled "emcee") and is a standard term for a rapper, particularly when emceeing/hosting a dance event.

lawn parties, far-carrying bass was essential. After a stabbing at one of his events, Kool DJ Herc withdrew from the nightlife in 1977, long before his invention would burgeon into a billion-dollar industry. (Brewster, 2006, p. 234)

Where Campbell was not especially precise in his transitions between records - often masking them with delay effects or through his MCs - the young electronics technician Joseph Sadler (Grandmaster Flash) set out to perfect these techniques and became one of the first hip-hop DJs to achieve national renown. Influenced on the one hand by Herc's block parties and on the other by the precise segues of disco DJ Pete Jones, Sadler posed himself the following problem:

> *„I got to be able to go to just the particular section of the record, just the break, and extend that, but on time. I had to figure out how to take these records and take these sections and manually edit them so that the person in front of me wouldn't even know that I had taken a section that was maybe 15 seconds and made it five minutes. So that these people that really danced, they could dance as long as they wanted."* (Brewster, 2006, p. 238)

Working as a stand-in for Pete Jones, Sadler meticulously analyzed the club DJ's craft and signal chain. Over months he built, on the foundation of disco DJs' beat-matched transitions, his Quick Mix Theory - a toolkit of techniques for creating precise, manually generated loops of short (15–30 s) segments by alternating between two copies of the same record. This required not only tempo alignment but also precise beat alignment - locking the downbeats - along with the rapid recall of an exact cue point. To that end he modified his mixer to add a headphone cue (pre-fader listen) - then found only on very expensive consoles because it demanded additional preamplification (George, Hip-Hop's Founding Fathers speak the Truth, 2004, p. 49) By 1975 he had achieved his goal and, in homage to then-popular kung-fu films, adopted the honorific Grandmaster. The Quick Mix Theory became the articulated foundation of hip-hop performance practice and, by extension, of later breakbeat genres such as drum & bass. Despite - or perhaps because of - his radical innovations, it took nearly two years before Sadler, with his MC ensemble the Furious Five, established himself by late 1976

as one of the leading DJs of the proto-hip-hop scene (Brewster, 2006, S. 238-240; Poschart, 1997, S. 171,172).

The third pivotal DJ in this formative period was Lance Taylor, better known as Afrika Bambaataa. Whereas Grandmaster Flash extended a small set of recognized hits via his Quick Mix, Taylor's contribution lay in rapidly interlinking a wide array of styles within a single party. His chief influences were the expansive record collection of his music-obsessed mother and his gang background. As a leading figure in the Black Spades, the charismatic Taylor helped broker a truce among rival South Bronx gangs in the early 1970s - an achievement that paved the way for his founding of the Zulu Nation in 1975 (George, 2004, S. 50; Poschart, 1997, S. 179-182) Conceived as a loose federation of emerging hip-hop practitioners - breakdancers, graffiti writers, DJs, and MCs - the Zulu Nation effectively consolidated the Bronx's cultural field as that of hip hop (Poschardt, 1997, p. 170). his position enabled Bambaataa, from his earliest appearances in 1976, to draw substantial crowds. Beyond the prevailing soul and disco repertoire, he expanded the hip-hop DJ palette to encompass jazz, television themes, and white pop and rock, spinning passages by the Beatles, the Rolling Stones, and Aerosmith. Especially consequential was his uptake of the German electronic pioneers Kraftwerk (see 2.6.3), whose tracks became signature materials in his sets (Brewster, 2006, S. 240-245).

By 1976, the essential foundations of hip hop as a nightlife performance culture had coalesced - even though not a single hip-hop record had yet been released (Poschardt, 1997, p. 179). A rising cohort of young DJs took their cues from the three exemplars. Campbell, Sadler, and Taylor had effectively partitioned the Bronx into territories and stood as the unchallenged authorities of the scene. (Brewster, 2006, p. 246)

2.7.2 Hip Hop as a Recording Culture

By the late 1970s, compact cassettes circulated in New York featuring mixes and live tapes of the few renowned hip-hop DJs and their MC ensembles. Alongside Grandmaster Flash and Afrika Bambaataa, the Cold Crush Crew figured prominently - their sound blasting from ghetto blasters and taxis across the city. (George, Hip-Hop's Founding Fathers speak the Truth, 2004, p. 51) Within the scene, however, there was

little sense that the new style should be rendered as a commercial song-form recording. (Dimitriadis, 2004, p. 421) „Who would want to hear a record which I was spinning, re-recorded with MCing over it?" As Taylor recalled of his stance at the time (Brewster, 2006, p. 259; George, Hip-Hop's Founding Fathers speak the Truth, 2004, p. 52) Campbell was similarly dismissive: "My thing was just playing music and giving parties. I wasn't interested in making no records." (George, Hip-Hop's Founding Fathers speak the Truth, 2004, p. 55)

Accordingly, the first impulses toward hip hop as a recording practice came from outside the scene but were quickly assimilated and reworked from within, yielding three template-setting releases whose influence remains audible in hip hop and popular dance music today.

1. The Sugarhill Gang – „Rapper's Delight"
2. Grandmaster Flash – "The Adventures of Grandmaster Flash on the Wheels of Steel"
3. Afrika Bambaataa & The Soulsonic Force – "Planet Rock"

Opinions differ on what counts as the first hip-hop record. Some point to the spoken-word funk of Gil Scott-Heron's "The Revolution Will Not Be Televised," released two years before Campbell's first parties, noting elements later central to 1990s conscious rap. Yet for the Chicago-born soul and jazz artist, any substantive contact with hip hop came only once that substyle had already gained traction. Others cite the B-side "King Tim III (Personality Jock)" by the Fatback Band as the earliest hip-hop disc. In spring 1979, the funk group - past its commercial peak - hired radio announcer Timothy Washington, a scene outsider, to emulate the nascent vocal style (Brewster, 2006, p. 259). Although Washington's rap struck many within the scene as inauthentic, "King Tim III" outperformed its A-side, "You're My Candy Sweet," and briefly fueled a minor comeback for the band (Poschardt, 1997, pp. 196-197).

There is, however, broad consensus on the first record to propel hip hop to substantial attention beyond the scene: "Rapper's Delight" by the Sugarhill Gang, released on the eponymous Sugar Hill label (Poschardt, 1997, p. 199). Sugar Hill was run by the seasoned and enterprising New Jersey producing duo **Sylvia and Joe Robinson**, who

came out of the funk and disco world and had no direct ties to the Bronx hip-hop milieu. (Poschardt, 1997, p. 197) eeing hip hop's commercial potential, Sylvia Robinson assembled a group of unknown faces. Henry Lee Jackson (Big Bank Hank), for example, had no prior musical profile; he worked as a doorman at the Sparkle disco, where Kool DJ Herc regularly performed. In Herc's circle was the then-prominent rapper Curtis Fisher (Grandmaster Caz), whose notebook Jackson borrowed - large portions of the Rapper's Delight lyric derive from it. This is most evident in the line "I'm the C-A-S-A-N-O-V-A and the rest is F-L-Y," reflecting Fisher's alias Casanova Fly. Additional lines were lifted from the Cold Crush Brothers and the Furious Five. None of these originators received royalties for the appropriated material. (Poschart, 1997, S. 198-199; Brewster, 2006, S. 261; George, 2004, S. 52-53).

For the three MCs' backing track, studio musicians replayed the bass line of Chic's 1979 summer hit "Good Times" as a seventeen-minute loop. Although no DJ took part in the production of "Rapper's Delight," this method was a clear concession to the block-party DJ performance format and, in effect, revived Jamaica's versioning practice (see 2.5.2) (Brewster, 2006, pp. 260-261). In this sense, "Rapper's Delight" can be understood as an African American, DJ-style dub of "Good Times." The approach became template-setting for many early rap records, which lifted signature bass lines and drum breaks from popular disco hits and paired them with party-oriented MC routines (George, Sample This, 2004, p. 439) A representative case is **Taana Gardner's** 1981 hit **"Heartbeat,"** which was repurposed **three times** for hip-hop releases that same year - most prominently by **The Treacherous Three** (featuring **Kool Moe Dee**) on **"Feel the Heartbeat."**[8].

[8] The database WhoSampled.com lists 76 tracks that incorporate material from "Heartbeat." The majority are hip-hop recordings; the most widely known is arguably Ini Kamoze's 1994 "Here Comes the Hotstepper (Heartical Mix).". (Who Sampled)

„Rapper's Delight" wurde mit über 2 Millionen abgesetzten Einheiten (Poschardt, 1997, p. 199) kommerziell höchst erfolgreich, erreichte die 4. Position der Billboard R&B Charts sowie Platz 36 der Hot 100 und löste die erste *Hip Hop* Welle in den USA aus (Brewster, 2006, pp. 260-261).

Figure 10: Artistic depiction of the recording of "The Adventures of Grandmaster Flash on the Wheels of Steel" in comic form - from left to right: J. Sadler, S. Robinson, R. Robinson; below: The Furious Five. Source: Ed Piskor, *Hip Hop Family Tree Collector's Edition Vol. 1* (2013), p. 79

Similarly, five singles of this type were also released under the name Grandmaster Flash and the (Furious) Five in 1979–1980 - without Sadler's direct creative input. By then, audiences were primarily seeking the MCs' vocal performances, yet the DJ's name remained the marquee that sold records; the same held for rivals such as Afrika Bambaataa. With "The Adventures of Grandmaster Flash on the Wheels of Steel," Sadler decisively broke from the "Rapper's Delight" template, enshrining his Quick Mix Theory and the broader technical repertoire of early hip hop while simultaneously inaugurating sample-based production. Working on three turntables, he assembled a seven-minute live mix built entirely from pre-existing recordings, intricately interwoven - most prominently Chic's "Good Times" and the Incredible Bongo Band's "Apache." Though its commercial chart impact was limited, the track became an

international club hit and a modern dance-music classic, serving as a proof of concept for countless subsequent productions

> *„To those who heard it at that time it was a revolutionary moment in the history of music: a record made from nothing more than other records […] Theorist heard the creaking of concepts like authorship, copyright, originality, musicianship. […] Musics possibilities had expanded dramatically."*
> (Brewster, 2006, p. 263)

Similarly, Sadler's rival Lance Taylor (Afrika Bambaataa) had little creative involvement in the earliest releases billed as Afrika Bambaataa & the Soulsonic Force. He would soon go a step further than Sadler, however: Taylor became the first hip-hop producer to deploy a drum machine (the Roland TR-808) together with an early digital sampler (the Fairlight CMI). The instrumental bed of "Planet Rock" draws extensively on Kraftwerk's "Numbers" and "Trans-Europe Express," as well as Babe Ruth's "The Mexican." Given the severe memory limits of early samplers, the CMI was reserved for the brief but defining "orchestra hit"; all other parts were recreated on the 808 and on synthesizers. The vocal tracks were performed, as before, by Bambaataa's MC ensemble, the Soulsonic Force (Brewster, 2006, pp. 264-265).
"Planet Rock" is groundbreaking for its multilayered interweaving of disparate musical lineages. It delivers a widely emulated rethinking of hip-hop production, inaugurates electrofunk (electro), and becomes a key influence on early American electronic-music producers (see 2.8.1 – 2.8.2) (Brewster, 2006, p. 265). In addition, its **ultra-low bass lines** suggested the expansive possibilities opened by the newest electronic means (Poschardt, 1997, p. 222).

Kraftwerk themselves expressed fascination with Taylor's repurposing of their material. Ralf Hütter recalled:

> *„When we visited New York at the end of the seventies, the dance department of our label took us to illegal clubs. We were dancing, and suddenly the DJ - Afrika Bambaataa - played 'Trans-Europa-Express' and 'Metall auf Metall.' But the tracks weren't ten minutes long, they were twenty! I thought: 'Strange, our*

pieces aren't that long.' Then I realized he was using two acetates of the same record and blending them together. We thought it was fantastic. In the studio we ourselves would sometimes play our music for hours; the ultimate track lengths were determined only by how much could fit on vinyl.." (Hoffmann H. , 2009)

Nonetheless, the release of "Planet Rock" precipitated a protracted legal dispute between the parties (Brewster, 2006, p. 266).

Taken together, "Rapper's Delight," "The Adventures of Grandmaster Flash on the Wheels of Steel," and "Planet Rock" established the core template of hip hop as a recorded music practice. On this foundation, subsequent generations of producers, DJs, and MCs built a tradition that grew into one of the most culturally and commercially consequential global youth - and music - cultures of the late twentieth and early twenty-first centuries.

2.7.3 Hip Hop as a Global Youth Culture

A principal driver of hip hop's early commercialization was Russell Simmons, who in the late 1970s both managed Kurtis Blow - one of the first significant rappers to operate outside a DJ's entourage - and organized some of the first hip hop events in Manhattan, beyond the confines of the Bronx. Unlike Sylvia Robinson, Simmons brought the passion of an insider to what he called "Black Teenage Music**"** (Brewster, 2006, p. 202) (Poschardt, 1997, pp. 201-202).

Deploying modern marketing methods, Simmons branded Kurtis Blow as the "King of Rap," securing the first major-label deal for a hip hop artist; the shrewdly timed "Christmas Rappin'" (1979) also played a part. In 1984, together with producer Rick Rubin, he founded Def Jam, which became the "Motown of hip hop" in the 1980s (Poschart, 1997, p. 203; Keyes C. M., 2014, p. 270). Among its many marquee acts, Run-D.M.C. and the Beastie Boys were especially consequential.

The trio Run-D.M.C. built on the production logic of "Planet Rock." Drum loops were the exception (as with the Bob James "Take Me to the Mardi Gras" break on "Peter Piper"); more typically they set spare, hard-edged beats with short samples - orchestra hits, clipped guitar chords - anchored by a punchy, stripped-down bass. Rappers Run (Russell Simmons's brother Joseph Simmons) and D.M.C. established an antiphonal

delivery reminiscent of work-song call-and-response, a template widely emulated by later MC duos. In 1986, Run-D.M.C. broke decisively into the mainstream - most conspicuously, under former punk Rick Rubin, with their crossover remake of Aerosmith's "Walk This Way," which reached No. 4 on the Billboard Hot 100 and opened the new music to the rock-leaning white American mainstream[9] (Billboard Magazine, 1986) (Gueraseva, 2011, pp. 74-75, 100; Blair, 2004, p. 499).

In the same year, hip hop established itself as an international fashion phenomenon. From the outset of Run-D.M.C.'s career, Russell Simmons outfitted the group in a marketing-savvy uniform - black leather jackets and white Adidas Superstar sneakers. African American youth, in particular, adopted the footwear with remarkable speed. Following the release of "My Adidas" in 1986, the German sportswear company Adidas took notice and signed the group to a US$5 million promotional deal (Gueraseva, 2011, p. 96). The moment both announced hip hop as a global commercial force and enshrined fashion as a constitutive element of hip-hop culture.[10] (Keyes C. M., 2014, p. 272; Blair, 2004, p. 500).

With the Beastie Boys, Def Jam signed the first prominent white hip-hop artists. Originally young punk rockers, the trio gravitated toward African American music amid the early-1980s cross-pollination of hip hop, new wave, punk, and the downtown art scene in New York. Discovered by Rick Rubin, they achieved a rare double feat: appealing to the white mainstream while earning credibility within Black hip-hop circles.

---

[9] Beyond this, they laid the groundwork for the crossover rock subgenre - and thus for the later success of bands such as Rage Against the Machine and the Red Hot Chili Peppers, who, in the 1990s, would achieve wide prominence with hybrids of funk-driven beats, rap-style vocals, and distorted guitars.

[10] Subsequent hip-hop luminaries would engage directly in the fashion industry. A case in point is Jay-Z, whose Rocawear label has reported annual revenues in the hundreds of millions of U.S. dollars. (Smith C. H., 2008, p. 63)

They opened for Madonna on *The Virgin Tour* and shared stages with scene heavyweights such as Run-D.M.C., LL Cool J, and even the Black Power provocateurs Public Enemy (Derry, 2004, p. 408). Crucially, they neither attempted to imitate an African American habitus nor marketed their whiteness (more precisely, their Jewish background) as a selling point. The Beastie Boys further anchored hip hop in the American and international mainstream and helped clear the way for later white hip-hop acts such as 3rd Bass and the hugely successful Eminem[11] (Hess, 2006, pp. 376-378; Stratton, 2008, S. 413-414) (Hess, Is Hip Hop Dead? The Past, Present and Future of Americas's Most Wanted Musik, 2007, p. 110).

Beyond Def Jam's activities, two additional developments in the early 1980s propelled hip hop to international visibility.

One such vector was the collaboration between Blondie's singer Debbie Harry and the African American artist Fab 5 Freddy (Fred Brathwaite), itself a product of New York's cross-pollinated uptown/downtown subcultural milieu. It culminated in Blondie's video-driven single "Rapture" (1981), in which Harry adopts a rap delivery modeled on the Bronx style - the first appearance of rapped vocals in a mainstream music video. The lyrics name-check Grandmaster Flash and Fab 5 Freddy, with other graffiti

---

[11] I offer a brief personal anecdote to underscore hip hop's global reach:
In autumn 2017, on a visual anthropology trip to the Burmese town of Nyaung Shwe, I met a young local who called himself "Stan," after the eponymous Eminem track. In a country that until 2010 had been largely closed to the outside world - where affinities with Western popular music are minimal and even the Beatles are scarcely known - "Stan" had made hip hop in general, and Eminem in particular, the center of his life. The small traditional restaurant he ran with his mother was covered wall to wall with homage paintings, and his clothing and self-presentation echoed a stylized hip-hop persona he had absorbed from YouTube videos. He had never encountered an "authentic" hip-hop scene in person, never attended a concert, indeed had never left Myanmar - yet hip hop functioned as the pivot of his world.

artists visible on screen. Widely regarded as a cultural broker between the art world and hip hop, Fab 5 Freddy went on in 1988 to host Yo! MTV Raps, an extraordinarily successful TV franchise later also broadcast on MTV Europe (Poschardt, 1997, pp. 209-210).

A second impulse came from the international circulation of the films Wild Style and Beat Street. The first feature to take hip hop as its subject, the docufiction Wild Style, was made by Charlie Ahearn, who - introduced to the nascent scene by Fab 5 Freddy - fashioned a cinematic landmark that canonized the culture on screen.

„Wild Style did more than capture the faces and gestures of hip hop's co-founders; it fixed on film their clothes, their weapons and apartments, their jams and the tools of their trade - offering, in sum, a portrait of a subculture poised to take the world by storm." (Poschardt, 1997, p. 220).

large share of the cast was drawn from marquee figures within the scene. Grandmaster Flash and the celebrated graffiti artist Lee Quinones appear, alongside numerous other musicians and writers. Wild Style also cemented the Zulu Nation's codification of hip hop's "four elements" - DJing, rap, graffiti, and breaking - according each equal documentary weight; these four (often subsequently expanded) remain canonical to this day (Silver, 1983; Poschart, 1997, pp. 2018-2019; Morgan, 2011, p. 177; Keyes C. M., 2014, p. 260)

By contrast, Beat Street (1984) focuses primarily on breaking, catalyzing an international breakdance wave that swept not only North America but much of Europe. In Germany, ZDF aired Breakdance mit Eisi Gulp in 1984, promoting the dance - by analogy to the aerobics boom - as a fitness trend (Rick, 2008).

Bankrolled by calypso legend Harry Belafonte, whose political activism marked him as a friend of socialism, the film also screened behind the Iron Curtain, helping to establish hip hop in the GDR, where the scarcity of Western recordings and paraphernalia fostered a distinctively resourceful local scene (Raschick, 2007; Elflein, 1998, p. 256).

By the mid-1980s, hip hop had spread from the Bronx across New York City, throughout the United States, into Western Europe, and ultimately Eastern Europe. In the years

that followed, the culture continued its ascent, establishing itself ever more firmly both commercially and culturally. In its wake, the bass-accented aesthetics of modern dance music took hold wherever the disco era had not already done so, becoming a global phenomenon that now encompasses Africa and Asia (Morgan, 2011, p. 179-180; Condry, 2011, p. 373; Brockhaus, 2017, p. 283; Keyes C. M., 2014, p. 272).

2.7.4 Miami and the Bass Sound

From the late 1980s onward, hip hop splintered into a wide array of substyles. For any account of the bass in modern popular dance music, Miami Bass - also known as Booty Bass or simply Bass - is foundational.

With its proximity to the Caribbean island nations and South America, Miami occupies an ethnocultural exception within the United States. It is a melting pot without a majority group: none of the three largest populations - whites, African Americans (including Black migrants from the Caribbean), and Hispanics - accounts for more than half of the city. Miami thus functions as a hinge between the global North and South, catalyzing cultural exchange. (Font-Navarette, 2015, p. 492-493; Keyes C. L., 2014, p. 324)

Miami Bass is the first style to explicitly center the bass, enabled in the 1980s by drum machines and the spread of sub-bass–capable synthesizers. Foremost is the Roland TR-808, whose timbres dominate the genre. The emphasis on energy below ~60 Hz ties the music to specific playback ecologies: it presupposes powerful amplification and large-excursion loudspeaker cones, without which crucial musical information disappears. In this sense, Miami Bass is a "booming, bass-driven" pop engineered primarily for dance-music sound systems - a clear nod to the sound-system culture of the nearby Caribbean (Keyes C. L., 2014, p. 324). Further stylistic markers include a comparatively high tempo (≈120–160 BPM) and percussive patterning inflected by Miami's Latin heritage. The lineage from "Planet Rock" - and, indirectly, Kraftwerk - is unmistakable, for example in 2 Live Crew's "Me So Horny" (Font-Navarette, 2015, pp. 490-491).

Luther Campbell of 2 Live Crew later underscored the centrality of bass to Miami Bass in an interview with *Electronic Beats*. Describing the competitive "arms race" among

producers, he recalls supervising the lacquer cutting of his records and instructing engineers to increase groove width/spacing beyond standard practice so that 12-inch maxi-singles would deliver greater low-frequency headroom at playback (Samuels, 2012, p. 58).

Miami Bass not only shaped the sound of Southern U.S. hip hop; alongside dancehall it also functioned as a catalytic nucleus for bass-forward musics across the Global South (see 2.7.7). Via Brazilian baile funk (funk carioca) - a local offshoot of hip hop - its influence radiated into numerous tropical bass idioms. Taken up by the American producer Diplo (Wesley Pentz) in 2004, baile funk became one of the early foundations of modern tropical bass (see 2.8.5). As head of the Mad Decent label and initiator of the Major Lazer project, Pentz played a pivotal role in consolidating and disseminating this stylistic complex (Font-Navarette, 2015, pp. 500-501; Palombini, 2014, pp. 320-321).

2.7.5 *Hip Hop* from 1987 to 2020: Further Substyles and Their Significance

Since its inception, innumerable substyles of hip hop have emerged. For understanding bass in modern popular dance music, several are especially salient and merit brief consideration.

1) Sample-Based Hip Hop / Jazz Rap

By the late 1980s, sampler memory - still far from inexpensive - had nevertheless become sufficiently affordable that machines such as the Akai S900 could store several seconds of audio. This enabled productions that (a) returned decisively to drum loops, now easier to deploy at higher fidelity, and (b) looped, filtered, and, where useful, sliced and recombined other musical materials into new loops. The result was a revitalization of earlier repertoires - especially funk and jazz. Canonical drum loops such as “Funky Drummer” (James Brown) and the “Amen” break (the four-bar drum solo

from the Winstons' "Amen, Brother")[12] were consolidated; without them, much of 1990s British breakbeat music would be unimaginable. (Brockhaus, 2017, p. 272) (Keyes C. M., 2014, p. 269; George, Sample This, 2004, pp. 439-440). For bass practice, this turn broadened the palette to include electric-bass figures sampled from funk and double-bass lines sampled from jazz. A paradigmatic case is the recontextualization of a bar from the double-bass solo in Young-Holt Unlimited's "Queen of the Nile" as the bass loop underpinning Eric B. & Rakim's "Don't Sweat the Technique." (Brewster, 2006, p. 267; Stewart, 2014, pp. 2-3)

Representative tracks (sample-based hip hop / jazz rap)::

Pete Rock & CL Smooth – "T.R.O.Y. (They Reminisce over You)"
Eric B. & Rakim – "Don't Sweat the Technique"
Public Enemy – "Don't believe the Hype"

2) Gangsta Rap / G-Funk:

Although Gangsta Rap first emerged on the U.S. East Coast with Schoolly D, it attained full stylistic autonomy only after Ice-T introduced it to the West Coast, from where it subsequently fed back into East Coast practice.

Anchored thematically in the pervasive gang violence of African-American inner-city neighborhoods, Gangsta Rap decisively normalized violent lyrical content and the glorification of crime within hip hop (Herd, 2009, pp. 398-401). The genre's point of departure is N.W.A.'s *Straight Outta Compton* - centered on the enterprising producer Dr. Dre (Andre Romelle Young) - released in 1987 and still operating within the

[12] . The magnitude of these loops' importance to sample-based music becomes evident in their sheer ubiquity. The database WhoSampled.com lists 1,512 tracks that sample "Funky Drummer" and fully 3,129 that draw on the Amen break. (WhoSampled.com, Funky Drummer) (WhoSampled.com, Amen Brother).

sample-hip-hop paradigm. As the style evolved, Young codified G-Funk, pairing hard-edged narratives with increasingly sleek, laid-back grooves. Both in production and sampling practice, G-Funk mines late P-Funk (Parliament/Funkadelic), most audibly in its prominently foregrounded synthesizer bass lines (Keyes C. M., 2014, pp. 267-268).

Representative tracks, Gangsta Rap:

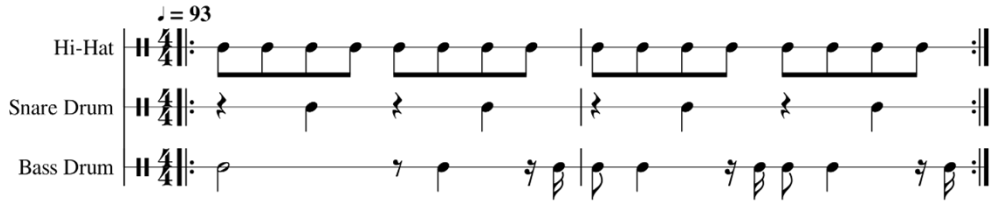
N.W.A. – Straight outta Compton
Mobb Deep – Shook Ones pt. 2

Representative tracks, G-Funk:

Snoop Doggy Dogg – What's my Name
Warren G. & Nate Dogg – Regulate

3) Boom Bap:

As sampling technology advanced, drum samplers and "sampling workstations" such as the Akai MPC series and the E-mu SP line became increasingly important in hip hop production (Schloss, 2004, p. 30; George, Sample This, 2004, p. 438). They made it easier and more affordable to sample and prep drum sounds for play on velocity-sensitive pads, and likewise to loop and slice other material (Brockhaus, 2017, p. 269; Tabron, 2015, pp. 136-137). At the same time, a series of copyright cases rendered the use of long, easily identifiable passages progressively uneconomical. (Schuhmacher, 2004, pp. 443-446, 455-456) From this context emerged Boom Bap - a sound especially characteristic of mid-1990s New York that remains widely favored. It can be understood as a slower, sample-based hip hop that largely avoids extended loops; samples function primarily as timbral color. (Schusterman, 2004, p. 462) he term *boom bap* names the genre's focus on a loud, low-frequency kick and a sharp snare, and their typical alignment within standard beat patterns (see Notation 14). Lyrically, the style spans hip hop's full thematic range. Its most prominent producer is DJ Premier (Christopher Edward Martin) of Gang Starr, who also supplied instrumentals for many other artists. (Schloss, 2004, p. 56; Krekow, Steiner, & Taupitz, 1999, p. 142-143).



Notation 14: DJ Cam ft. Afu Ra „Voodoo Child (DJ Premier Remix)" / Source: Author's own transcription

Representative tracks, Boom Bap:

Gangstarr – „Full Clip"
Mos Def – „Ms. Fat Booty"
DJ Cam ft. Afu Ra – „Voodoo Child (DJ Premier Remix)"
The Artifacts – "Wrong Side of da Tracks"

4) RnB / Club Hip Hop:

Through the 1990s, hip hop's popularity remained unbroken, driving an ever-greater commercialization of the genre. Two developments followed. First, the soul idiom was folded into hip hop under the rebranded rubric R&B, understood as hip hop production paired with melodic, harmonically oriented singing rather than rap. (Brockhaus, 2017, pp. 272, 283) (White M. , 2014, pp. 375-376). Second, producers such as Timbaland (Timothy Zachary Mosley) and Pharrell Williams reshaped the formal logic of the hip hop instrumental: hooks became more foregrounded, textures more electronic, and the once-dominant, cracking snares receded - opening headroom for more expansive low-end design. The result was a highly successful strain - often labeled club hip hop - that aligned less with the aesthetics of the Afro-American block party and more with the preferences of international (and largely white) club audiences. Since 2005, such productions have accounted for over half of Top-40 placements on the *Billboard* charts. (Brockhaus, 2017, pp. 284,289).

Representative tracks, RnB:

Ginuwine – Pony
Destiny's Child – Survivor

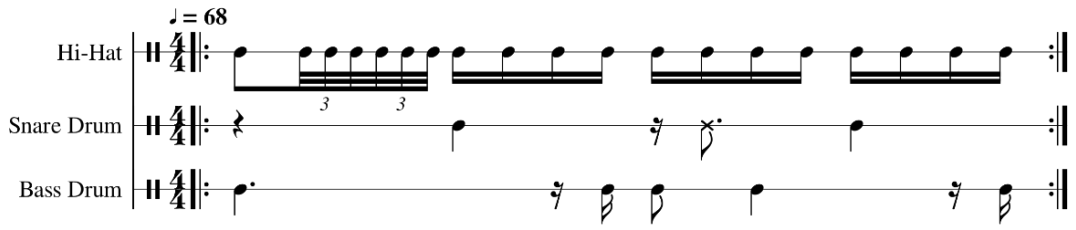
Representative tracks, Club Hip Hop:

50 Cent – P.I.M.P.
Snoop Dogg – Drop it like it's hot

5) Trap:

The currently dominant strain of hip hop, trap emerged in Atlanta out of Miami Bass and other Southern lineages (Keyes C. M., 2014, p. 270; Leonard, 2019, pp. 180-181) while also absorbing strong influences from dubstep and adjacent electronic genres. (Fonesca, 2019, p. 701)

Hallmarks include a reduced tempo around 75–85 BPM (often articulated in double-time), extreme low-end emphasis, and a timbral palette built around TR-808/909–derived drums, cavernous sub-bass, and ostinato synthesizer figures. Vocally, trap frequently favors a pared-down "mumble rap" delivery that privileges timbre, cadence, and atmosphere over densely wrought rhythmic or linguistic intricacy. Early examples appear from ca. 2005; by c. 2010 the style had consolidated in the mainstream, as marquee artists - Jay-Z, Kanye West, and R&B crossovers such as Drake - released tracks in the idiom.



Notation 15: Cardi B "I like it" Beat Pattern / Source: Author's own transcription

Trap is typified by slow, halftime beat whose perceived momentum is animated by prominent, often triplet-based hi-hat rolls. Most salient, however, is the kick drum: long-decay, extremely low-frequency, and high in level, it occupies the foreground of the mix. (Fonesca, 2019, pp. 701-702) All of this is exemplified in Cardi B's hit "I Like It" (Notation 15). In addition, the conspicuous sample loop from Pete Rodriguez's boogaloo classic "I Like It Like That" underscores the Latin American inheritance within Southern hip-hop idioms.

Alongside the hip-hop substyle, since c. 2012 there has also been a European-leaning electronic style bearing the same name - effectively a dubstep offshoot with different beat schemata and tempi (see 2.8.5). Trap tracks in the 100–110 BPM band are frequently labeled twerk or twerk bass. (DJMag, 2013).

Representative tracks, Trap:

Cardi B – I like it
Rick Ross - B.M.F. ft. Styles P
Desiigner – Panda
Beyoncé - Drunk in Love ft. Jay-Z

Representative tracks, elektronischer Trap:

Flosstradamus - "Mosh Pit"
Yellow Claw - Shotgun ft. Rochelle

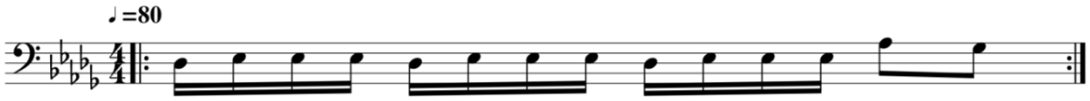
Representative tracks, Twerk Bass:

DJ Snake ft. Lil John – Turn down for What
Tropkillaz x Snavs - Here we go now!
Megan Thee Stallion - Body

2.7.6 Dancehall and Bass Music in the Global South

Just as hip hop cultivated a large youth culture among socio-economically marginalized African Americans, young people across the Global South have forged their own styles and scenes. Hip hop and reggae - musical cultures that thematize the position of the racialized underdog - were readily adopted, localized, and integrated into existing traditions throughout the Caribbean, South America, and Africa. From roughly 1984 to the present this process yielded numerous genres, including dancehall in Jamaica, reggaeton in Latin America, Afrotrap in Francophone West Africa, and Afrobeats in Anglophone West Africa. In the second decade of the twenty-first century these currents of "tropical bass" began to flow back into - and decisively shape - the global pop mainstream.

The cradle of modern tropical club music is, once again, Jamaica. In 1985 Jammy's Records issued the first fully electronic riddim version. Wayne Smith and Noel Davey built the "Sleng Teng" riddim (Notation 16) around the auto-accompaniment pattern of a Casio MT-40 keyboard, its tempo slowed by tape. The newly minted digital sound aesthetic electrified Jamaican audiences and prompted an avalanche of tracks voiced over that instrumental. The online database Riddimguide.org lists 354 distinct releases on the Sleng Teng riddim since 1985. (Riddimguide.org: Sleng Teng Riddim).

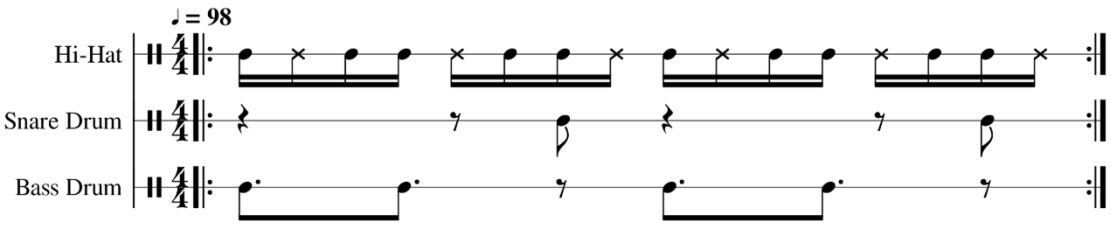


Notation 16: Wayne Smith "Under my Sleng Teng" (Sleng Teng Riddim) Bass / Source: Author's own transcription

Other producers - most notably Henry "Junjo" Lawes and Augustus "Gussie" Clarke - quickly emulated the new sound, and as affordable synthesizer technology spread, the sonic aesthetic of Jamaican club music shifted dramatically over the remainder of the decade (Stolzoff, 2000, pp. 106-107; Howard, 2014, pp. 253-256).

Dancehall marked a break with the continual recycling of Studio One and Treasure Isle versions and a renewed turn toward Afro-Jamaican ritual traditions such as Kumina and Pocomania. At the same time, hip hop's ascent - already carrying distinctly Jamaican inflections via Kool DJ Herc and others (see 2.7.1) - fed back into

Jamaica. As a result, dancehall became governed less by conventional song forms and chord progressions than by short, looped, percussive patterns with a quasi-clave profile (cf. Notation 17). Bass lines increasingly took the form of pared-down Afro-Caribbean figures realized on sub-bass synthesizers. Meanwhile, the Jamaican toasting style intermingled with American rap to yield a vocal idiom popularized internationally in the 1990s by artists such as Shabba Ranks, Buju Banton, and Shaggy under the rubric ragga. (Stolzoff, 2000, p. 108) (Howard, 2014, pp. 255, 257).



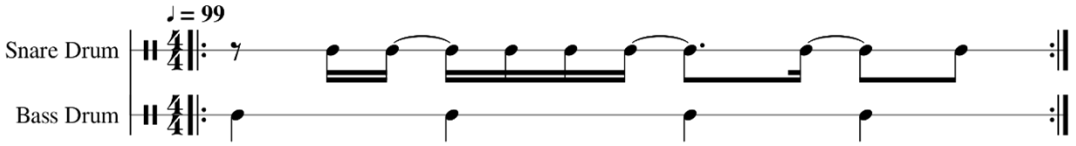
Notation 17: Sean Paul „Like Glue" Beat Pattern / Source: Author's own transcription

The international success of 1990s dancehall extended not only to Jamaica and the Western pop mainstream in North America and Western Europe, but also - indeed, especially - to developing and emerging nations of the Global South with strong ties to the African diaspora. Across these scenes, styles derived from reggae through dancehall consistently foregrounded the bass as a privileged musical parameter. (Howard, 2014, p. 257).

The first major adaptation of this electronically produced "Third World" music emerged in Panama. Although hip hop, dancehall, and soca[13] vielfältig vermischten, bedurfte es des Drumloops des 1990er Hits „Dem Bow" (Notation 18) had already been intermixing there by the late 1980s, the drum loop from Jamaican artist Rexton "Shabba Ranks" Gordon's 1990 hit "Dem Bow" (Notation 18) became the

[13] from "soul of calypso" (soca) - then a calypso–disco hybrid that predominated across the Anglophone Antilles. (Brathfisch, 2003, p. 494) (Munro Smith, 2014, p. 778).

crystallization point for a coherently defined style: reggaetón (Marshall, 2008, S. 491; Kattari, 2014, S. 672-674).



Notation 18: Shabba Ranks „Dem Bow" (Poco Man Jam Riddim) Beat Pattern / Source: Author's own transcription

The emergent style pioneered by artists such as El General and, later, Daddy Yankee spread rapidly across the Americas by way of U.S. Latino communities. This diffusion was accelerated - not least - by Universal Music's concerted marketing push in Puerto Rico, which quickly became a stronghold of the genre. Reggaetón thus served both as a vehicle for a pan–Latin American identity and as a medium for articulating local identities and intra–Spanish-language distinctions. Rhythmically, the "Dem Bow" riddim (originally the "Poco Man Jam" riddim) overlays clave-based accent patterns onto an isochronous grid, satisfying Afro-Jamaican stylistic logics while aligning with multiple Latin American traditions, especially cumbia. Accordingly, reggaetón readily hybridized with idioms such as cumbia, son, and salsa, becoming internally diversified and, outwardly, increasingly distinguishable from dancehall. (Marshall, 2008, p. 493; Kattari, 2014, pp. 673-674; Wade, Cumbia, 2014, pp. 247-250, 253; Samponaro, 2009, pp. 490-492).

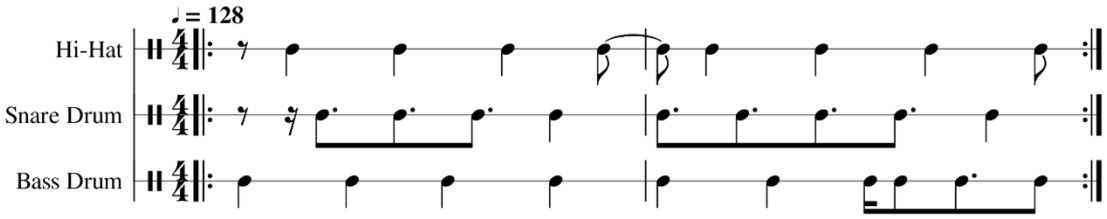
Once stigmatized as a disreputable music of the urban underclass, reggaetón moved into the "pan-Latin mainstream" (Marshall, Dem Bow, Dembow, Dembo: Translation and Transnation in Reggaeton, 2008) and subsequently became a fixture of global pop. The style's international breakthrough arrived with Puerto Rican star Daddy Yankee's club hit "Gasolina" and the U.S.–Puerto Rican collaboration "Oye Mi Canto" (N.O.R.E. with Daddy Yankee and Nina Sky), among the first reggaetón tracks to secure sustained U.S. radio airplay and to chart in the Top 100 across multiple non-Spanish-speaking markets (Rossmann, 2012, pp. 81-83; Samponaro, 2009, p. 489). In the years that followed, reggaetón became so entrenched in the pop canon that "Despacito" (Luis Fonsi feat. Daddy Yankee, 2017) tied the Billboard Hot 100 all-

time record with 16 weeks at No. 1 (Billboard Magazine, 2017) nd earned quadruple-platinum certification in Germany (Bundesverband der Musikindustrie, 2018; Kattari, 2014, p. 674).

West Africa constitutes a second focal point in the development of modern dance-music styles across the Global South. Owing partly to World War II and partly to return migration from the African diaspora - especially from the Caribbean and Latin America - West African musics were increasingly shaped by Afro-American and Afro-Caribbean influences. With the introduction of European-derived instruments such as brass and, above all, the (electric) guitar, and with the uptake of styles like swing and later rhythm and blues and calypso, Ghana and Nigeria in the 1950s saw the emergence of highlife and juju. These genres formed hybrids of Afro-American popular idioms and the traditional musics of the Yoruba, Hausa, and other communities, and, given West Africa's ethnically heterogeneous milieu, often displayed strong local inflections (Storb, 1986, pp. 68-69). In the 1970s, the trumpeter Fela Kuti - who had studied in England - played a decisive role in shaping Afro-funk (also called Afro-soul or Afrobeat). Drawing on American funk, he not only emulated African rhythmic logics but extended Afro-American music by integrating a full African percussion section; through layered polyrhythms and genuine interlocking, the style forged a distinctive groove. For two decades Kuti was the most influential West African musician, decisively establishing a recognizably African style within modern dance music (Storb, 1986, p. 70). West African popular music has also long been marked by a split along the linguistic lines of the former colonial powers, Britain and France; a francophone counterpart to highlife emerged in Côte d'Ivoire with the style known as zouglou (Taylor, Zouglou, 2019, pp. 585-588; Emielu, 2011, p. 372; Mitter, 2012).

Driven by the same technological shifts that reshaped electronically produced music in Europe and the Americas, a new strand of popular music took shape in anglophone Ghana in the late 1990s. Under the rubric Hiplife, artists forged a hybrid idiom from American hip hop, Jamaican dancehall, and Ghanaian highlife. The genre's template-setting release is widely held to be Reggie Rockstone's album *Makaa Makaa*. Tellingly, Rockstone's stage name itself derives from a line in Bob Marley's "Talkin' Blues," underscoring a Jamaican feedback loop that is as audible as it is onomastic

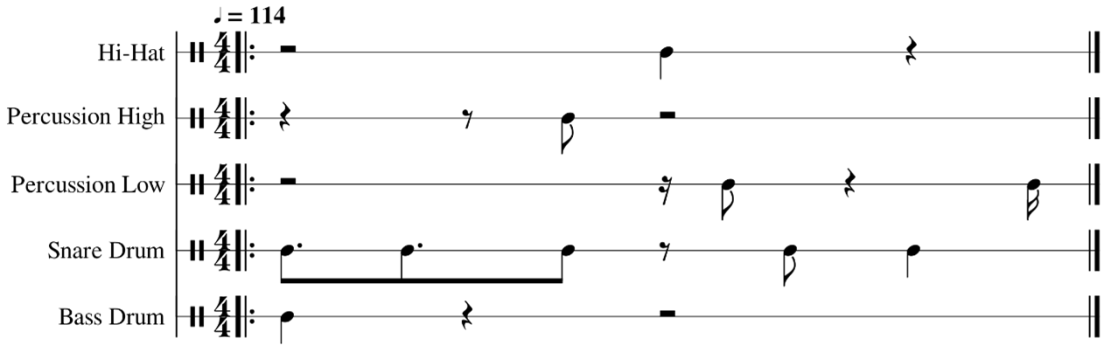
(Emielu, 2011, p. 375; Osumari, 2019, S. 273-274 Ghana's modern popular music reached a new peak of international visibility in 2011 with Fuse ODG's hit "Azonto" (see Notation 19), which broke into the mainstream especially in the UK and registered notable successes in North America and continental Europe. "Azonto" helped inaugurate a phase within Afro-American dance music in which many mainstream productions drew inspiration from Afro-Caribbean and Afro-American styles (Shipley, 2013, pp. 363-364; Mitter, 2012; Dot, 2019, pp. 50-51).



Notation 19: Fuse ODG „Azonto" Beat Pattern / Source: Author's own transcription

With Lagos's rise to West Africa's economic and media hub in the late 1990s, not only the film industry but also the music sector gravitated there to extend Fela Kuti's legacy. (Boluwaduro, 2018, pp. 53-55). In the early twenty-first century a modern, distinctly local sound coalesced under loosely drawn labels - Nigerian hip hop, Naija pop, and Afro Beats[14]. A representative example of Nigeria's stripped-down, contemporary aesthetic is Maleek Berry's 'Kontrol' (see Notation 20).

[14] The term Afrobeats (often written "Afro Beats") should not be confused with Afrobeat, which denotes West African musical currents of the 1970s–80s (e.g., Fela Kuti and related styles). Owing to the present dominance of Nigeria's music market, Afrobeats also circulates as a pars pro toto label for contemporary pan-African popular music.



Notation 20: Maleek Berry „Kontrol" Beat Pattern / Source: Author's own transcription

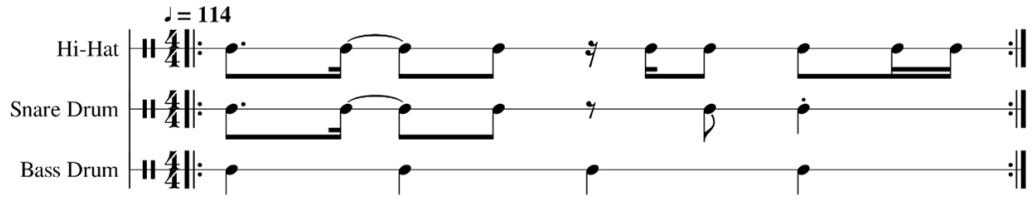
Through the close cultural ties between Lagos and London, British popular music has undergone a second wave of influence from the global South. In recent years, collaborations between Afro-British and West African artists have become integral to the UK market; a salient example is the partnership of the British rapper J Hus with the Port Harcourt–born singer Burna Boy on tracks such as "Sekkle Down" (Eyre, 2019, pp. 19-22). The popular musics of Nigeria and Ghana find an East African analogue in Bongo Flava: originating in Tanzania, this localized adaptation of hip hop, reggae, and dancehall has spread across much of the Swahili-speaking world, though its stylistic autonomy is now increasingly attenuated under the growing influence of Nigerian music (Reuster-Jahn, 2019, pp. 84-85, 87).

- In the second decade of the twenty-first century, African dance music became one of the most consequential forces shaping the global mainstream. A series of blockbuster releases by internationally established artists underscores this development:
- Ed Sheeran, "Shape of You." Built on a characteristically Nigerian, clave-derived beat with a complementary kalimba pattern; the single moved over 40 million units worldwide in 2017–2018 and held the No. 1 position for weeks across major markets. (McIntyre, 2017)
- Drake feat. Wizkid, "One Dance." Released in 2016 to immense commercial success. Whereas "Shape of You" can be heard as a pop song inflected by West African idioms, "One Dance" is a comparatively uncompromising and idiomatically authentic Nigerian Afro Beats composition; it nonetheless

reached No. 1 in all key markets and became Spotify's most-streamed track until surpassed by "Shape of You." (Schneider M. , 2017; Mistry, 2016).

- RAF Camora, Bonez MC & Maxwell, "Ohne mein Team." Issued in Germany in 2016; apart from its German lyrics, the track closely hews to Nigerian Afro Beats aesthetics. It became the first German single to exceed 100 million streams and earned diamond certification for more than one million units, making it the most commercially successful German-language rap single to date. (Kiß, 2018; Bundesverband Musikindustrie, 2018).

From the late 1990s onward, popular music in the francophone nations of West Africa followed a broadly similar path. Most decisive was the fusion - by Ivorian musicians in Parisian exile - of (dancehall) reggae and zouglou, Côte d'Ivoire's two most popular styles, into coupé-décalé. (Schuhmann, 2009, pp. 118-119). This hybrid was prefigured by Magic System's "Premier Gaou," released in 1999 but only becoming a surprise hit in France and francophone Africa in 2003. Although Magic System is commonly classified as a zouglou group, their sound is more contemporary than that of comparable ensembles (e.g., Les Garagistes) and serves as a bridge to the modern coupé-décalé aesthetic. With Côte d'Ivoire's participation in the 2006 FIFA World Cup, new coupé-décalé artists such as Douk Saga garnered greater international visibility; crossover hits, however, initially surfaced only to a limited extent in France (Gawa, 2014, pp. 113-115; Akindes, 2002, p. 98). Commercial success - at least across the francophone world - ultimately accrued to the most recent incarnation of this stylistic constellation: Afrotrap, popularized in 2016 by the Paris-based rapper MHD. Afrotrap is, in effect, an updated sonic rendering of coupé-décalé with strong borrowings from contemporary hip hop (Dongnon, 2018, pp. 2, 7). Because its beat designs typically trace the rapid, clave-derived patterns of West Africa (see Notation 21), the label "trap" functions less as a precise stylistic descriptor than as a nod to contemporaneity (see 2.9.2). (Taylor, Coupé Decalé, 2019, pp. 120-121).



Notation 21: MHD „Afrotrap Part. 7 (La Puissance)“ Beat Pattern / Source: Author's own transcription

As with baile funk (see §2.7.5), these styles were progressively incorporated into the Tropical Bass canon (Font-Navarette, 2015, p. 502).

2.8 Electronic Dance Music

Alongside hip hop, electronic dance music and its numerous substyles constitute the second major lineage of contemporary popular dance music. Its development began in the early 1980s in the United States, with the emergence of house music from the ruins of the disco era and with techno's abstraction of newly available electronic production technologies. Although the pioneers of these styles were already influenced by the European synthesizer avant-garde, this sound later returned to the old continent, where it gave rise to a distinct celebratory culture in the form of rave. While continental Western Europe produced additional four-to-the-floor styles such as trance and minimal, British producers cultivated the breakbeat through drum & bass and dubstep.

2.8.1 Chicago and the Birth of House

House is the point of origin of all electronic dance music and, like hip hop and reggae, began as a purely DJ-driven musical form and celebratory culture (Poschardt, 1997, p. 254). The genre takes its name from the Chicago nightclub The Warehouse, which opened in 1977. Housed in a former industrial building, it remained - unlike many New York discotheques - faithful to disco's original conception as a celebratory culture of queer people of color. Through Frankie Knuckles, the Warehouse's resident DJ, the techniques developed by New York DJs found their way with great success into the ears of Chicago club-goers (Brewster, 2006, pp. 312-313).

Much like the term *funk*, *house* was initially a fashionable buzzword that referred less to a clearly defined musical style than to an attitude or sensibility (Brewster, 2006, p. 314). "House was a feeling, a rebellious taste in music, a way of declaring yourself in the know" (Brewster, 2006, p. 315).

When Frankie Knuckles moved from New York to Chicago in 1977, he initially continued to play what he had played before: disco - „The funky soulful – and the dangerous – side of disco" (Brewster, 2006, p. 314) By the early 1980s, however, the near-total commercialization of the style made it increasingly difficult to find new productions of this kind. Unlike many other DJs, Knuckles did not want to shift toward

emerging styles such as *Hip Hop* or E*lectro* (siehe 2.7.2). *Disco* first lost its distinctive character and, shortly thereafter, its commercial relevance for the American music industry, with the result that ever fewer uptempo dance records were being released. Much like Tom Moulton, Knuckles began using tape machines to produce edits of disco tracks in order to generate new material for his DJ sets. His aim throughout was to keep disco alive. Yet Knuckles did more than simply rearrange these songs: he overlaid them with new drum patterns from a Roland TR-909 and synthesizer bass lines in the style of Giorgio Moroder and other European producers, particularly from the Italo-disco milieu. These simple bootleg remixes defined the aesthetic framework of what would later become *House* music (Brewster, 2006, pp. 314-317).

Knuckles's style quickly found imitators in Chicago nightlife. Among them, Ron Hardy occupied a particularly prominent position. Whereas Knuckles's focus lay in preserving a culture in decline, Hardy was committed to shaping a sonic future. Although increasing numbers of young heterosexual dancers were beginning to make their way to the Warehouse, it was Hardy's DJ sets at the nightclub The Music Box that opened the scene to a non-gay audience. Both men are regarded as exceptional DJs who, from 1983 onward, effectively divided the scene between them. Both employed sophisticated techniques to rearrange tracks live at the DJ booth, and both relied on the bootleg remixes produced on tape machines that were then known as reel-to-reels. These, however, were for the most part not made by the DJs themselves, but by an acquaintance of both men, Erasmo Riviera. While Knuckles represented a more traditionalist, musically oriented style and Hardy a more energetic, rebellious one, both drew at that time from the same pool of music: uptempo *Disco* from the late 1970s by artists such as Isaac Hayes and Loleatta Holloway, *Mutant Disco*[15] by acts such as ESG and Atmosfear, and European *Synth-Pop* by groups such as Visage and Klein & MBO (Brewster, 2006, pp. 318-321).

---

[15] A playful late form of *Disco* that was influenced by both *Prog-Rock* and *New Wave*.

Ron Hardy hatte eine Reputation dafür, das Level an Energie zu maximieren. Er gestaltete seine Nächte als Aneinanderreihung von Höhepunkten, spielte Musik meist mit +6 bis +8 % Pitch und setzte ähnlich wie King Tubby Equalizer effektvoll ein, um Frequenzbereiche ein- und auszublenden. Insgesamt spielte er experimenteller, europäischer und risikofreudiger als Franky Knuckles.

> *„Hardy's sound was about bombshells and surprises, an onslaught of sound reaching climax after funky climax. "* (Brewster, 2006, p. 321)

Further European influences on the early development of *House* came from the radio show Hot Mix 5, which, from 1981 onward, enjoyed enormous popularity among Chicago youth. During the program, various DJs played a mix of music in which European synthesizer pop - by artists such as Depeche Mode, Yello, and Falco - formed an integral component. Electronic music production had advanced further in Europe than in the United States, owing to the successes of Moroder, Kraftwerk, and many others. Hot Mix 5 thus embedded this sound both in the taste repertoire of young Americans within its broadcast range and in the playlists of Chicago DJs. This electronic sonic aesthetic, increasingly shaped by *Italo-Disco* hits such as "Problèmes d'Amour" by Alexander Robotnick, came to signify the new and the desirable. By contrast, the organically produced African American music of established *Funk* and *Disco* musicians increasingly acquired the aura of something stale and passé. DJs such as Farley Williams of Hot Mix 5, as well as Frankie Knuckles, now began using Roland drum machines such as the 808 and 909 to augment traditional *Disco* records during their sets with this new sonic aesthetic. Other DJs achieved similar effects by using records that contained nothing but electronic drum tracks (Brewster, 2006, pp. 325-326) Frankie Knuckles described it in an interview as follows:

> *„There was plenty of good Soul around, but I had to make the records at the Warehouse sound fresh to keep the dance floor moving - there just wasn't enough real dance music. So I took the tracks that really excited me, changed the tempo, and added drum-machine percussion to make them more dance-floor-friendly. There was no grand plan to invent a new genre. Once Disco*

had been declared dead, I simply had to find a new way of bringing people back to the Warehouse on Saturday night." (Uhlig, 2013, p. 47).

By 1984, *House* music could be defined by two principal factors:

a) the extreme extension of instrumental passages through DJ techniques, culminating in the long-anticipated chorus; and
b) the fusion of African American musical tradition with the aesthetic language of various European *Synth-Pop* styles.

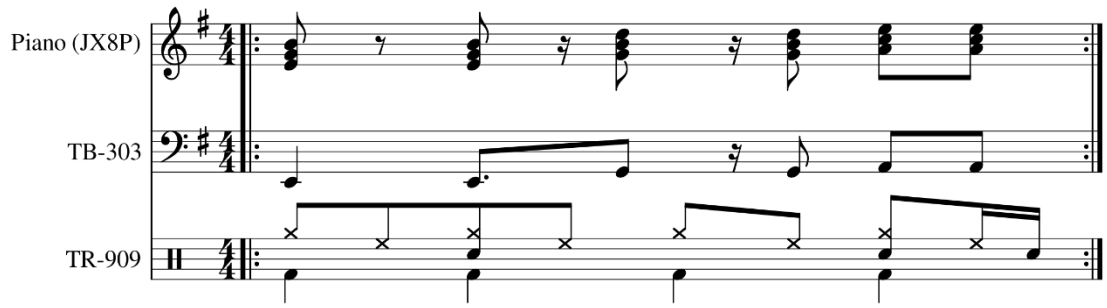
The moment was ripe for original music productions in the Chicago style. In 1984, Byron Wilson - recording as Jamie Principle - first released the local *Synth-Pop* hit "Your Love," which proved enormously successful in Chicago, though, for lack of a more distinctive sonic identity, it was often mistaken for a European production. It was only later that Jesse Saunders's minimalist "On and On," consisting of little more than an 808 drum track, a 303 bass line, and a pad sound, laid the foundation for *House* as a musical style in the same year. Precisely the fact that Saunders's production was so much simpler, and in many respects technically inferior to Wilson's, created a gold-rush atmosphere within the Chicago scene. Convinced that they could do better than Saunders, a great many musicians began producing *House* music in 1985. (Brewster, 2006, pp. 326-329).

Most *House* releases of 1985 and 1986 were produced by amateurs with no formal musical training. By that point, synthesizers and four-track tape machines had become affordable enough to enable an early form of home recording. (Brewster, 2006) It is therefore possible to ascribe a certain musical arbitrariness to many of these early productions - for example, "On and On." Drum-machine patterns are arranged in an arbitrary sequence: while they feature the continuous bass drum of the four-to-the-floor beat, they otherwise contain numerous playful, if not outright chaotic, syncopations. The tonal components of the music, moreover, stand in only a limited relation to one another. "On and On," for instance, consists of a continuous one-bar bass pattern to which the other synthesizer parts bear little harmonic relation, functioning for the most part as effects.

One of the first *House* tracks to display the fully developed form of the style was Marshall Jefferson's 1986 "Move Your Body" (Notation 22). It contains

a) the four-to-the-floor rhythm in the bass drum;
b) a functional yet distinctive synthesizer bass;
c) a lightly swung hi-hat figure, with the unaccented eighth-note offbeats played open;
d) a snare part articulating a backbeat with only a few, but deliberately placed, syncopations;
e) a repetitive pattern structure, here only one bar in length;
f) a simple chord progression attributable to the African American musical tradition; and

a simple vocal part that likewise belongs to the African American musical tradition, but is also strongly repetitive in design.



Notation 22: Marshall Jefferson „Move Your Body" Pattern / Source: Author's own transcription

That same year saw the release of the first two internationally successful productions to emerge from the *House* scene: "Love Can't Turn Around" by Farley Jackmaster Funk and "Jack Your Body" by JM Silk. Both records achieved success in the United States as well as in the United Kingdom, and together they already pointed toward the two principal directions in which electronic dance music would go on to develop. (Brewster, 2006, p. 323)

"Love Can't Turn Around" is an adaptation of a piece by Isaac Hayes. It combines the sonic world of electronic music with its roots in African American music of the 1970s. On the one hand, the track is built around a bass ostinato only a single bar in length;

on the other, it features *Soul*-style vocals that are not limited to fragmentary phrases, but instead follow a conventional verse-and-chorus design. The drum beat, meanwhile, is that of a classic *House* track.

"Jack Your Body," by contrast, is markedly more progressive. Here, too, one finds the wild syncopations of the earliest *House* productions, yet they appear deliberate rather than chaotic. Syncopated passages alternate with minimalist four-to-the-floor beats. The synthesizer parts stand in a harmonic relationship to the two-bar bass loop. There are no vocals apart from the rhythmically triggered and continually recurring sample, "Jack your body."

Going one step further than "Jack Your Body" was "Acid Trax," released in 1987 by Phuture, a project in which Marshall Jefferson was also involved. This production consisted of nothing more than a drum track and a 303 bass synthesizer. Yet the filter of the TB-303 was used so skilfully that, as the cut-off frequency was shifted, its self-resonance supplied the synthesizer's tonal component, while the instrument's nominally pitched material took on a largely percussive character. The track was originally intended to bear the title "I've Lost Control." After Ron Hardy tested the master tape at the Music Box, however, and it was met with a particularly frenzied response from those dancers who had sampled a punch laced with lysergic acid diethylamide, it was first retitled "Ron Hardy's Acid Track," then simply "Acid Tracks," and was ultimately pressed under that name. (Brewster, 2006, pp. 335-336; Leuffen, 2017, pp. 64-69, Sicko, 2010, S. 72).

"Acid Tracks" would go on to found the genre of *Acid House*. Musically, the style was not to exert a particularly lasting influence on dance music, apart from the timbral vocabulary associated with the TB-303. Its heyday, however, coincided with the emergence of a distinct European electronic party culture. (cf. 2.8.3) In late-1980s and early-1990s Britain, *Acid House* thus long functioned as an umbrella term for electronic styles more generally (Brewster, 2006, p. 400; Kirby, Acid House, 2017, pp. 13-14, Sicko, 2010, p. 72)

The success of *House* as the first major electronic style of modern dance music was thus firmly established. To this day, *House*, together with its many substyles such as

Acid House and *Deep House*, remains one of the central categories of electronic dance music.

2.8.2 Detroit and the Birth of Techno

The second major line of development in electronic dance music began in the early 1980s, only 300 kilometers from Chicago. If *Soul*, in the boom years of Detroit and Motown, had entered mainstream dance music, then with *Techno* it departed from it again - this time against the post-industrial backdrop of the very same city.

The story of *Techno* begins with the childhood friends Juan Atkins, Derrick May, and Kevin Saunderson, who grew up together as African American teenagers in the late 1970s in Belleville, a predominantly white suburb of Detroit. Beyond their unusual position within that social environment, they were bound above all by a shared fascination with progressive music. Their gateway to it was the radio show Electrifying Mojo, hosted by the nonconformist Charles Johnson, who played an eclectic and adventurous selection ranging from Detroit *P-Funk* to classical music and European *Synth-Pop*. Through the show's mysterious, Afrofuturist mode of self-presentation, Johnson also anticipated the technoid and anonymous habitus later associated with *Techno* DJs. He released only his silhouette to the public and would regularly invite his listeners to designate a landing site - using flashlights - for a fictional Afronaut mothership. (Brewster, 2006, p. 342; Sicko, 2010, pp. 42, 44).

Whereas the early producers of *House* were, for the most part, musical amateurs, the first protagonists of Detroit *Techno* were considerably more accomplished in this respect. Atkins, for example, had played bass in various *Funk* bands during his teenage years and, through the synthesizer bass lines of Parliament-Funkadelic keyboardist Bernie Worrell, developed an increasing interest in translating *Funk* into electronic music. This interest also led him to engage intensively with the music of Kraftwerk.

After graduating from high school in 1980, he founded the group Cybotron together with the considerably older Vietnam veteran and producer of experimental electronic music Rick Davis. Working in parallel to the New York *Hip Hop* pioneers around Afrika Bambaataa, they created a remarkably similar concept of electronic *Funk*. Unlike Bambaataa, however, Cybotron did not use samples from other songs in their

productions. Overshadowed by the major New York figures, Cybotron attracted only limited attention, though the group did manage to release several records. Thanks to airplay on Electrifying Mojo, they succeeded in placing their 1983 single “Clear” in the *Hot R&B* charts before the two musicians went their separate ways in 1984 (Brewster, 2006, pp. 345-346; Sicko, 2010, pp. 43-44, 47).

The music scene in post-industrial Detroit was smaller than that of Chicago and also far more fragmented. The oil crisis and its consequences for the American automobile industry had left their mark on the Motor City. One such consequence was the near absence of discotheques of the kind found in other major cities (Poschardt, 1997, p. 326). There were indeed successful one-off events in larger bars, as well as semi-public parties organized by high-school students for high-school students, but large-scale, excessive events of the kind associated with the Warehouse, the Power Plant, or the Music Box were hardly conceivable. This meant that the Detroit scene placed greater emphasis on the music itself than on the party context surrounding it. As the Detroit DJ and producer Eddie Fowlkes put it: “It’s what separates us from New York or Chicago - They’re all too busy going out” (Brewster, 2006, pp. 350-351).

In 1985 and 1986, Atkins, May, Saunderson, and their wider circle began, under Atkins’s guidance, to release their first records. At this stage, they still understood themselves as a local variant of the Chicago *House* sound. Atkins founded the label Metroplex and, under the name Model 500, first released “No UFO’s,” which is generally regarded as the starting point of this distinct Detroit sound. “No UFO’s” has a dark quality. Over the course of its two-bar loop, a restless synth bass leaps back and forth between three pitches. The drum track strongly recalls early Chicago productions, yet sounds both harder and more refined. The additional synthesizer elements are tonally compatible, but they do not establish a harmonic context in the sense of a chord progression. Further releases by Atkins and Eddie Fowlkes followed soon thereafter (Brewster, 2006, p. 351; Sicko, 2010, p. 48).

May then established the Metroplex imprint Transmat. Of the Belleville Three, he was the only one with neither experience in music production nor any real grounding in club culture. Yet it was precisely this freedom from existing conventions that enabled him, under the artist name Rhythim Is Rhythim, to develop a distinctly electronic

sound of his own. Although his earliest releases were still of questionable quality, from 1987 onward he issued several genre classics. The first of these was "Nude Photo," produced in collaboration with Atkins and structured entirely around a one-bar sequence on a 303 synthesizer that seems almost arbitrary in its succession of pitches. The beat is a typical four-to-the-floor pattern from a TR-909, only lightly enriched with snare syncopations. There is no tonal context whatsoever; indeed, not even a tonic character can be identified within the bass loop. (Brewster, 2006, p. 352; Sicko, 2010, p. 51)

Kevin Saunderson was the third to enter music production, doing so in 1987. Unlike May and Atkins, he was familiar with the New York *Disco* scene and placed greater emphasis than either of them on the club viability of his productions. On the label KMS, which he founded himself, he released tracks such as "The Sound" (as Reese & Santonio), which combined May's electronic abstraction with Atkins's precision and the dance-floor functionality of DJ music. Saunderson also introduced into the canon of electronic music several bass sounds that would prove highly influential, among them the organ-like bass of "The Sound," built on a square waveform, and the sustained, lightly modulated sine-wave sub-bass of "Just Another Chance." In this way, all three producers made a decisive contribution to shaping the sound of Detroit *Techno* (Brewster, 2006, p. 352; Sicko, 2010, p. 52).

Although the most important market for these records initially remained the Chicago scene, and although the Detroit style could at first still be understood without difficulty as a local substyle of *House*, by 1987 *Techno* had musically emancipated itself from that framework.

„While House was happy to reheat old tunes, Techno rejected tradition. Whereas House rejoiced in funky, soulful Disco, Techno was transfixed in Giorgio Moroder's uptempo computerized version. […] While house was about lustful churchy energy, Techno dealt in lament and anxiety." (Brewster, 2006, p. 354).

The term *Techno* itself, however, was not coined until 1988 in the United Kingdom. While *Acid House* had already begun to attract attention there, Virgin Records was preparing to release a compilation of Detroit productions under the working title *The*

House Sound of Detroit. Since an autonomous new trend was thought easier to market, Atkins was asked to provide a name for the music being made by his circle. This gave rise to the term *Techno* and to the compilation title *Techno! The New Dance Sound of Detroit* (Brewster, 2006, p. 355; Sicko, 2010, pp. 67-68). In 1988, the album was reviewed in the music magazine *SPEX* in the following terms:

> *"Where the better-known Chicago house cuts of the early days - 'Love Can't Turn Around,' for instance - still retained something of song form, with vocals and dramatic arc, Techno! The New Dance Sound of Detroit begins where house, by way of 'acid,' had since arrived: trance-like, Spartan rhythmic repetition, joined by a European early-'80s inflection of lingering keyboard touches."* (Niemczyk, 1988, p. 40).

With the developments in Detroit and Chicago, by the end of the 1980s both the conventions of electronic dance music had been fundamentally defined and the possibilities for further musical innovation had been dramatically expanded. In the years that followed, not only would electronic dance culture celebrate a return to ecstatic collectivism, but a great many producers would also establish new sounds, forms, and rhythms. This applies in particular to the shaping of bass through new production methods and the growing availability of powerful synthesizers. For, as Poschardt observed, "Nowhere in the mainstream of this period did bass sound fatter, rounder, or more powerful" (Poschardt, 1997, p. 327)."

2.8.3 Rave as Dance Culture

The establishment of *Acid House* in British discotheques, together with the rise of the "Ecstasy Culture" (Sicko, 2010, p. 75) surrounding the drug MDMA, led in 1988 to England's "Second Summer of Love" (Brewster, 2006, S. 500; Kirby, Acid House, 2017, S. 14). The opportunities for living out youth and music culture in the United Kingdom were limited even in the major cities and, where they did exist, often markedly elitist. A combination of still relatively early closing hours, exclusive door policies, and the prevailing spirit of the Thatcher era left little room for such forms of expression. (Brewster, 2006, pp. 399-400). The social vision underlying that era was famously summed up by the British Prime Minister as follows:

„ […] there's no such thing as society. There are individual men and women and there are families." (Kaey, 1987, pp. 29-30).

The *Rave* scene, with its collective mass dancing and substantial use of empathogenic drugs, can thus be understood as a counterreaction to the interpersonal coldness of the economically individualist social vision of the late 1980s. The success of electronic dance music and that of MDMA and its derivatives mutually reinforced one another. The influence of these substances on the *Rave* scene is illustrated by Artur Schroers's study, which in 1998 found an MDMA prevalence rate of 78.2% among German rave-goers (Brewster, 2006, pp. 427, 500; Schroers, 2001, pp. 213-214, 216, 226).

As a response to precisely these shortcomings of British nightlife, there had already been, in the eras of *Punk*, *Post-Punk*, and *Rare Groove*, a marked tendency toward irregular events in irregular venues. These often took place in occupied buildings of various sizes, many of them disused warehouses - hence the term *warehouse*[16] *party* for this type of event (Brewster, 2006, pp. 417-418).

With the growing demand for *Acid House*, these parties gradually developed into what became known as raves: usually illegal large-scale events whose focus lay on the collective intoxication produced by empathogenic drugs, extravagant lighting technology, and dancing to endlessly mixed, repetitive electronic dance music. Within the established conventions of British nightlife, this expansive demand could scarcely have been satisfied otherwise. (Brewster, 2006, p. 500; Sicko, 2010, pp. 78-79; Schroers, 2001, p. 228).

Accordingly, raves grew ever larger, to the point that a move into open-air spaces became inevitable. As early as 1989, events were already drawing more than 10,000 ravers. The movement understood itself as revolutionary and idealistic. Ravers built a

[16] There is no connection to the Chicago Warehouse (cf. §2.8.1) beyond the nature of the venue itself.

utopian “city for a night” that did not wish to be part of Thatcherite mainstream society. (Brewster, 2006, pp. 501-502)

Where raves were initially tolerated, the backlash from the establishment was not long in coming: as early as autumn 1988, the British government introduced new legislation threatening rave promoters with draconian penalties. These laws were tightened step by step over the following years. Yet this did not bring about the decline of *Rave* culture; it merely produced a cat-and-mouse game between organizers and the authorities. Events of this kind - whether in the form of legal festivals or illegal raves - remain an essential part of Europe’s electronic dance music culture to this day. (Brewster, 2006, p. 503).

Perhaps the most extreme manifestation of electronic dance music’s[17] counter-society was the Berlin Love Parade from 1989 to 2003. Officially registered as a political demonstration, the Love Parade had, by 1993 at the latest, become a succession of raves moving annually through the German capital, with crowds dancing behind loudspeaker-laden trucks. What began in 1989 on a relatively modest scale, with around 200 participants, saw attendance surge over the following years, reaching a peak of 1.5 million participants in 2001 (Poschardt, 1997, pp. 337-338).

Although many participants were no doubt driven simply by hedonistic motives, the Love Parade long saw itself as both revolutionary and utopian. At the heart of its self-image was the idea of presenting a peaceful, collective alternative to mainstream society. (Borneman, 2000, pp. 295, 297.299). As Poschardt puts it, “The Love Parade strips the demonstration of its demanding character and turns itself into the demonstration” (Poschardt, 1997, p. 339) In 2003, however, the event lost its legal status as a demonstration. Combined with the collapse in record-label revenues during the crisis of the

[17] Since *Acid House* had by then given way as an umbrella term to a temporary parallel use of *House* and *Techno* in similarly broad senses, a more general wording is appropriate here.

physical-record market, this meant that the event was no longer financially viable in its existing form. It was subsequently discontinued, then revived in 2006 as a marketing event backed by major sponsors from outside the scene, including McFit. From 2007 onward, it was relocated to North Rhine–Westphalia, and after the disaster at the 2010 Love Parade in Duisburg, it was brought to an end altogether (Hellbing, 2012, p. 3).

Both the British *Rave* model and the German Love Parade concept have been widely adopted internationally and continue to shape electronic dance music culture in lasting ways. (Brewster, 2006, p. 370).

2.8.4 British Divergences

Because of a number of distinctive features of the British music market, the stylistic development of modern popular dance music in the United Kingdom followed a path of its own, though one by no means untouched by mutual influences and exchange. Characteristically British dance-music styles include *J"ungle*, *Drum & Bass*, *UK Garage*, *Breaks*, *Grime*, and *Dubstep*" (Brewster, 2006, p. 447) , along with their later offshoots.

Unlike the United States, where migrant musical culture was shaped above all by African American traditions, the United Kingdom was influenced more strongly by the musical roots of immigrants from the former Caribbean colonies. Here, the Jamaican sound-system tradition once again deserves particular emphasis (cf. §§2.5 and 2.7.7). From the early 1980s onward, the groundwork for a distinct dance-music culture was laid through a move away from the conservative *Lover's Rock* of British *Reggae* labels such as Trojan Records and toward a modern Anglo-Caribbean sound of the second generation, developed by so-called soul sounds such as Soul II Soul (Brewster, 2006, pp. 448-449).

These soul sound systems combined, on the one hand, the performative format of *Reggae* - with its oversized speaker stacks, bass affinity, and the presence of a deejay as host - with, on the other, a musical openness both to current African American trends and to the British *Northern Soul* scene, which was carried largely by young white audiences.

„The British Bass grew fat on music from America – funk, hip hop, house and techno – but it came, originally, from Jamaica." (Brewster, 2006, p. 447).

Whereas the electronic dance-music culture of the 1980s had still looked to its great American models in *Acid House* and the Manchester rave, enriching them with elements of European dance culture, by the end of the decade electronic music had begun to merge with the Afro-American and Afro-Caribbean party culture of the soul sound systems. A characteristic example of this early foundation of British styles is the 1989 hit "Back to Life," released by the Soul II Soul collective, which combines elements of *House*, *Hip Hop*, *Dub*, and *Soul*. (Brewster, 2006, pp. 455-456). In an interview with *The Guardian*, producer Jazzie B (Trevor Beresford Romeo) described the genesis of the track as follows:

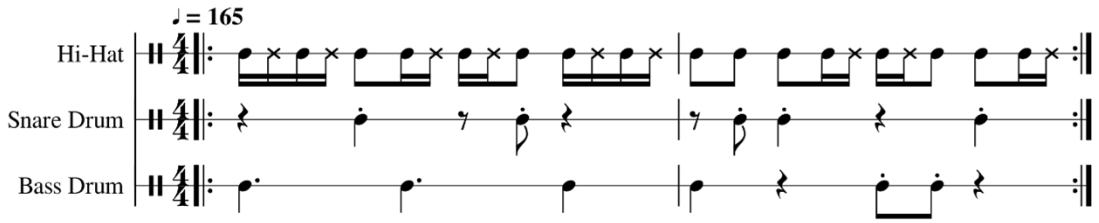
„We weren't trying to follow any trend or fit into any category – we were just doing our own thing. […] Its shuffling beats were a cross between reggae and what was to become known as Hip Hop: breakbeats and electronic sound. Caron Wheeler's [Soul] vocal, coming over these very heavy bass beats, was the icing on the cake. […] We often look to America for our influences, but this was a moment that put British music back on the map." (Watkins J. , 2012).

With *Trip Hop*, the first of these styles emerged in the early 1990s. The Bristol collective Wild Bunch pursued a musical approach similar to that of Soul II Soul, but was less oriented toward dance music. The Bristol sound developed into a comparatively slow form of electronic music that favored *Funk*- and *Hip Hop*-derived drum patterns over four-to-the-floor rhythms, while also drawing on the relaxed sonic aesthetic of *Dub*. Wild Bunch would go on to spawn, among others, the highly successful group Massive Attack. (Brewster, 2006, p. 456; Poschart, 1997, p. 303-302; Kirby, Trip Hop, 2017, p. 783-784).

Meanwhile, in London, *Hardcore*, *Happy Hardcore*, and *Hardcore House* marked the next intermediate step toward the enduring and distinctly British styles that followed. In search of a more uncompromising form of *Hip Hop*, the production trio Shut Up and Dance developed a sound in which entire tracks, vocals, and drum loops were played back at ever faster speeds. Although this breakbeat aesthetic found little

resonance within the *Hip Hop* scene, it was enthusiastically embraced by the *Rave* scene. Groups such as The Shamen, and later the globally successful The Prodigy, adopted this sound and fused it with *Rave* and *House*. *Hardcore* would become the most important precursor of *Jungle* and, later, *Drum & Bass*. Tracks such as The Prodigy's "Charly" and DJ Vibes's "Sing It Loud" are representative examples of this style (Brewster, 2006, pp. 460-461).

Since England's major urban centres had, since the 1960s, become important hubs of *Dancehall* and *Reggae* sound-system culture alongside Kingstonand *Reggae* sound-system culture alongside Kingston and New York, it is hardly surprising that in the 1990s *Dancehall* also displaced *Lover's Rock* there. Its catchy clave-based beats, together with the modern form of toasting known as *Ragga*, also left their mark on the island's dance-music scene, which was already strongly attuned to Caribbean influences. Out of *Hardcore* and *Dancehall* there first emerged *Jungle*: a style that combined high-pitched, clave-triggered *Funk* loops with elements of *Reggae* and toasting vocals. *Jungle* is further characterized by extremely fast tempos of 160 BPM and above. The style achieved its commercial breakthrough in 1994 with Shy FX & UK Apache's "Original Nuttah" and M-Beat featuring General Levy's "Incredible" (Notation 23). It is noteworthy that both tracks are driven to a significant extent by *Ragga* vocals. *Jungle* was the first electronic style to make sub-bass frequencies (below 80 Hz) a central stylistic device. (Brewster, 2006, pp. 463-465; Melville, 2017, pp. 427-430).

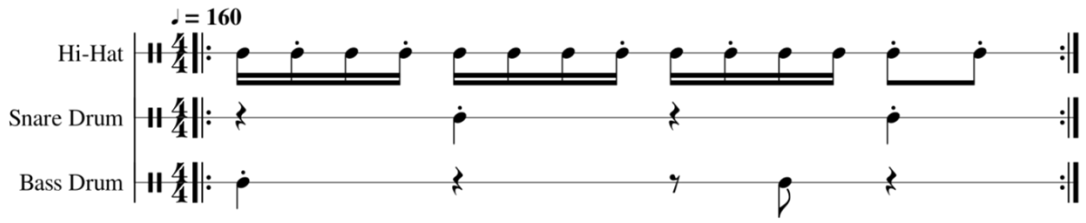


Notation 23: M-Beat ft. General Levy "Incredible" Beat Pattern / Source: Author's own transcription

Toward the end of the decade, the genre moved away from sampled loops and *Reggae* influences, turning instead toward *Jazz* on the one hand and more overtly electronic sonorities on the other. As an umbrella term for the various fast breakbeat styles, the label *Drum & Bass* became established. To this day, this form of British electronic

music remains, alongside *House* and *Techno*, one of the most important stylistic categories within electronic dance music.

In the years that followed, the genre's musical differentiation pushed tempos up to as much as 180 BPM. Beats were only rarely constructed from chopped loop samples; instead, they were increasingly produced anew in similar forms. The emphasis on bass remained intact, but advances in synthesizer plug-ins meant that simple sine-wave basses were gradually replaced by more complex bass structures and automated parameter modulations, developments that would ultimately lead to the emergence of *Dubstep* (cf. §2.9.2) (Brewster, 2006, pp. 465-467) Diese Entwicklungen können durch den Vergleich von Goldies „Inner City Life" oder dem Titel „Soulbeatrunna" des Produzenten Boymarang mit den oben genannten Titeln von Shy FX und M-Beat nachempfunden werden. Im 21. Jahrhundert reduziert sich das Repertoire des Genres immer mehr zu einer Beatform, die die wandernden Betonungen der Clave vollständig ablegt. Viele moderne Drum & Bass-Titel weisen sehr ähnliche Varianten desselben Beats auf, wie beispielsweise „Racing Green" von High Contrast (Notation 24) (Kirby, Drum & Bass, 2017, pp. 11-12).



Notation 24: High Contrast "Racing Green" Beat Pattern / Source: Author's own transcription

The most recent - and at the same time the most commercially successful on a global scale - form of British electronic music is *Dubstep*. This style, which brings together a wide range of influences, emerged out of *Grime*, a British form of club-oriented *Hip Hop* (cf. §2.7.6) that itself already drew heavily on various electronic styles. The role of rapped vocals in British styles - shaped on the one hand by *Dancehall* and on the other by *Hip Hop* - was always more significant than in American or continental European electronic music. In the early 2000s, this led to the transformation of an electronically inflected vocal music into a vocal-driven music shaped by electronic

production, represented by artists such as Dizzee Rascal and Wiley. (Brewster, 2006, S. 472-473; Kirby, Grime, 2017, S. 343).

> *„While Grime had some success […], it was Dubstep that made British bass a global powerhouse.“* (Brewster, 2006, p. 474).

Dubstep, in turn, represents a renewed turn toward electronics, grounded in the beat structures of *Grime*. Particularly striking are its altered tempo, its deliberate subversion of the listening habits established by progressive electronic music, and the so-called bass drop.

Dubstep typically operates at a tempo between 70 and 75 BPM - precisely half the speed of harder *Trance* and *Techno* styles. One encounters forms of buildup comparable to those introduced by *Progressive House*; unlike in that style, however, these do not culminate in an intensified version of the same pattern, but in the drop, which runs counter to the anticipation that has been so carefully built up. In a drop, the drum tracks typically collapse into a half-time beat, while a complex synthesizer figure moves to the foreground. This figure usually consists of dense, overtone-rich bass sounds made possible by a new generation of software synthesizers. At this point, a clear distinction between timbre and pitch notation is no longer always possible. Automated controller variables, step sequencers, and real-time interpolation between wavetables of complex waveforms across multiple oscillators - combined with far-reaching freedom in the design of signal paths - generate sonic landscapes that extend across an immense frequency range and remain identifiable as bass only because they also contain pronounced sub-bass and bass components. (Brewster, 2006, S. 474-475; Albiez, Dubstep, 2017, S. 213-215). The sonic complexity of this texture is illustrated by the spectrogram of the bass drop in Skrillex's "Bangarang":

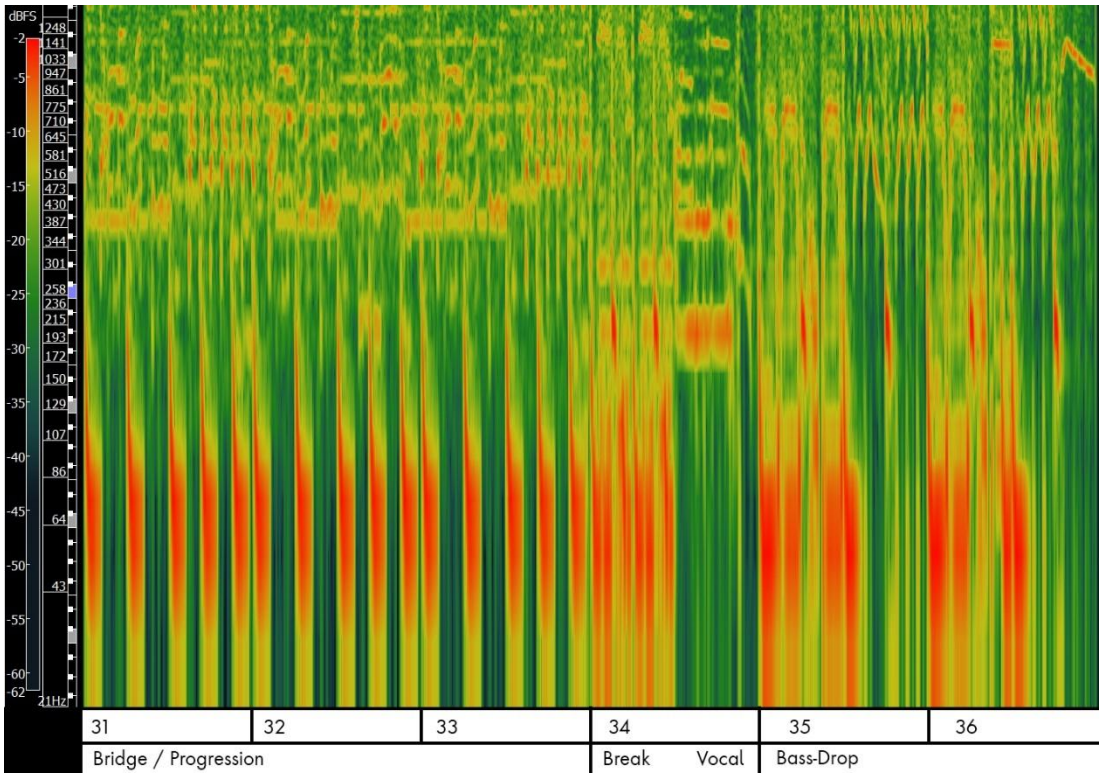


Figure 11: Spectrogram of Skrillex's "Bangarang" (bars 31-36). Source: Author's own representation

In the bridge (bars 31 to 33), the kick drum is clearly visible below 100 Hz, occupying that space on its own. The progressive character becomes apparent in the second half of bars 31 and 33 through the use of so-called risers. Risers are sustained sounds of ascending frequency - in this case rising from approximately 400 Hz to around 650 Hz - which create an intensifying effect. The actual *Dubstep* bass enters in the break (bar 34) and in the drop (from bar 35 onward). Particularly striking, in comparison with the isolated kick drum, is the intensification of the entire bass range, especially below 50 Hz. The complex overtone contours, meanwhile, make visible, for example, the "frequency arcs" on beats 1+ and 2+ of bar 35, as well as on 1+ of bar 36. Here, in temporal coincidence with the sub-bass, a tonal component shoots from 150 Hz up to 800 Hz and back again.

"There is the prototypical "wobble" bass that emerged as far back as the penchant for "bass mutation" in ragga-jungle and drum 'n' bass, the structural likeness to Hip Hop (most noticeable in the half-time emphasis on the back beat as well as the use of "bass

drops"), and the formal similarities to minimal techno (in the emphasis on gradual structural development)." (D'Errico, 2015, p. 4).

So ist es vor allem das Stilmittel des Bass Drops, das von Dubstep in andere Musikstile – besonders in *EDM* und *Tropical* - ausstrahlt.

Representative tracks, *Grime*:

Dizzie Rascal – Bonkers
Wiley ft Devlin - Bring Them All
Lady Sovereign - Love Me Or Hate Me

Representative tracks, *Dubstep*:

Doctor P – SweetShop
Zomboy & Must Die – Survivors
Skrillex - Bangarang feat. Sirah

2.8.5 Further Electronic Substyles

Although the basic form of four-to-the-floor-based electronic dance styles had already been defined by the late 1980s, the decades since have seen the emergence of a great many electronic dance-music substyles. Since many of these styles - such as *Tech House* or *Deep House* - can ultimately be understood as differing degrees of fusion between disco-oriented *House* music and highly abstract *Techno*, only a selective discussion of a few individual developments is required here. It should also be noted that these labels are often fluid in meaning and, at different historical moments, have operated within different frameworks of definition.

1) Belgian Techno / Dutch Techno / Gabber

The contribution of the Benelux countries to the canon of electronic dance music grew out of a preference for especially hard Detroit sounds in the late 1980s. Around 1991, Belgian *Techno* producers began developing their own interpretation of the genre on this basis. Their focus lay above all on the shaping of complex synthesizer timbres,

especially in the bass range, made possible by the growing availability of powerful digital synthesizers. In its own time, Belgian *Techno* was regarded as progressive and served as a model for the soundscapes of subsequent styles (Brewster, 2006, p. 362-363; Albiez, Trance, 2017, p. 781, Sicko, 2010, p. 74-75).

The Dutch scene adopted these new sonic possibilities but intensified their hardness through ever-increasing speed, thereby creating *Gabber*, "*Techno*'s most extreme incarnation" (Brewster, 2006, p. 365). *Gabber* reaches tempos of over 200 BPM and, with its one-sided focus on hardness and its martial, morbid semiotics, invites comparison with the Scandinavian *Death Metal* scene. Its sound is shaped above all by the staccato impact of foldback-distorted kick-drum hits. (Brewster, 2006, p. 365-366; Mutsaers, 2017, p. 319-320).

Representative tracks, Belgian Techno:

Second Phase – Mentasm
Channel X – Rave the Rhythm

Representative tracks, Gabber:

Euromasters – Alles Narr De Klote
Neophyte – Recession

2) Trance / Goa / Psytrance

Trance, by contrast, may be understood as an attempt to create a form of *Techno* without extremes. Where in Detroit stochastic procedures had governed pitch organization, in *Trance* harmony takes precedence. *Trance* grew out of *Progressive House*, a style that may here be regarded as an intermediate stage. Around 1990 in England, in the attempt to maximize the compatibility of *Acid House* with empathogenic drugs, this style emerged, defined by the gradual intensification of energy through shifting sound parameters, the layering-in of additional tracks, and increasingly rapid break rolls.

This style was developed into *Trance* by German DJs and producers such as Frankfurt's Sven Väth and Berlin's Paul van Dyk. *Trance* tracks generally follow a highly explicit harmonic design and feature memorable melodies. This combination of a technoid rhythmic section with elements drawn from pre-electronic popular music - and extending at times as far as classical music - while avoiding any kind of abrasive avant-gardism, was aimed at the production of euphoria and proved highly successful commercially. It is noteworthy that there appear to be correlations between the style's popularity in particular times and places and the respective popularity and availability of MDMA (Reynolds, 2000, p. 72). Throughout the second half of the 1990s, *Trance* was the dominant form of *Techno* in Germany; it also established itself internationally within nightclub repertoires and may since then be regarded as "one of the main currents of electronic music" (Albiez, Trance, 2017, p. 780) Progressive buildup, moreover, became a production technique adopted by virtually all electronic music styles. (Brewster, 2006, pp. 367-369; Reynolds, 2000, pp. 74-76; Albiez, Trance, 2017, pp. 780-783; Brockhaus, 2017, p. 287).

Parallel to the development of *Trance*, a comparable style emerged in the backpacker enclaves of South and Southeast Asia: *Psytrance*, also named after the Indian coastal city of Goa. This was not, however, a South Asian creation, but rather the product of European visitors. *Psytrance* developed directly out of *Acid House* and the European electronic pop music that was popular in Goa during the 1980s. Unlike *Trance*, it

retained the acid bass lines of the TB-303 and similar synthesizers, as well as the subordinate role of harmonic context, while at times incorporating so-called ethnic elements. Nevertheless, this style, too, arrived at the same progressive form - a form that may be understood in relation to the individual track, the DJ set, or the shaping of an entire night. *Psytrance* remains relevant both as a tourist attraction in India, Thailand, and Australia and as a globally established subcultural scene. (Reynolds, 2000, pp. 68-70).

Representative tracks, Trance:

Age of Love – Age of Love (Jam & Spoon Remix)
Paul van Dyk – For an Angel
Armin van Buuren – Communication
Delerium ft. Sarah McLachlan - "Silence (Tiësto In Search Of Sunrise Remix)"

Representative tracks, Psytrance:

Der Dritte Raum - Alienoid
Shpongle – Divine Moments of Truth
Astrix – Deep Jungle Walk

3) Minimal

Minimal is the concept of an abstraction of electronic dance music that was conceived in the mid-1990s, though it did not reach its peak until the mid-2000s. Through omission, *Minimal* throws the few remaining elements into sharper relief - ideally, those that contribute most directly to the listening experience. This applies both to the number and character of the tracks involved and to the modulation of sounds or changes within patterns over time. In this sense, *Minimal* also represents a counterreaction to the proliferation of electronic music's many other substyles. Early Basic Channel productions, for example, consist of little more than a continuous kick drum, a one-bar TB-303 pattern, and a delay effect. The real compositional substance emerges through changes in the parameters of the synthesizer and the echo. In this reduction to "drum and bass," *Minimal* reveals its inheritance from *Dub* (cf. §2.5.3), which, since Sly Dunbar's steppers beat, had also made use of a continuous bass drum.

In the new millennium, however, the concept of *Minimal* became less rigorous as it grew more successful. "*Minimal Techno* has produced a style of production that remains influential even when the tracks themselves are no longer minimal" (Wöltz, 2006, p. E7). Conceptually, the ambition remained to achieve a great deal with very little, even without pursuing abstraction to its furthest limit. In this way, the term *Minimal* also began to lose its precision and was at times used as a catch-all label for virtually all four-to-the-floor styles. (Wöltz, 2006, pp. E6-E7).

Representative tracks, Minimal (1990s)

Moritz von Oswald/Basic Channel – Radiance I
Wolfgang Voigt/Studio 1 – Lila A1

Representative tracks, Minimal (2000s)

Kollektiv Turmstrasse – Holunderbaum
Ricardo Villalobos – Easy Lee

4) American EDM

As is so often the case with stylistic labels in electronic dance music, *EDM* (*Electronic Dance Music*) functions simultaneously as the name of a specific substyle and as a pars-pro-toto term for the genre as a whole. As a stylistic label, however, *EDM* refers to a young, mainstream American variant. In the U.S. music market, long dominated by *Rock* and *Hip Hop*, electronic dance music remained markedly underrepresented until around 2009. One sporadic exception was the British Chemical Brothers' 1997 track "Block Rockin' Beats," which drew on the sonic aesthetic of *Hip Hop* and, tellingly, received a Grammy for Best Rock Instrumental Performance. Although this helped open the market to a small number of artists such as Norman Cook (*Fatboy Slim*) and The Prodigy, the American mainstream remained resistant to electronic dance music for a long time. (Sicko, 2010, pp. 5-6) Only the easier availability of music outside traditional radio airplay - through online video and streaming platforms - together with the international success of *Dubstep*, would eventually open this market. The continued availability of empathogenic drugs may also have played a role.

The first artist to establish himself decisively under these new conditions was the French DJ and producer David Guetta. His deft fusion of catchy elements from *House* and *Trance* with the bass drops of *Dubstep*, alongside American star vocalists from *Hip Hop* and *R&B*, was almost perfectly tailored to American music culture. Other major figures from the European market, such as Tiësto and Paul van Dyk, soon followed, while American DJs such as Steve Aoki were also able to establish themselves.

In many respects, American *EDM* follows the logic of the U.S. mass market: its event culture and performative habitus are closer to the commercial stadium rock of American superstars than to European club culture, and its musical form shows a renewed orientation toward traditional song structures (Brewster, 2006, pp. 538-541, 549-550; Brockhaus, 2017, p. 296, Sicko, 2010, p. 8).

Exemplarische Titel, amerikanische EDM

David Guetta ft. Kelly Rowland - When Love takes over
LMFAO – Party Rock Anthem
Avicii – Levels

5) Tropical Bass

Through the influence of *Baile Funk*, *Dancehall*, and *Soca* on the *Techno* producer Diplo, and with the founding of the collective Major Lazer, an electronic hybrid of club styles from the Global South began to emerge around 2005, usually referred to as *Tropical* or *Tropical Bass*. Typical features include the fusion of clave and four-to-the-floor rhythms, the use of *Dubstep* drops - though without the half-time beat - harmonic and tonal material drawn from the respective source styles, and a comparatively frequent use of vocalists for an electronic genre. Because of the sheer range of influences involved, *Tropical Bass* remains a relatively diffuse field. One modern substyle, for example, is *Moombahton*: a blend of slow *House*, *Dubstep*, and *Dancehall l* (Zambrano, 2018, pp. 4-9).

Exemplarische Titel, Tropical Bass

Major Lazer ft. Vybz Kartel– Pon De Floor
Tropkillaz - Que Passa Amigo
Douster – King of Africa
Buraka Som Sistema – Kalemba (Wegue Wegue)

Exemplarische Titel, Moombhaton

Major Lazer ft. Busy Signal & The Flexican – Watch out for this (Bumaye)
DJ Snake ft. MØ – Lean on

2.9 Modern Popular Dance Music by 2020

By 2020 -before the rupture brought about by the pandemic - the field of modern popular dance music encompassed a wide range of styles and a substantial canon of elements and techniques. At the same time, however, genre boundaries had become increasingly porous. *Hip Hop*, electronic dance music, and dance music from the tropics were being combined with ever greater freedom. Even so, the field can still be clearly delineated through its structural conditions and shared musical features.

2.9.1 Modern Popular Dance Music as a Cultural Phenomenon

Modern popular dance music is the product of an ongoing process of combination and recombination between elements of African and European musical culture. Through the African diaspora, these two cultural spheres came into sustained contact. European elements are especially evident in formal parameters such as tonal and metrical systems, as well as in harmonic theory. African influence, by contrast, is most clearly apparent in rhythm, but also in the significance accorded to pentatonic structures.
As understood in this study, modern popular dance music is the contemporary manifestation of a chain of developments that led from *Rhythm & Blues* to *Reggae* and *Soul* - rather than to *Rock* music. Among the defining factors in this trajectory are the DJ culture established by *Reggae* and *Disco*, in contrast to the live-performance model of *Rock* bands, and the continued pursuit of a (often African American) subcultural identity.

A simplified linear representation of the major transfers of traits that shaped modern popular dance music, as discussed in this study, is shown below in Figure 12.

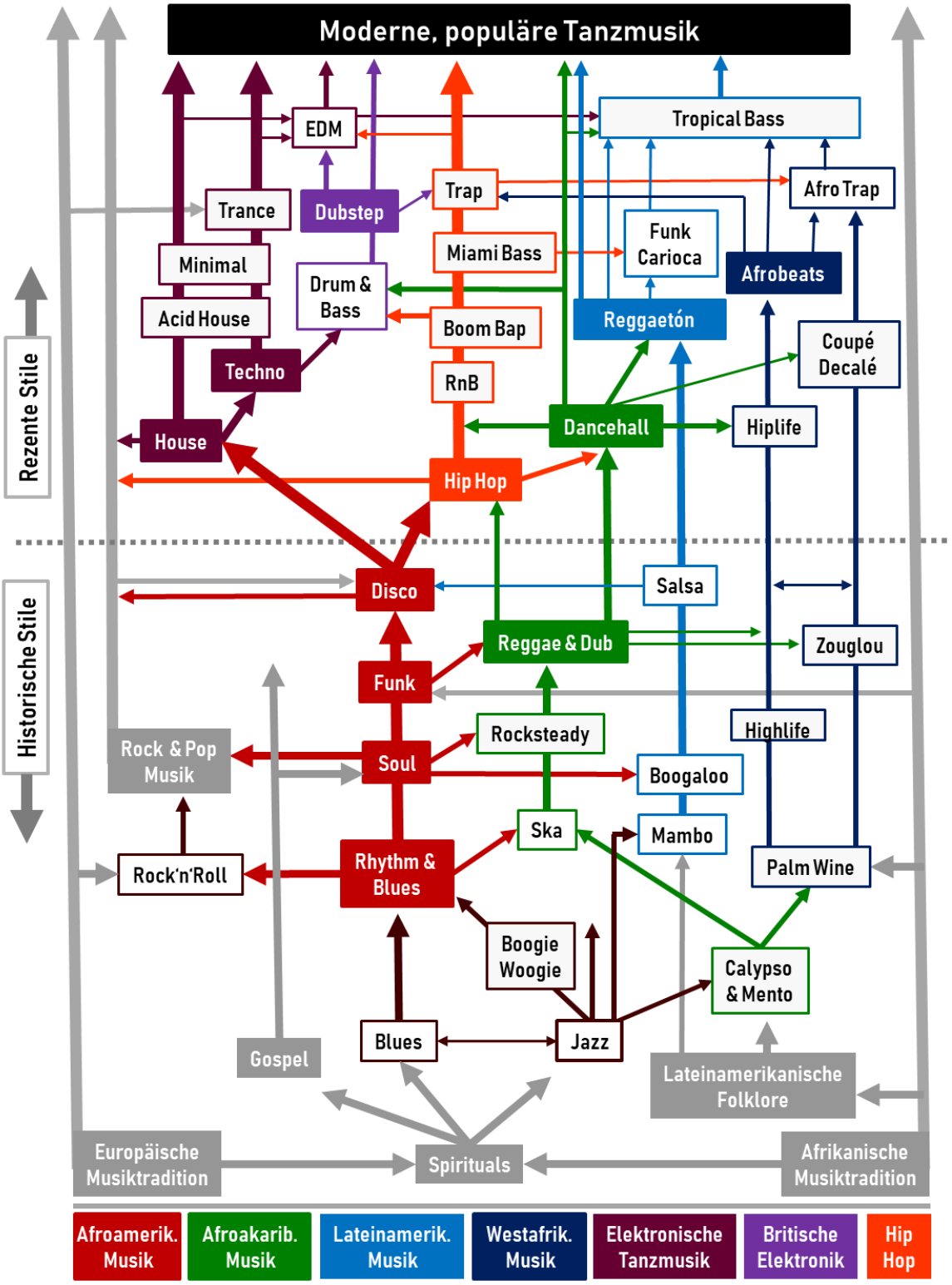


Figure 12: Simplified linear development of modern popular dance music / Source: author's own illustration

2.9.1.1 Sociocultural Factors and Dance-Music Culture

Throughout the development of modern popular dance music, structural pressures and social conditions repeatedly emerge as driving forces of innovation. A great many of the cultural techniques and stylistic forms described in this field owe their existence to such pressures.

One important factor is the suppression of subcultures by an at least perceived majority culture. Thus, the music of enslaved African Americans adapted to the cultural and religious dictates of the white ruling order; likewise, the emergence of DJ culture can be traced to the repression of nightlife under alcohol prohibition and National Socialist cultural policy. The influence of the British Criminal Justice Act on the concrete shape of *Rave* culture also belongs in this category. The cultural techniques developed under such conditions were often retained even after the repression itself had disappeared, and came to be preferred over the practices for which they had originally served as provisional substitutes.

Another recurring factor is the development of strategies for satisfying cultural and social needs under conditions of scarcity, poverty, and underrepresentation. In *Reggae*, for instance, versioning emerged from economic necessity; yet even today, tracks are still released on classic riddims without any such practical constraint. *Hip Hop*, *Disco*, and *House*, too, were profoundly shaped by minorities carving out spaces of their own and establishing celebratory cultures that were accessible to them and capable of generating identity. It is unlikely that these developments would have unfolded in the same way had their protagonists enjoyed easy social and financial access to the dominant forms of collective celebration available within the white or heterosexual mainstream.

Conversely, musical cultures also repeatedly prevailed when they were able to absorb, with particular speed, freedoms that had already been established in other areas of society. This is evident in the move away from formalized partner dances in the wake of women's advancing emancipation, and in the establishment of an African American mainstream music through Motown in the years following the American Civil Rights Movement. Yet it also applies to more informal freedoms: for instance, to the gradual optimization of electronic music in relation to the effects of empathogenic drugs, or to the influence exerted on early-1990s music by the legally ambiguous status of sampling.

2.9.1.2 Technological Progress

The space of possibility for these innovations is repeatedly defined and expanded by technological progress. It is striking that such technical innovations are often taken up precisely by individuals or small circles of actors with diverse musical backgrounds. On the basis of this experience, the codification of the new can draw on a rich repertoire of musical cultural techniques.

James Jamerson's bass playing, for example, is scarcely imaginable without the Precision Bass - but neither is it conceivable without his experience in *Blues*, *Jazz*, and *Rhythm & Blues*. The same applies to Afrika Bambaataa and Juan Atkins, whose profound influence on the formation of modern popular dance music would have been impossible without the TR-808, but equally without an eclectic openness to stylistic diversity.

A close examination of the emergence of modern popular dance music therefore confirms the assumption that it unfolds within a space of possibility defined by both sociocultural and technological conditions.

2.9.2 Characteristics of Modern Popular Dance Music

Although the various styles of modern popular dance music are highly diverse, several defining elements are characteristic of almost all of them:

1. The Dominance of Bass

The tendency to maximize the low-frequency content of dance music can be traced throughout the history of modern popular dance music. This is true, first, of musical production, which incorporated bass-capable sound generators such as the Precision Bass, the Moog Modular, and the TB-303 in stylistically formative and innovative ways. It is equally true of sound reproduction, as demonstrated by developments in recording, amplification, and loudspeaker technology. Above all, the protagonists of Jamaican sound-system culture established this emphasis as a lasting element of stylistic history, allowing these bass-centered practices to be transferred to the block-party culture of the South Bronx and, later, to European *Rave* culture.

2. Repetitive Patternstruktur

By the time *Funk* emerged, the formal organization of modern popular dance music had begun to move away from song form and chord progression as its primary organizing principles, and toward the succession and layering of polyrhythmic patterns rooted in West African rhythmic traditions. This pattern-based logic is central both to the sample and loop culture of *Hip Hop* and to the ostinato-driven processes of electronic dance music.

3. Progressiver Songaufbau

With the increasing dissolution of genre boundaries over the past decade (Brockhaus, 2017, pp. 298, 303) the progressive organization of musical elements - anticipated in *Disco* and firmly established by *Trance* - has become a broadly transferable feature of modern popular dance music. Numerous productions in *Hip Hop*, *Dancehall*, and *R&B* have adopted techniques of progressive intensification, as well as the bass drop and the synthesizer break.

Pressure and anticipation are likewise generated through the gradual addition and removal of layers within the rhythmic texture. As Brockhaus notes, “A relatively large number of productions followed the simple formula of removing or adding an element, particularly in the field of dance-oriented music” (Brockhaus, 2017, p. 297)

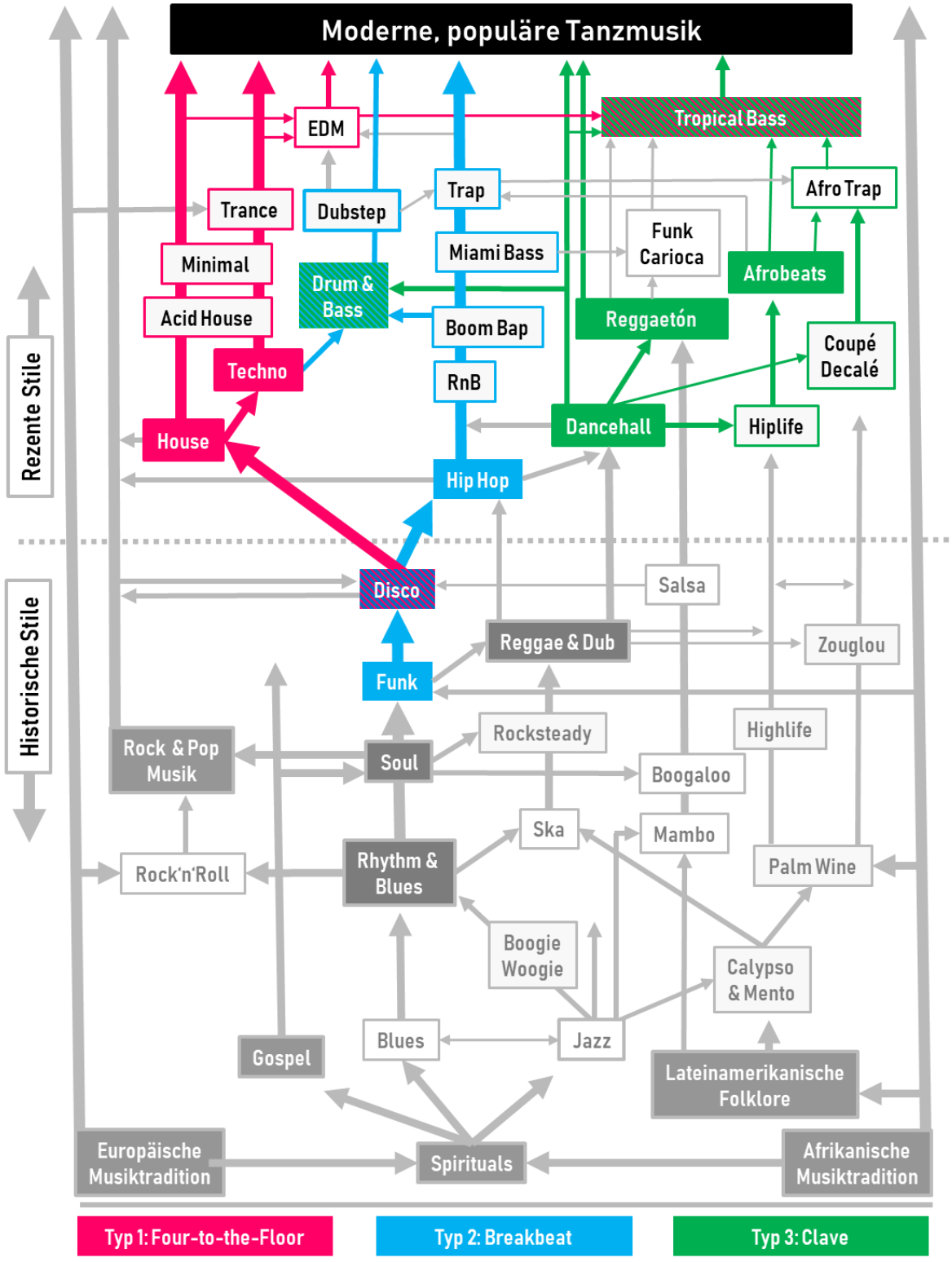


Figure 13: Basic Rhythmic Types of Modern Popular Dance Music / Source: author's own illustration

Three basic rhythmic types occur in modern popular dance music. Their development and dissemination are shown schematically in Figure 13.

1) Four-to-the-Floor

Most styles of electronic dance music are characterized by a continuous kick drum on all four quarter-note beats of the bar: the defining feature of the four-to-the-floor beat. This pattern is often expanded with handclaps or snares on beats two and four, as well as with subtle syncopations.

This rhythmic type is characteristic of *House*, *Techno*, *Trance*, and their many derivatives. It derives from the simplified *Funk* beats of *Disco* music, which were electronically adapted during the early *House* era, and can first be observed in the electronic productions of Giorgio Moroder.

2) Breakbeat

In many *Funk* productions, and in some later *Soul* recordings, a drum - and, where applicable, percussion - solo forms the energetic climax of the track. Both the *Disco* mix and the quick-mix theory of early *Hip Hop* established the heightened importance of these breaks within the mainstream. Reproduced beats of this type can be found both in *Hip Hop* from the 1990s onward and in British electronic music.

As a further development of the backbeat, the breakbeat is defined above all by snare-drum accents on beats two and four, even though these may, in individual cases, be reshaped through rhythmic displacement or syncopation. The kick drum usually emphasizes the first downbeat, but it is also common for later downbeats within a pattern not to receive the same degree of emphasis. Beyond this, the breakbeat is characterized by a more or less complex rhythmic design shaped by displacement, subtle polyrhythm, and snare syncopations.

This type is used primarily in *Hip Hop*, *Drum & Bass*, *Dubstep*, *Trap*, and their derivatives.

3) Clave

For the purposes of this study, clave-type beats are understood as those that arise from polyrhythmic interlocking and are not oriented toward either the backbeat or the breakbeat. In most cases, the decisive feature is the division of a four-four bar into three events, although other forms of interlocking may likewise serve as a basis for stylistic development. Despite the presence of an underlying pulse, these techniques produce non-isochronous accent patterns within the beat..

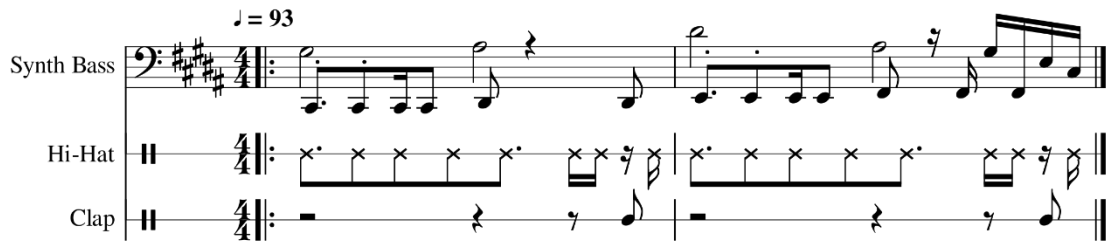
The simplest form of the clave beat can be found in Jamaican *Dancehall*, with kick-drum strokes on beat one and on two-and, and a snare drum or clap on beat four (vgl. 2.7.7).

This rhythmic type occurs above all in modern dance music of the Global South and reflects the greater importance these styles attach to Africa's cultural legacy.

1.9.3 Der Bass in der modernen, populären Tanzmusik

In modern popular dance music, bass forms the link between rhythm and harmony. Less frequently, it also assumes the role of a lead sound, especially in styles such as *Reggae*, *Jungle*, and *Dubstep*.

For the perception of bass, it appears to matter little whether it is produced by kick drums, by a bass instrument, or by both. Run-DMC's "Peter Piper," for example, dispenses with a bass instrument altogether, relying instead on the kick drum from the loop sampled from "Take Me to the Mardi Gras" and on that of the TR-808. Rihanna and Drake's "Work," by contrast, forgoes a kick drum entirely in favor of low synthesizer dyads (Notation 25). Both tracks are nevertheless strongly defined by their bass-heavy character. The tonal sine-wave kick drums of the TR series and its emulations, in particular, further blur these categories.



Notation 25: Rihanna ft. Drake „Work" Pattern / Source: author's own transcription

The precise configuration of bass, moreover, is highly diverse. In electronic dance music shaped by *Minimal* and *Trance*, bass often operates in a highly abstract and uniform manner, using synthetic sounds; in *Hip Hop*, by contrast, sampled or newly reproduced *Soul*, *Funk*, and *Jazz* bass lines with an organic timbral character remain common. Nevertheless, by analogy with the three basic rhythmic types, three basic types of bass can also be described. As with the beats, these may be broadly associated with the three main fields of *House*/*Techno*, *Hip Hop*, and Afro-Caribbean dance music. Since these types aggregate rhythm, tonality, and timbre, however, they should by no means be understood as sharply delineated or mutually exclusive categories.
The development and dissemination of these types are shown in Figure 14.

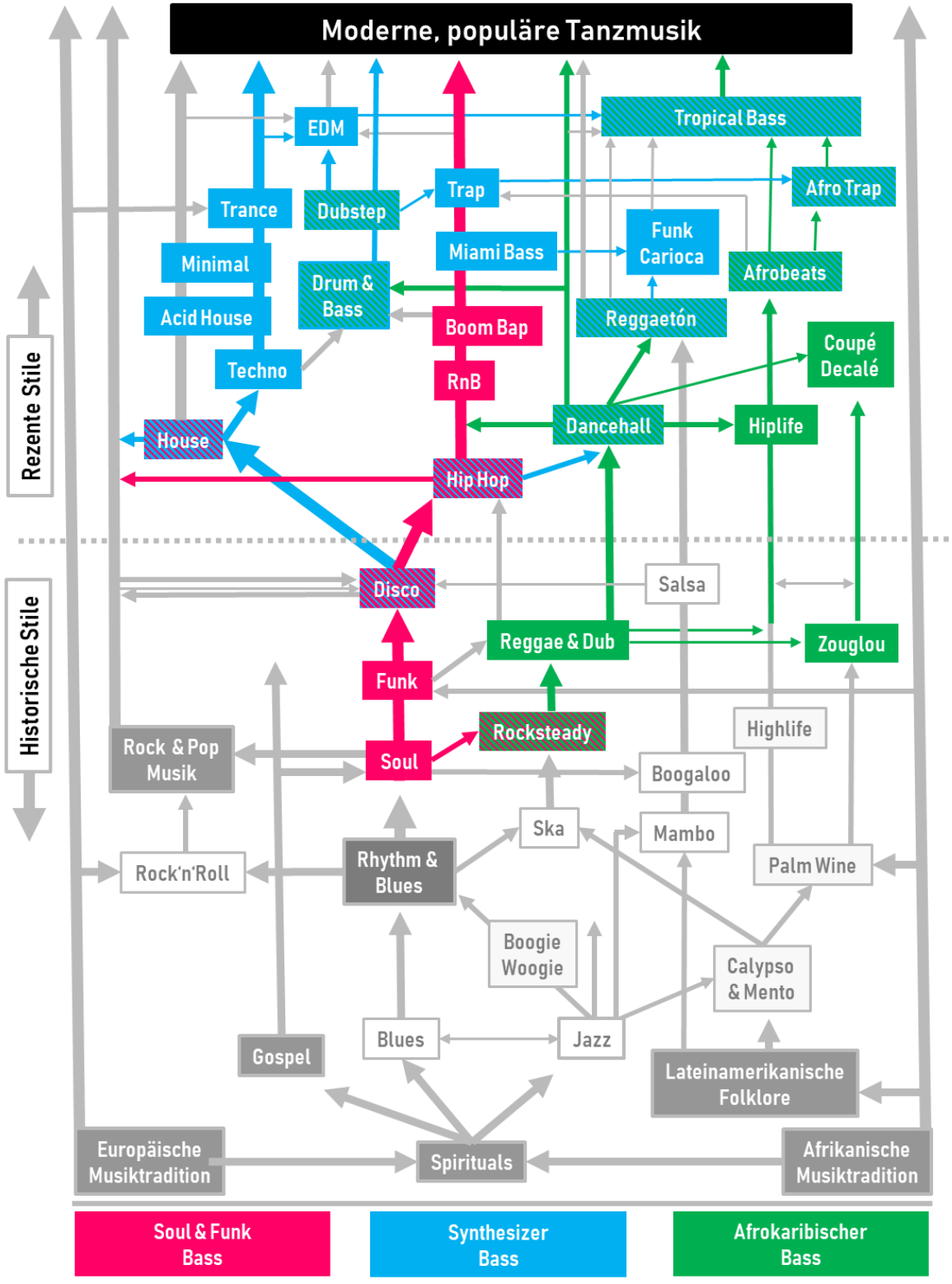
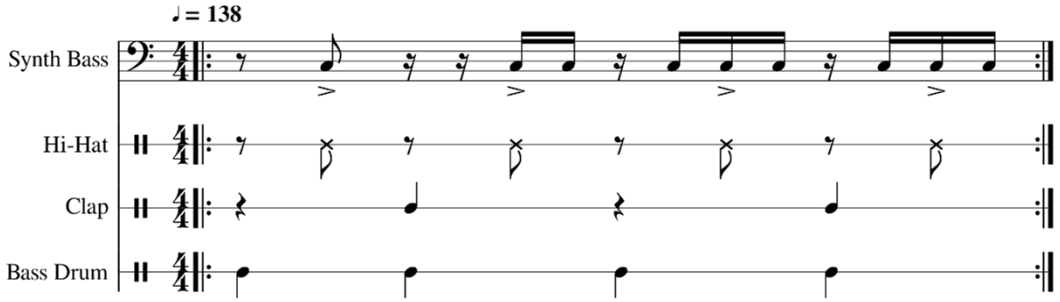


Figure 14: Basic Types of Bass in Modern Popular Dance Music / Source: author's own illustration

1) The Technoid Synthesizer Bass

Since their emergence in *Funk* and *Soul* and their subsequent success in *Disco*, synthesizer basses have enjoyed considerable popularity. The modern synthesizer bass is used above all in electronic dance music and generally makes no attempt to imitate electroacoustic instruments or their performance techniques. Although it may play tonal and rhythmic material that could also be assigned to the other two categories, synthesizer basses are usually more abstract, tonally reduced, and less melodic than the other types. Isochronous accent patterns and very short, repetitive motifs are also typical.

These elements can be heard, for example, in Paul van Dyk's "For an Angel" (Notation 26). The square-wave sound of the synthesizer plays a rhythmic pattern without any vertical movement. Sonic variation arises solely through changes to the downstream low-pass filter and through a delay with a duration of one sixteenth note. A common technique in *Minimal* production is the offset interplay of bass synthesizer and kick drum, which allows for an optimal use of the low-frequency range.



Notation 26: Paul van Dyk „For an Angel" Pattern / Source: author's own transcription

A special case within this type is represented by the modern basses of *Dubstep*, whose spectral eventfulness lies less in the melodic-rhythmic domain than in the continuous variation of timbre. Unlike the *Trance* example discussed above, these are generally sustained tones subjected to highly complex, multiparametric modulations.

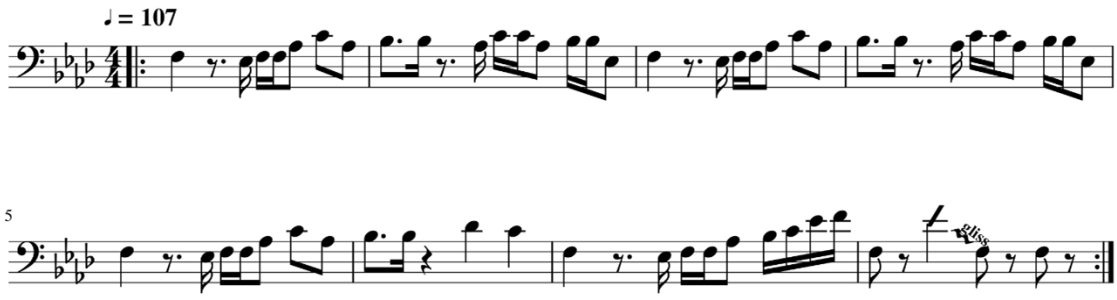
2) The Soul & Funk Bass

The bass of *Soul* and *Funk*, discussed in §§2.4.3 and 2.6.1, remains an important element of African American popular music more than fifty years after its emergence. It is especially prominent in various *Hip Hop* styles, particularly *Boom Bap* and *R&B*, but also appears in many *House* tracks. Possible sound sources for the *Soul* bass include sample loops from classic African American recordings, synthesizers, and bass instruments such as the electric or double bass.

The *Soul* and *Funk* bass frequently appears together with the breakbeat. This type of bass, in particular, serves to interlock harmonic and rhythmic figures within the pattern structure established by *Funk*. Together with the beat, it creates a usually two-, four-, or eight-bar rhythmic pattern, often consisting of several layers. The typical points of emphasis within these patterns are beat one of the first pattern bar, as well as beats two and four of each bar.

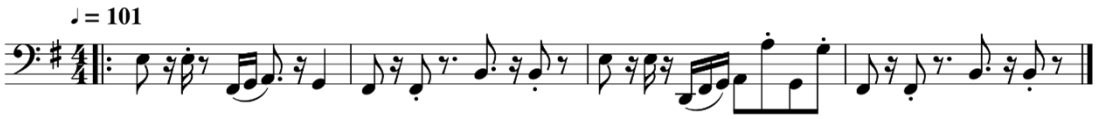
Examples of the *Soul* bass in popular dance music of recent years include Bruno Mars's "24K Magic" (Notation 27) and Calvin Harris's "Feels," featuring Pharrell Williams, Katy Perry, and Big Sean (Notation 28).

The distinctive synthesizer bass of "24K Magic" draws, both timbrally and tonally, on Bernie Worrell's *P-Funk* figures and recalls the track "Flash Light." Although diatonic passing motion is rare in the modern *Soul* bass, this example contains many of the techniques established by Jamerson. It should be noted, however, that this is a production that deliberately draws on retro elements.



Notation 27: Bruno Mars „24k Magic" Synth Bass Riff / Source: author's own transcription

The electric bass in "Feels," by contrast, is, in its simplicity, more typical of many modern *Soul* basses, though it illustrates the cultural legacy of this bass type less clearly. Here, the bass connects the root notes of the harmonies through subtle diatonic transitions.



Notation 28: Calvin Harris ft. Pharrel Williams, Katie Perry & Big Sean "Feels" Bass Riff / Source: author's own transcription

3) The Afro-Caribbean Bass

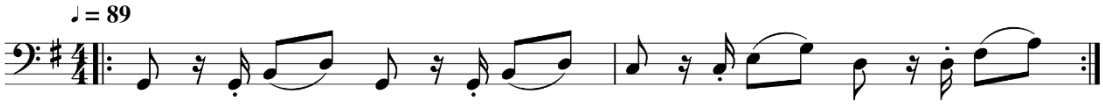
The Afro-Caribbean bass, as an element of modern popular dance music, emerged in Jamaica, as discussed in §2.5, and owes its wider dissemination to the far-reaching influence of *Reggae*. The bass in *Reggae* and *Rocksteady* was always more strongly shaped by African musical traditions than its African American counterparts. This made it easier to integrate into other African-influenced styles from West Africa and Latin America. It is therefore hardly surprising that it often appears in conjunction with clave-type beats.

Like the *Funk* bass, the Afro-Caribbean bass links harmony and rhythm, but it often comes to the fore in a more melodic and prominent manner. Its sound sources include both synthesizers and electric basses. Samples are relatively rare and, when used, tend to draw on Jamaican classics rather than African ones. Compared with the *Funk* and *Soul* bass, the Afro-Caribbean bass makes less use of passing tones and other harmonic refinements. It usually operates in shorter patterns based on pentatonic harmonic resolutions. The rhythmic centers of gravity are determined by the particular realization of the clave beat, but are rarely isochronous.

Recent examples of Afro-Jamaican bass include the *Dancehall* track "Couple Up" by *Ragga* singer Konshens (Notation 29) and the *Afrobeats* track "Ay Mama" by the Congolese artist Singuila (Notation 30).

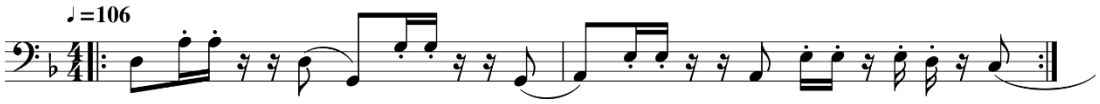
The bass in "Couple Up" shows - much like the beat in "Like Glue" - that Jamaican *Dancehall* tends toward comparatively simpler forms within Afro-Caribbean music.

Rhythmically, it largely doubles the clave of the drum track. Tonally, the bass consists of single notes drawn from the respective harmonies.



Notation 29: Konshens "Couple Up" (Calabash Riddim) / Source: author's own transcription

The West African variant of the Afro-Caribbean bass is usually more complex, as can be seen in "Ay Mama." It complements the accents of the drum pattern typical of *Afrobeats* in a polyrhythmic manner. This becomes especially clear in the striking closing turn.



Notation 30: Singuila „Ay Mama" Bass Riff (Refrain) / Source: author's own transcription

Despite its manifold realizations in tonality, rhythm, and timbre, bass appears to constitute a coherent and socially shared concept that occupies a central position in modern popular dance music. Irrespective of these factors, basses may be said to possess a certain common character. Although this chapter has described and delimited bass in modern popular dance music and traced the development of its constituent elements, the question remains as to the higher-order principle underlying the phenomenon of bass itself. A psychoacoustic investigation of what exactly constitutes the bass-like quality - that is, the perceptual fatness - of a sound will be the subject of the following chapter.

3. Empirical Approach to Fatness

As the preceding section has shown, bass in modern popular dance music encompasses a highly heterogeneous field of possible manifestations. The timbres in which it appears range from the percussive character of the TR-808 kick drum, through electric basses and various synthesizer sounds, to the frequency cascades of *Dubstep*. Yet all these sounds share a bass-like character, which in everyday language is referred to as their fatness. The author's observations in his work as a professional DJ for modern popular dance music since 2001 support this assumption.

What, then, constitutes the perception of fatness that all these acoustic events have in common? As already shown, the material category of "instrument" is not suitable for explaining what is perceived as fat-sounding and what is not. Nor can the acoustic category of frequency range alone provide an adequate explanation. If it could, not only certain sounds of modern dance music would sound fat, but also noise phenomena such as thunder or aircraft turbines.

The question of perceived fatness is therefore a question of how a musical-acoustic stimulus gives rise to a complex sensation, and thus belongs to the field of psychophysics in general and psychoacoustics in particular. Psychoacoustics provides the conceptual and methodological tools needed to describe the relationships between sounds and sensations by means of psychoacoustic parameters (Schneider A. , 2018, p. 563).

The empirical assessment of this fatness on the basis of psychoacoustic considerations is the subject of the following chapters.

To this end, three successive listening studies were conducted:

1. An exploratory online survey

   This study examined the fundamental factors underlying the perception of fatness. For this purpose, 124 participants were surveyed on dance-music bass sounds in typical playing contexts. The data were then evaluated psychoacoustically.

2. A listening experiment in the author's recording studio:

In this experiment, 37 participants were each presented with 110 test sounds. These sounds were constructed with specific variances designed to make the factors identified in the first study quantifiable.

On the basis of measurement results, constructed factors, and behavioural measures, a preliminary psychoacoustic model of perceived fatness was developed using multivariate regression.

3. An online survey based on a comprehensive dance-music sample

   In this study, 37 professional disc jockeys and 31 regular club-goers were each presented with 35-second excerpts from 100 relevant dance-music tracks recorded between 1961 and 2019, whose fatness they were asked to evaluate.

From the measurement results and survey data of the final two stages of the study, practical metrics were modelled for both **momentary perceptual fatness** and the **integrated fatness** of complex sounds.

On the basis of momentary fatness, a basic model for a theory of rhythm was then developed, grounded in the superposition of overlapping loops. Integrated fatness, in turn, was used - together with other measures - to develop a clustering procedure for dance music based on a Kohonen map within the Apollon system.

This chapter therefore summarizes the methodology underlying the empirical approach to fatness. It considers, in particular, the current state of bass research, the foundations of psychoacoustics, machine learning and self-organizing Kohonen maps, as well as other necessary acoustic measures.

3.1 Bass in Scholarship

The scholarly literature on “bass” remains regrettably sparse. This is due in large part to the fact that research on the styles in which bass is particularly significant has tended to be sociologically oriented, often leaving the music itself underexamined. Musicology, by contrast, has traditionally devoted greater attention to performable musical

styles such as *Rock* and European classical art music when studying sound and musical practice. The following section outlines several scientific findings on bass.

1) Although Adelman-Larsen's study *Rock and Pop Venues* deals primarily with live-performed music rather than dance music in the sense used in this study, many of the Danish concert halls he examines are also used for club events without live music.

   The venues studied were both measured acoustically and evaluated in terms of their sonic qualities through surveys of musicians and sound engineers. Adelman-Larsen identifies the study's most important finding as the fact that a positive evaluation of a hall depends to a considerable degree on clear bass reproduction. For a favourable sonic impression, the highest possible values for Thiele's D50[18], measured in relation to frequencies in the 63 Hz and 125 Hz bands, are preferable. (Adelman-Larsen, 2014, pp. 30-31,112-113,121-122).

2) A further study that approaches the club context from an architectural-acoustic perspective is R. Bader and A. Schneider's investigation of Hamburg's Star-Club. Since this focal point of the German *Beat Music* scene of the 1960s was demolished in 1986, it was digitally reconstructed and made audible through a process of auralization. Here, too, the venue was primarily a concert hall for *Rock* music. At the beginning of the 1960s, however, *Rock* and African American music had not yet diverged as sharply as they later would, and major

[18] Thiele's D50 is a measure of sound clarity. It relates the sound energy arriving within the first 50 ms after an acoustic event to the later reflections that follow. A high D50 value indicates that a large proportion of the acoustic energy is concentrated within the first 50 ms.

figures of *Soul* and *Rhythm & Blues*, including Ray Charles and Fats Domino, also performed there. The study is therefore relevant to the context of the present work. (Bader & Schneider, Playing "Live" at the Star-Club: Reconstructing the Room Acoustics of a Famous Music Hall, 2011, p. 186).

The acoustic analysis of the Star-Club yields results that differ from those of Adelman-Larsen. In the lower frequency bands in particular, the hall appears to exhibit low D50 values. This, however, has the effect of reinforcing low tones through prolonged bass sustain. (Bader & Schneider, Playing "Live" at the Star-Club: Reconstructing the Room Acoustics of a Famous Music Hall, 2011, p. 203). A comparable effect is also considered desirable in halls for unamplified orchestral music, where it counteracts the problem of pre-electrical bass reinforcement described in §2.1.1. (Adelman-Larsen, 2014, p. 111).

This is likely due to the fact that concert halls of the 1960s and those of the twenty-first century are based on entirely different concepts of sound reinforcement. The Star-Club was amplified through a P.A. system of 200 to, at most, 400 watts, supplemented by the direct sound from the stage (Bader & Schneider, Playing "Live" at the Star-Club: Reconstructing the Room Acoustics of a Famous Music Hall, 2011, p. 190). Modern club loudspeaker systems, by contrast, provide thousands of watts for bass reproduction alone. (Adelman-Larsen, 2014, p. 122). In the *Beat* and *Soul* era, additional bass reinforcement was therefore preferable to optimal bass clarity. In the age of generously dimensioned amplification systems and modern sound technology, such a compromise is no longer strictly necessary; instead, preference is given to a sound that is both bass-rich and precise. What both studies nevertheless have in common is that their particular attention to bass reproduction points to the heightened importance of bass in comparison with higher frequency ranges.

3) This is also suggested by M. Oehler et al.'s contribution to DAGA 2015. The study presented there addresses, among other things, the increasing proportion of low frequencies in the Media Control/*Musikmarkt* annual charts from 1965 to 2013. It demonstrates a steady shift in the ratio between frequencies above

182 Hz and those below this threshold. The average bass content rose from 8% to 13%, thereby evidencing an "increased significance of low-frequency signal components". (Oehler, 2015, p. 1).

4) Comparable findings are also reported by Hove, Vuust, and Stupacher, whose study identifies a steadily increasing proportion of bass in the top two entries of the *Billboard Hot 100* between 1955 and 2016. They show that much of the loudness gain achieved through advances in mastering occurred in the two lowest pitch registers. In addition, they demonstrate a trend toward increasing bass fluctuation and toward lower frequency ranges more generally. (Solberg, 2014).

5) Building on Burger et al.'s findings concerning the perceptual influence of different audio features, Van Dyck et al. demonstrate a relationship between the accentuation of the bass drum in dance music and listeners' dance behaviour. They show that a higher SPL level of the bass drum leads both to increased dance activity and to more precise entrainment to the metre. (Van Dyck, et al., 2013, pp. 355-357)

6) Edith Van Dyck likewise emphasizes the outstanding role of bass in contemporary popular music, with particular attention to the bass drum. She was able to demonstrate empirical relationships between the partial loudness of the bass drum and both the intensity of dancers' movements and motor entrainment - that is, synchronization with the rhythm. (Van Dyck, The Impact of the Bass Drum on Human Dance Movement, 2012).

7) Although McCown et al. examine indicators for a preference for exaggerated bass in relation to gender and parameters of the Big Five inventory, the applicability of their findings to the present study is limited in several respects. Their focus is not on the club context, but rather on subwoofer technology in extended car-audio systems or portable playback devices such as boomboxes

and ghetto blasters in urban settings. In the study, the stimuli were boosted globally by 12 dB at 190 Hz and below, which does not reflect the reality of discotheque playback. Moreover, the measured effects are of limited interpretive value. It cannot be ruled out that the assumed slight male preference for exaggerated bass is a covariate of the generally higher psychoticism scores among men. (McCrown, Keiser, Mulhearn, & Williamson, 1997)

8) A number of studies in the field of hearing protection address the sound-pressure threshold required for the optimal reception of dance music in the discotheque context. This so-called "Rock'n'Roll threshold" was first postulated at 120 dB by Rupp and Koch (Rupp & Koch, 1969). Dibble later located the threshold at which *Rock'n'Roll* and other club music begins to "work" at 96 dB(A) (Dibble, 1995), , while Todd and Cody place it at 90 dB, or at 105 dB(A) where the sound contains significant energy between 100 and 300 Hz (Todd & Cody, 2000).

9) In a study of Hamburg discotheques by A. Schneider and A. von Ruschkowski on the risk of hearing damage, the prevalence of loudness in the "low and very low frequency ranges" of modern dance music is confirmed (Schneider & von Ruschkowski, 2011, p. 50). The authors also make a plausible case that A-weighting is not suitable for measurements of this kind and propose C-weighting for measurements in dance-music venues. They postulate a *Rock'n'Roll* threshold of 105 dB© and warn of possible hearing damage already from 90 dB© upward. Alongside the spectral dimension, they also attach importance to the temporal dimension, particularly with regard to the impulsive character of the sound (Schneider & von Ruschkowski, 2011, pp. 11, 50-54).

10) Bass is also discussed in Owsinski's standard works on audio engineering. For the monitoring of popular music, he recommends a lower frequency limit of no higher than 40 Hz (Owsinksi, 2009, p. 20). He locates the "fat" components of the kick drum around 80–100 Hz and those of the electric bass around 50–80

Hz, while also emphasizing the importance of overtones for the perception of bassness (Owsinski, 2006, pp. 33,35).

Where these publications address bass explicitly at all, they tend to conceive of it either as the total loudness below 200 Hz or as the product of a bass instrument. It is regrettable that the literature contains no sustained psychoacoustic engagement with the broader phenomenon of “bass.”

3.2 Psychoacoustic Perspective

he human body first registers the physical stimuli of its environment through the sensory organs (*sensation*). These stimuli are then processed neurally by rapid, lower-order processes (*perception*) and, finally, by slower, higher-order processes (*cognition*). Information is transmitted between neurons by means of electrochemical processes. Unlike cognition, perception does not require processing with reference to explicit knowledge; rather, it relies only on low-threshold functions of comparison and categorization. (Schneider A. , Psychophysics / Psychoacoustics, 2018, p. 565)

In their chronometry of music cognition, Brattico et al. describe the analysis and integration of musical features as a process that, at approximately 20 ms, unfolds far more rapidly than cognitive processes, which are situated at around 200 ms. Cognition already begins, in the sense of embodied cognition, with the functioning of the basilar membrane (see §3.2.1) and proceeds through further spectrotemporal analyses in the auditory cortex. There, complex stimuli are divided into individual acoustic phenomena, while timbre and rhythm are also processed (Brattico E. B., 2013, pp. 2-4).

Since the fatness of a sound can plausibly be assigned to the domain of timbre, and is presumably upstream of rhythm perception, it may be assumed that the fatness of musical sounds is a perceptual phenomenon.

Psychophysical quantities are usually investigated by measuring the physical stimulus, eliciting the corresponding psychological sensation, and then mathematically modelling the relationship between the two sets of measurements. The assessment of sensation is particularly problematic, since it can only be accessed indirectly. Possible methods include neurological measurements, for instance by means of EEG or fMRI, the observation of participants' behaviour, and the classical survey or self-report procedure, in which participants evaluate and communicate their own experience. All of these techniques are susceptible to specific forms of interference, and researchers' preferences often depend on whether their paradigmatic orientation lies closer to the natural sciences or to psychology (Schneider A. , 2018, pp. 566-568).

For the assessment of sensation in the present study, I chose self-report primarily for the following reasons:

1. The author's academic training and professional experience to date are rooted in psychology. Existing experience in the design and implementation of surveys - particularly in digital contexts - can therefore be applied productively.
2. Access to neuroimaging procedures is limited. The available EEG technology is labor-intensive and especially susceptible to interference from motor reflexes, which plausibly stand in close relation to the phenomenon of bass.
3. A gyroscopic investigation of dance behaviour in response to musical stimuli was rejected for lack of suitable technical equipment. In a pretest, the resolution of the university-owned devices proved inadequate. The gyroscopes built into mobile phones are generally suitable for this purpose, but at the system level they are assigned such low priority that the isochrony of the time series cannot be guaranteed.
4. Direct visual observation of dance behaviour promises an even more indirect access to sensation. As an experienced DJ, the author is accustomed to drawing connections between audio-engineering settings and the dance intensity of a group. Yet this, too, could ultimately be framed as a self-report of one's own perception of the sensations of others.

Dance experiments were also ruled out for the following reasons:

1. The sound-pressure levels customary in discotheques are potentially capable of causing permanent hearing damage. Whether incentivizing participants to expose themselves to such levels is compatible with the principles of ethical research is, at the very least, open to debate.
2. From 15 March 2020 to 28 August 2021 - that is, for almost the entire period during which this dissertation was written - discotheques and bars in Hamburg were closed or subject to a ban on dancing as part of infection-control measures.

Psychoacoustic parameters differ from acoustic parameters in that they do not describe a physical event as such, but rather the auditory sensation it produces. In other words, "a doubling of the psychoacoustic quantity produces a doubling of the corresponding auditory sensation" (Hauswirth, Psychoakustische Analysen II, 2011, p. 1) but not necessarily a doubling of the corresponding physical quantity. The object of psychoacoustics, then, is the relationship between an objective stimulus and subjective auditory experience.

Common psychoacoustic parameters include:

- loudness in sone, after Zwicker, which expresses the relationship between sound-pressure level and perceived loudness (Schneider A. , Psychophysics / Psychoacoustics, 2018, pp. 732-733).
- roughness in asper, after Helmholtz, Aures, and Sottek, which describes the degree of modulation or beating in a sound (Schneider A. , Psychophysics / Psychoacoustics, 2018, pp. 631-634).
- sharpness in acum, after von Bismarck, Aures, and others, which expresses the proportion of unpleasant high-frequency content in a sound (Schneider A. , Psychophysics / Psychoacoustics, 2018, pp. 699-700).

Psychoacoustic parameters are used primarily in industrial acoustics. They are applied especially where unpleasant sounds are to be avoided or attenuated - for example in the design of vehicle interiors or in road-traffic noise control, but also in the industrial design of devices with vibrating components, such as motors or dot-matrix printers. (Schneider A. , 2018, p. 556; Genuit & Sottek, 2010, pp. 53-54).

This practical orientation has two consequences that are relevant to the present study:

1) A substantial share of the knowledge produced in this field does not circulate within public academic research or peer-reviewed publication, but exists instead as the intellectual property of commercial companies. There are therefore numerous useful parameters whose algorithms have either not been published at all or have only been disclosed in part. This makes the current state of research difficult to access and produces a certain heterogeneity among the algorithms used by different commercial actors.

In other words, several competing providers of psychoacoustic algorithms measure the same quantities in slightly different ways, while their models remain proprietary for commercial reasons.

2) Existing psychoacoustic parameters are often only partly suited to the analysis of musical sounds, since they tend to conceptualize sound primarily as a disturbance or nuisance.

Further criticism of the concept of psychoacoustic parameters is formulated by A. von Ruschkowski in the context of his investigation of different forms of loudness. He criticizes the practice of using artificial test sounds, which carries the "risk that what is being assessed is not loudness, but the annoyance of the sound events" (Ruschkowski, 2013, p. 179). As a result, measurements of complex musical sounds in sone exhibit "entirely unsystematic variances," which calls into question their suitability for evaluating music or natural sound events (Ruschkowski, 2013, pp. 180-181).

3.2.1 Critical Bands

For psychoacoustic explanatory models, the basilar membrane in the inner ear is of particular importance. The basilar membrane may be understood as a "chain of parallel band-pass filters with specific characteristics, bandwidths, and centre frequencies" (Schneider B. v., 2009). The frequency ranges of these filters are distributed monotonically between the scala vestibuli, which corresponds to high frequencies, and the helicotrema, which corresponds to low frequencies. (Kern, Heid, Steeb, Stoop, & Stoop, 2008).

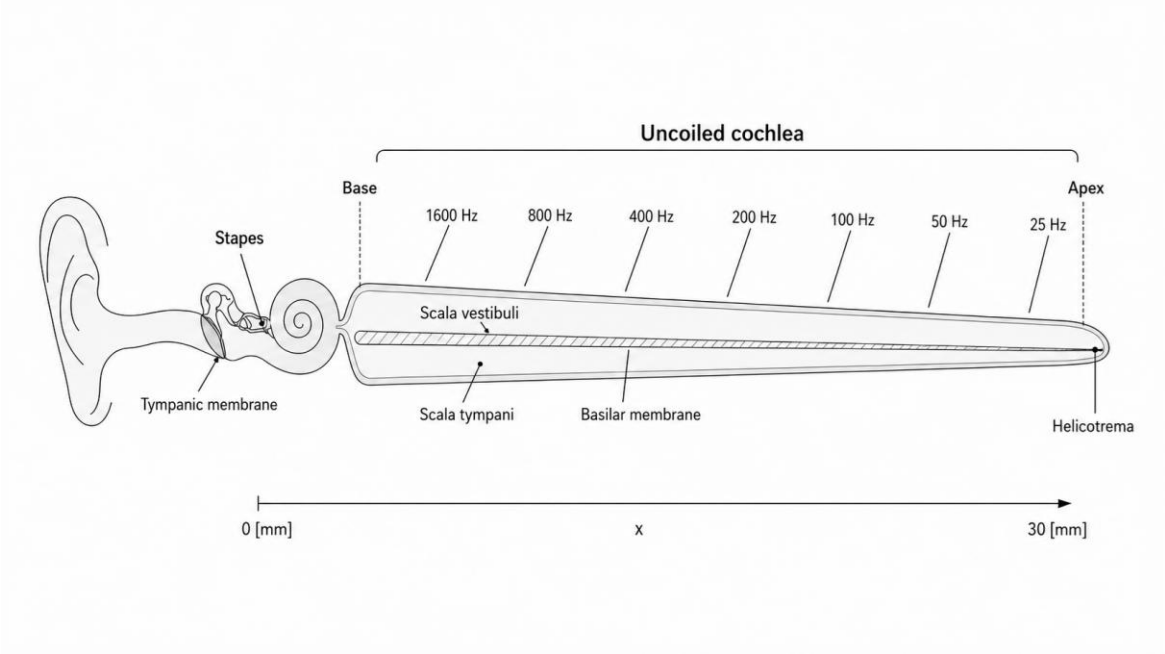


Figure 15: Schematic representation of the human auditory system, with the basilar membrane shown uncoiled. Diagram by the author, created with AI assistance, informed by Kern et al. (2008), p. 3.

As a rule, psychoacoustic models assume 24 to 25 frequency groups, also referred to as critical bands or tonal bands (Table 1). Within each of these bands, only one frequency can be discriminated at a given moment; for this reason, they are described as critical bandwidths. They are particularly important for the perception of sensory dissonance, but are also used in the analysis of loudness and pitch. The unit of these critical bandwidths is the bark (z). One bark corresponds to approximately 0.9–1 mm of the basilar membrane (Schneider A. , Psychophysics / Psychoacoustics, 2018, p. 631).

Critical Band rate z [Bark]	f [Hz]	Δf [Hz]	Critical Band rate z [Bark]	f [Hz]	Δf [Hz]
0	0	100	**13**	2000	320
1	100	100	**14**	2320	380
2	200	100	**15**	2700	450
3	300	100	**16**	3150	550
4	400	110	**17**	3700	700
5	510	120	**18**	4400	900
6	630	140	**19**	5300	1100
7	770	150	**20**	6400	1300
8	920	160	**21**	7700	1800
9	1080	190	**22**	9500	2500
10	1270	210	**23**	12000	3500
11	1480	240	**24**	15500	
12	1720	280			

Table 1 Bark Scale / Source: Hauswirth, *Application Note: Psychoacoustic Analyses I*, p. 2

3.2.2 Sottek's Auditory Model

In order to mathematically model the auditory apparatus, R. Sottek developed the following model (Figure 16). First, the acoustic stimulus is divided into the critical frequency bands by means of a cascade of parallel band-pass filters corresponding to the

bark scale - here comprising 28 bands. To calculate intensity, the signal in each individual band is squared and then smoothed by means of a band-specific low-pass filter. These three steps correspond to signal processing in the human inner ear.

Signal processing in the auditory centre of the human brain is modelled by means of a psychologically and empirically derived characteristic curve, according to which the signal in each band is evaluated and normalized.

Depending on the desired parameter, this characteristic curve takes a different form, or additional computational steps are applied. In this example, summing the values across the different bands would - given the appropriate characteristic curves - produce a value for the loudness, that is, the perceived volume, of an acoustic signal. (Hauswirth, Psychoakustische Analysen II, 2011)

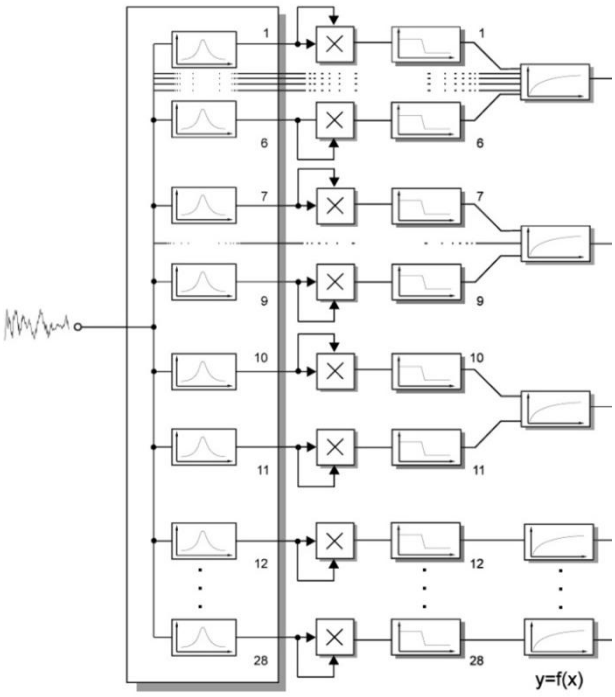


Figure 16: Sottek's Auditory Model / Quelle: Hauswirth, Psychoakustische Analysen II, (2011) S.10

3.2.3 The Parameter of Sharpness as a Working Basis

Although *sharpness* as a psychoacoustic parameter belongs to a different field of application than the analysis of low-frequency sounds in the context of dance music, it offers a useful starting point for designing a parameter that is likewise determined to a substantial degree by the spectral composition of sound. In what follows, I will therefore examine sharpness and its development in greater detail.

"A sound is perceived as sharp when its spectrum consists predominantly of high-frequency components" (Aures, 1985) What matters here is not so much the presence

of “fine spectral structures” as the tonal bands in which the greatest share of excitation occurs.

The unit of psychoacoustic sharpness is the acum. According to Zwicker, band-pass noise with cutoff frequencies of 920 Hz and 1080 Hz, presented at a sound-pressure level of 60 dB, has a sharpness of 1 acum. (Aures, 1985, p. 133).

3.2.3.1 Sharpness according to von Bismarck

The method developed by G. von Bismarck in 1974 for calculating the sharpness of general sound signals is likewise based on the theory of critical bandsFor each tonal band *z*, the share *N′(z)* of the total excitation *N* is determined and weighted by the function *g(z)*. Since sharpness depends on high-frequency spectral components, *g(z)* assigns substantially greater weight to higher tonal bands than to lower ones. The integral across all 24 tonal bands, divided by the total loudness *N*, yields the overall sharpness of a sound, which is then normalized to acum by the constant *c*.

$$S = c \frac{\int_{z=0}^{24\ \text{Bark}} N'(z) \cdot g(z)\, \mathrm{d}z}{N}\ \text{acum}$$

The weighting function *g(z)* was established through several series of experiments using test sounds. (Aures, 1985, p. 131).

3.2.3.2 Sharpness according to Aures

In the context of his studies on sensory pleasantness, W. Aures conducted several series of experiments designed to test the robustness of von Bismarck’s sharpness calculation. These revealed that “excessively high sharpness values were calculated for sounds in high frequency ranges” (Aures, 1985, p. 131), and that the method did not sufficiently account for loudness differences between different test sounds.

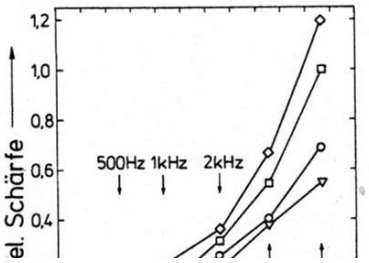


Figure 17: Measurement Results by Aures at 28, 14, and 7 sone / Source: Aures, 1985, p. 132

Aures refined the method by introducing a more accurate weighting function, *g′(z)*. To this end, he conducted

further experimental series in which participants were asked to judge the sharpness of sounds with the same frequency but different loudness levels. (Figure 17)

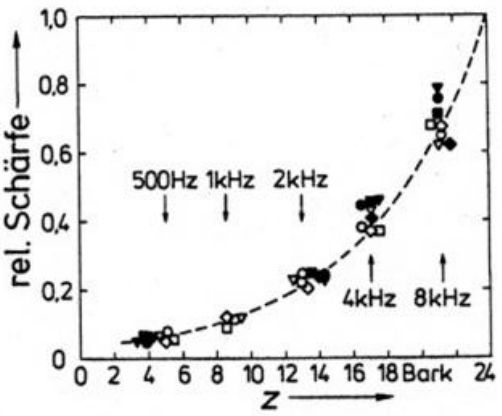


Figure 19: Weighting Function $g'(z)$According to Aures / Source: Aures, 1985, p. 132Image quotation pursuant to § 51 of the German Copyright Act (UrhG); not covered by the Creative Commons license of this dissertation.

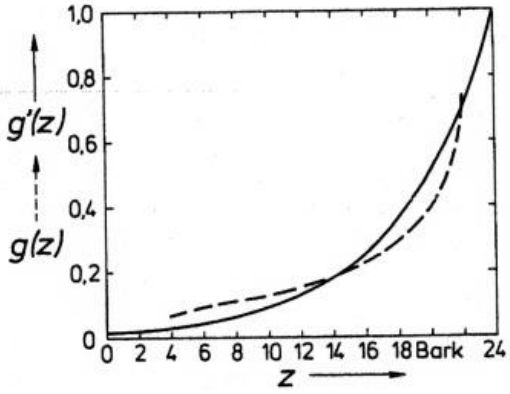


Figure 18 Comparison of Aures's $g'(z)$(solid line) and von Bismarck's $g(z)$(dashed line) / Source: Aures, 1985, p. 13
Image quotation pursuant to § 51 of the German Copyright Act (UrhG); not covered by the Creative Commons license of this dissertation.

From these measurement results, Aures developed an approximation function, *g'(z)*, using the least-squares method, and then compared it in turn with the measured data, obtaining satisfactory results. (Figure 19). As expected, the new function fulfils the requirement of yielding lower sharpness values than von Bismarck's *g(z)* in the very high tonal bands (Figure 18)

Aures addressed the problem of level dependence by replacing the denominator used by von Bismarck (N) with the loudness-dependent weighting function g_n. As a result, the formula no longer applies "only to sounds of approximately equal loudness."

Aures's formula for calculating the sharpness of general sound signals is therefore as follows:

$$S = c \frac{\int_{z=0}^{24\,\text{Bark}} N'(z)\, g'(z)\, \mathrm{d}z}{\ln\left(\frac{N/\text{sone} + 20}{20}\right) \text{sone}} \text{acum}.$$

(Aures, 1985, p. 133)

Nevertheless, both methods have their respective advantages and disadvantages, and the choice between them depends primarily on the sound under investigation. Aures's method produces a wider range of output values and is therefore more suitable, for example, for assessing the proper functioning of technical devices on the basis of the sound they emit. Von Bismarck's method, by contrast, corresponds more closely to the subjective auditory impression of the human earuntersuchenden Schall ab. (Figure 20) (Hauswirth, Application Note: Psychoacoustical Analyses I, 2011, pp. 8-9)

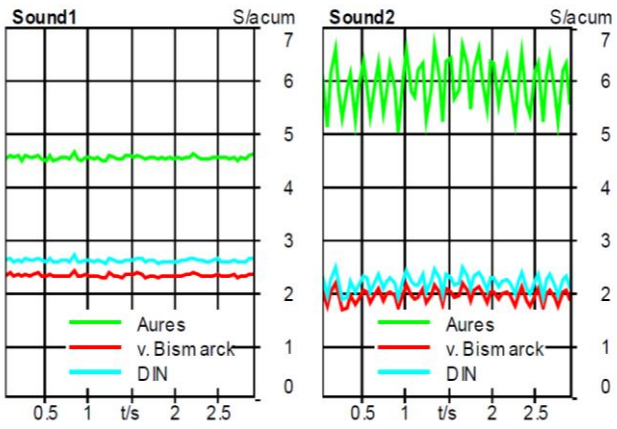


Figure 20: Comparison of Sharpness Predictions According to Aures, von Bismarck, and DIN / Psychoakustische Analysen I, (2011) S.8

The fatness of a sound under investigation, however, is not simply the reciprocal of sharpness - as in the case of the parameter *booming* - since fine spectral structures may well be relevant to its musical evaluation (Shin, Ih, Hashimoto, & Hatano, 2009, p. 209).

A research design aimed at establishing a psychoacoustic parameter of perceptual fatness should therefore take the structure of sharpness as a point of orientation, while also allowing, where necessary, for further details of subjective experience in the listening of music.

3.2.4 Measures of Loudness

In addition to Zwicker loudness, already discussed above, two further measures of loudness are relevant to this study: weighted sound-pressure level according to ISO 266, and integrated loudness according to EBU R 128.

Building on the work of Fletcher and Munson, ISO 266 describes perceived loudness as a function of sound pressure and frequency. The fact that loudness does not vary linearly with pitch can be represented by equal-loudness contours. Each of the curves shown in Figure 21 (left) passes through points of equal perceived loudness. (Schneider A. , Psychophysics / Psychoacoustics, 2018, p. 578). On this basis, the standard establishes weighting curves that allow sound-pressure levels to be weighted in a way that approximates perceived loudness. The reference point in each case is a 1 kHz sine tone of equal loudness. The A-weighting curve applies to sounds around 60 phon, while the C-weighting curve applies to sounds around 135 phon (Figure 21 right). This provides a simple, though also relatively crude, method for making the loudness of sounds comparable (Dickreiter, Dittel, Hoeg, & Wöhr, 2008, p. 565).

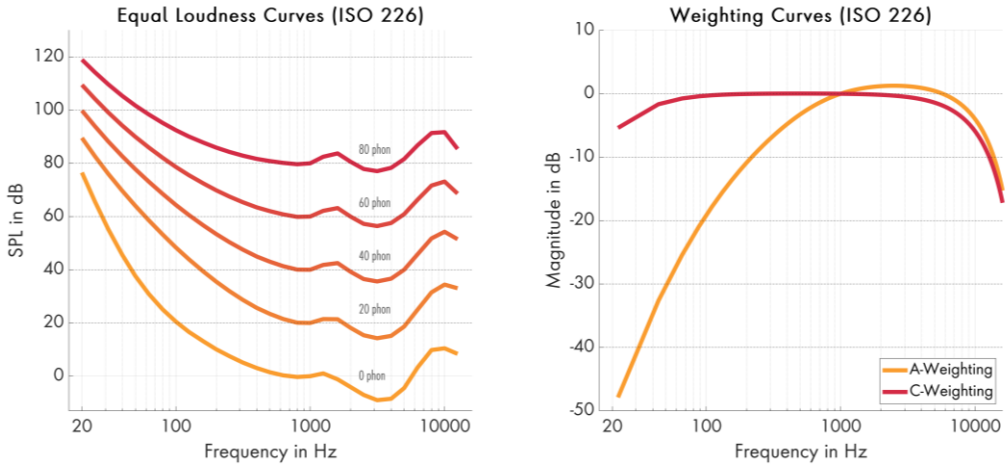


Figure 21: Equal-Loudness Contours and Weighting Curves According to ISO 226

A more accurate procedure, though one that also places greater demands on measurement duration, is proposed by the EBU R 128 standard and has become established worldwide in broadcasting. This standard, in turn, is based on the ITU-R BS.1770 algorithm, whose weighting curve provides a reliable estimate of perceived loudness. The R 128 guideline defines three loudness measures: Momentary Loudness, with a measurement window of 400 ms; Short-term Loudness, with a measurement window of 3 s; and Integrated Loudness, which is measured over the duration of the programme or segment and uses gating according to ITU-R BS.1770. Although the measurements are, in technical terms, level measurements, they are expressed as LUFS (“Loudness

Units relative to Full Scale") for absolute loudness values (Adriaensen, 2011, pp. 3-4; European Broadcasting Union, 2016).

3.2.5 Weitere Audio Features

A more recent paradigm for measuring and computing the properties of specifically musical sounds can be found in the field of Music Information Retrieval (MIR). The task of this field is to describe the immense complexity of music as a "multicultural, multi-experiential, and multidisciplinary" phenomenon by means of robust, relevant, and meaningful features. (Downie, 2003, pp. 295-296) On the basis of measurement-derived information about music, these features provide meaningful representations of properties such as harmony, melody, rhythm, or timbre. (Bello, Grosche, Müller, & Ron, 2018, p. 826) For the empirical investigations conducted in this study, numerous such audio features are also extracted and their influence on fatness examined. These are described below. Here:

f_k denotes the frequency corresponding to frequency band k

s_k denotes the spectral value at frequency band k

b_1 and b_2 denote the frequency-band limits

μ_f denotes the arithmetic mean of the spectral distribution

3.2.4.1 Harmonic Ratio (HR)

The harmonic ratio measures the proportional share of harmonic components in a signal. It is equal to the maximum of the signal's autocorrelation within the measurement window. MATLAB calculates the harmonic ratio using the more informative modified version of the MPEG-7 standard, which ignores the zero-lag peak. (Sen, Dutta, & Dey, 2019, p. 52; Hyoung-Gook, Moreau, & Sikora, 2006, pp. 33-34; Mathworks, 2021)

$$\Gamma(m) = \frac{\left(\sum(n=1)^{N} s(n)s(n-m)\right)}{\sqrt{\left(\left(\sum(n=1)^{N} s(n)^2\right)\left(\sum(n=0)^{N} s(n-m)^2\right)\right)}} \quad \text{for } 1 \le m \le M$$

Figure 22: Calculation of the Harmonic Ratio / Source: Mathworks (2021)

3.2.4.2 Fluctuation Strength

Fluctuation strength models the perceived fluctuation of a modulated signal. It is calculated from the relationship between a normalized perceived modulation rate and a normalized perceived modulation depth (Mathworks, 2021; Fastl & Zwicker, 2007, pp. 248, 254).

$$fluctuation = \frac{0.008 \int_{z=0}^{24} \Delta L \, dz}{\left(\frac{f_{mod}}{4}\right) + \left(\frac{4}{f_{mod}}\right)}$$

Figure 23: Calculation of Fluctuation Strength / Source: Mathworks (2021)

3.2.4.3 Signal-to-Noise Ratio (SNR)

The signal-to-noise ratio (SNR) describes the relationship between signal and noise. It may be understood as the ratio of a useful signal to background noise. It is calculated as the logarithmic ratio between signal level and noise level. (Camastra & Vinciarelli, 2015, pp. 28-29)

$$SNR = 10 \log_{10} \left\{ \frac{\sum_{n=0}^{M-1} s^{2[n]}}{\sum_{n=0}^{M-1} (s[n] - \hat{s}[n])^2} \right\}$$

Figure 24: Calculation Signal to Noise Ratio / Source: Camastra & Vinciarelli (2015)

3.2.4.4 Spectral Centroid / Spektraler Zentroid ($S_{centroid}$)

The spectral centroid represents the mean of a spectral energy distribution (Dorochowicz & Kostke, 2018, p. 507) It describes the “centre of force” of a spectral distribution whose frequencies are projected logarithmically with a base of 1000 Hz. (Sen, Dutta, & Dey, 2019, p. 51)

$$\mu_1 = \frac{\sum_{k=b_1}^{b_2} f_k s_k}{\sum_{k=b_1}^{b_2} s_k}$$

Figure 25: Calculation of the spectral centroid / Source: MathWorks (2021)

3.2.4.6 Spectral Flux (S_{Flux})

Spectral flux is a measure of spectral dynamics. It is calculated from the normalized squared differences between successively measured spectra. It thus describes the magnitude of spectral change within a signal (Eyben, 2016, p. 42; Mathworks, 2021) .

$$\text{flux}(t) = \left(\sum_{k=b_1}^{b_2} |s_k(t) - s_k(t-1)|^p \right)^{\frac{1}{p}}$$

Figure 26: Calculation of spectral flux / Source: MathWorks (2021)

3.2.4.5 Spectral Crest (S_{crest})

Spectral crest describes the ratio between the maximum and the arithmetic mean of a spectral distribution. A high value indicates tonality. (Peeters, 2004, p. 20; Mathworks, 2021)

$$\text{crest} = \frac{\max\left(s_{k\in[b_1,b_2]}\right)}{\frac{1}{b_2 - b_1}\sum_{k=b_1}^{b_2} s_k}$$

Figure 27: Calculation of spectral crest / Source: MathWorks (2021) (2021)

3.2.4.6 ($S_{entropy}$)

Spectral entropy is a measure of the uniformity of a signal. (Dorochowicz & Kostke, 2018, p. 508) It is calculated from the probability mass function (PMF) of the spectrum (Eyben, 2016, p. 41)

$$\text{entropy} = \frac{-\sum_{k=b_1}^{b_2} s_k \log(s_k)}{\log(b_2 - b_1)}$$

Figure 28: : Calculation of the spectral entropy / Quelle: Mathworks (2021)

3.2.4.7 Spectral Flatness ($S_{flatness}$)

Similar to spectral entropy, spectral flatness measures the evenness of a spectrum. A uniformly distributed signal, that is, white noise, corresponds to maximum flatness. Tonal and harmonic spectra, by contrast, produce lower values because of their pronounced peaks and can therefore be distinguished from noise. (Sen, Dutta, & Dey, 2019, pp. 51-52; Mathworks, 2021)

$$\text{flatness} = \frac{\left(\prod_{k=b_1}^{b_2} s_k\right)^{\frac{1}{b_2 - b_1}}}{\frac{1}{b_2 - b_1}\sum_{k=b_1}^{b_2} s_k}$$

Figure 29: Calculation of spectral flatness / Source: MathWorks (2021)

3.2.4.8 Spectral Kurtosis ($S_{kurtosis}$)

Spectral kurtosis tests the degree to which a frequency distribution obtained through Fourier transformation corresponds to a Gaussian normal distribution. (Vrabie, Granjon, & Serviere, 2003; Dorochowicz & Kostke, 2018, pp. 507-508) Among other things, it is suitable for identifying relationships between frequency and

impulsiveness. In industry, spectral kurtosis is used, for example, to detect damage in machines that perform periodic movements. (Sawalhi, 2004)

$$\mu_4 = \frac{\sum_{k=b_1}^{b_2}(f_k - \mu_1)^4 s_k}{(\mu_2)^4 \sum_{k=b_1}^{b_2} s_k}$$

Figure 30: Calculation of spectral kurtosis / Source: MathWorks (2021)

3.2.4.9 Spectral Roll-Off-Point ($S_{rop(85)}$)

he spectral roll-off point is the frequency below which 85% of the signal's energy is located. (Dorochowicz & Kostke, 2018, p. 508) Alongside the spectral centroid, the roll-off point provides another reliable measure of energy distribution within a spectrum. Put simply, it therefore allows conclusions to be drawn about the overall pitch register of a sound (Sen, Dutta, & Dey, 2019, p. 48) For this purpose, an energy threshold *k* is defined, usually at 85% (Mathworks, 2021).

$$\text{Rolloff Point} = i \text{ such that } \sum_{k=b_1}^{i} |s_k| = \kappa \sum_{k=b_1}^{b_2} s_k$$

Figure 31: Calculation of the spectral roll-off point / Source: MathWorks (2021)

3.2.4.10 Spectral Skewness ($S_{skewness}$)

Spectral skewness is a measure of the symmetry of a spectrum around the median. It can be used, for example, to infer the distribution of overtones. A low value indicates a tendency toward low-frequency components, while a high value indicates a tendency toward high-frequency components. (Dorochowicz & Kostke, 2018, p. 507; Mathworks, 2021)

$$\mu_3 = \frac{\sum_{k=b_1}^{b_2}(f_k - \mu_1)^3 s_k}{(\mu_2)^3 \sum_{k=b_1}^{b_2} s_k}$$

Figure 32: Calculation of spectral skewness / Source: MathWorks (2021)

3.2.4.11 Spectral Slope (S_{slope})

Spectral slope describes the decline of energy toward higher frequencies. It is calculated from the spectrum by means of linear regression. (Peeters, 2004, p. 14) Among other things, spectral slope can provide information about the timbral character of noise. (Fastl & Zwicker, 2007, p. 125) It can also be used to analyze the dominance of partials within a complex tone. (Mathworks, 2021)

$$\text{slope} = \frac{\sum_{k=b_1}^{b_2}(f_k - \mu_f)(s_k - \mu_s)}{\sum_{k=b_1}^{b_2}(f_k - \mu_f)^2}$$

Figure 33: Calculation of spectral slope / Source: MathWorks (2021)

3.2.4.12 Spectral Spread ($S_{variance}$)

pectral spread is a measure of the distribution of spectral energy around the spectral centroid. It corresponds to the standard deviation around the spectral centroid. (Mathworks, 2021). It can be used, for example, to distinguish between periodic signals and noise. (Sen, Dutta, & Dey, 2019, p. 51)

$$\mu_2 = \sqrt{\frac{\sum_{k=b_1}^{b_2}(f_k - \mu_1)^2 s_k}{\sum_{k=b_1}^{b_2} s_k}}$$

Figure 34: Calculation of spectral spread / Source: MathWorks (2021)

3.2.6 Measures for Music and Human Perception

Systematic musicology has a considerable need for reliable and standardized measures for the analysis of sound. This applies in particular to measures capable of interpreting musical sounds in meaningful ways.

While the parameters of sharpness and booming discussed above evaluate the spectral composition of a sound in terms of unpleasantly high or low frequency components, both neglect questions of fine spectral structure: for example, whether the sound is tonal or noise-like, and what specific difference this makes to the listening experience. For the musical evaluation of sound, however, such aspects are essential.

Similarly, the measures of tonality proposed by Aures, Zwicker, and Sontacchi assume that noise can be more easily suppressed by the human brain than a tonal stimulus, and therefore treat tones and narrow-band noise as aesthetically equivalent (Sontacchi, 1998, p. 29) (Zwicker, 1991, pp. 94-95) (Vormann M. , 2011, p. 1). This assumption may well hold for noise control, but it is questionable when applied to the evaluation of musical pleasantness.

MIR features, by contrast, are often well suited to producing meaningful assessments of music. These assessments, however, remain abstract and are considerably more difficult to interpret. For musicology, it would therefore be desirable to have measures that are both musically meaningful and aligned with human perception.

3.3 Machine Learning

The term “machine learning” refers to modern approaches within the field of computer science often described as data science. Unlike conventional software, which dynamically executes a predefined set of rules, machine-learning approaches enable software to generate such rules itself on the basis of data sets. (Rebala, Ravi, & Churiwala, 2019, pp. 1-2)

Machine-learning procedures are commonly divided into three principal types of tasks:

- **Classification:**

  assigning data sets to predefined categories

- **Prediction / Regression:**

  predicting values on the basis of previously collected data and models

- **Clustering:**

  organizing data sets into clusters, where data sets within the same cluster share properties or exhibit similarity; the clusters themselves need not be known in advance (Rebala, Ravi, & Churiwala, 2019, p. 4).

Three phenomena are essential for machine learning:

- **Data:**

  Data are, by definition, indispensable to machine-learning procedures. Data sets may be generated either manually or automatically. Machine learning is especially well suited to very large quantities of data, including, for example, audio data and extracted audio features.

- **Models:**

  Models provide the mathematical framework for the learning task. They are generally based on human observations, although machine-learning procedures that generate models also exist.

- **Training:**

Training refers to the iterative process by which the model is adjusted so that the input contained in the training data is mapped as effectively as possible onto the corresponding output. Various training methods are distinguished in machine learning. For the purposes of this study, the two most common types are of particular importance:

- Supervised learning trains models using training sets that have previously been manually supplied with the expected output data, or labels. These data sets must be sufficiently large to produce significant results and must also cover the full relevant range of both input and output. Classification and regression tasks usually fall under supervised learning.

- Unsupervised learning does not rely on manually prepared data sets. It is generally an exploratory method used to identify hidden structures within data. Clustering tasks usually fall into this category. (Thomas, 2017, S. 4-5) (Rebala, Ravi, & Churiwala, 2019, S. 19-21)

A classification task using machine learning, for example, would derive from a data set with known category memberships a rule for assigning categories, which can then be used to predict the memberships of other data sets.

In this context, machine learning denotes the iterative approximation of an optimal solution. The regression procedures widely used in inferential statistics, and also employed in the present study, can likewise be understood as prediction by means of machine learning. In regression, known input variables are mapped onto known output variables with the smallest possible error by iteratively approximating the unknown coefficients of a predefined model. Once established, such models, including the coefficients calculated in this way, can then be used to generate predictions for other input data sets.

3.3.1 Neural Networks and Self-Organizing Maps

Artificial neural networks (ANNs) constitute a distinct group of applications within machine learning. The modelling approach used in ANNs imitates the human brain.

Mathematical nodes are understood as neurons and are represented by functions with one or more inputs and exactly one output. These functions are referred to as activation functions. The neurons are linked together across one or more layers.
The connections between neurons, in turn, are referred to as synapses and are assigned variable weights. By iteratively adjusting these synaptic weights, arbitrary functions can be represented in a manner analogous to regression analysis. (Rebala, Ravi, & Churiwala, 2019, pp. 103-105)
In supervised learning, neural networks offer the principal advantage of being able to compute complex models that would otherwise have to be calculated individually as compartmentalized regressions. In unsupervised learning, they expand the possibilities for uncovering hidden informational structures.
A self-organizing map (SOM), as developed by Kohonen, is a clustering technique based on a neural network and unsupervised learning.
„The SOM may be described formally as a nonlinear, ordered, smooth mapping of high-dimensional input data manifolds onto the elements of a regular, low-dimensional array.“ (Kohonen, 1997, p. 106)
An SOM performs a nonlinear reduction of dimensionality. This “elasticity” (Kohonen, 1997, p. 105) of the “nonlinear projection surface” (Kohonen, 1997, p. 119) generally allows for a more accurate representation than conventional principal component analysis (PCA).

Unlike other neural networks, an SOM imitates the brain’s tendency to organize similar neurons in spatial proximity within specialized cortices. In this way, it creates a topographic map of similarity (Rebala, Ravi, & Churiwala, 2019, p. 138)

.

4. Fatness as a Psychoacoustic Parameter

Building on the understanding of bass in modern popular dance music established through the cultural-historical considerations of Chapter 2, the present study aims to describe the higher-order principle underlying all sounds perceived as bass. To this end, a musical-psychoacoustic parameter of **fatness** was first designed, drawing on the procedure described by Aures. This was carried out in two stages of data collection.

The first stage of the investigation took the form of an online survey, which made it possible to reach a large number of participants. They were presented with eight test sounds and asked to evaluate them in several perceptual categories, one of which was fatness. The test sounds corresponded to typical bass sounds in modern popular dance music. As control sounds, a classical bowed double bass and a technoid but bass-light synthesizer lead sound were also included. On the basis of the data thus collected, fundamental relationships between the physical properties of the test sounds and their perceptual fatness could be defined.

In the second stage, a listening experiment was conducted under controlled conditions in the author's recording studio. Thirty-seven participants evaluated a large number of specially constructed, standardized test sounds, each three seconds in duration.

The two investigations discussed in this chapter thus serve as the basis for a simple psychoacoustic modelling of perceived fatness. Building on the insights gained in this way, a third survey was conducted in order to develop a model suitable for practical application. This is the subject of Chapter 5.

All three survey stages elicit judgments of fatness by means of Likert scales. From a conservative measurement-theoretical perspective, these data are ordinally scaled. In the social sciences and the humanities, however, it is common practice, under certain conditions, to treat such data as quasi-metric and therefore to analyze them methodologically as if they were interval-scaled. (Völkl & Korb, 2017, p. 20; Bortz & Schuster, 2010, pp. 22-23) In medicine, too, Likert scales are used in a quasi-metric manner when investigating perceptual responses to stimuli. Sullivan and Artino, for example, recommend a reflective case-by-case assessment that should be discussed in the analysis (Sullivan & Artine, 2013). The simulation study by Wu and Leung likewise suggests that, particularly for scales with a large number of response levels, the results correspond sufficiently well to the actual distribution. (Huiping & Leung, 2017) As Gaito already argued in 1980, the key criterion for the applicability of such methods is not the *modus operandi* of data collection, but the nature of the research object: that is, whether the variable being measured can be assumed to describe a metric phenomenon, and whether the underlying variable is therefore continuous. (Gaito, 1980) The recommended conditions for a quasi-metric analysis differ across the literature. Völkl and Korb state: "A prerequisite for interpretation as quasi-metric is that the variables have at least five levels and that the distances between the responses can be interpreted as equal in both semantic terms and through the assignment of numerical values" (Völkl & Korb, 2017, p. 20) Bortz, by contrast, points to the possibility of assuming that, if a substantive hypothesis can be empirically confirmed, this may at the same time serve as evidence for the correctness of the scale-theoretical assumption, without explicitly endorsing either a conservative or a liberal reading. He also emphasizes, however, the importance of reflection in both measurement and analysis. (Bortz & Schuster, 2010, p. 23) Leung's comparison of Likert scales with different numbers of response levels suggests that eleven-point Likert scales are best suited to quasi-metric treatment. Although central values such as "arithmetic mean, standard deviation, and correlations between items" do not differ from those obtained with five- or seven-point scales, this form of measurement reduces the skewness of the distribution and thus produces results that more closely approximate a normal distribution. (Leung, 2011) This, in turn, corresponds to Hodge and Gillespie's assumption that the endpoints 0

and 10 are best suited to encouraging participants to understand and use rating scales in a quasi-metric manner. Zero most clearly represents the absence of an effect, while 10 represents its maximum. (Hodge & Gillespie, 2008, p. 3)

For the present study, this means that:

1. ll surveys of sound properties that use rating scales are designed in a way that supports the validity of quasi-metric analysis:
    a. the first stage of data collection uses a seven-point scale from 1 to 7;
    b. the second and third stages use an eleven-point scale from 0 to 10;
    c. n the preliminary briefing, all participants in stages 2 and 3 were instructed to understand the survey as metrically as possible;
    d. in all instructions, only the endpoints of the scales were labelled, while intermediate steps were deliberately left undesignated.
2. Wherever non-parametric methods are applicable, they are given preference.
3. Where this is not possible, the data are treated as quasi-metric; this procedure is explicitly identified and discussed.

4.1 Exploratory Online Survey

In the first stage of my investigation, 124 participants were surveyed online on eight typical test sounds. The aim of this stage was to identify factors that influence the perception of fatness. In addition to perceived fatness and an inventory for the verbal description of timbres (Stepánek, 2006, p. 125) , age and gender were recorded, along with several items concerning musical taste and club-going behaviour. A further item asked participants to indicate their preferred frequency band in the acoustics of discotheques.

4.1.1 Experimental Procedure

The online survey was first conducted in December 2017 with 41 participants. In order to increase the statistical significance of the calculations, a further 83 responses were recruited in March 2018. The survey was administered via the platform SoSciSurvey.de.

4.1.2 Test Sounds in Typical Playing Styles

he test sounds were taken from commercially available sample libraries for music production and selected so that each combined a typical sound with a playing style characteristic of that sound. Although this reduces comparability between the individual stimuli, it increases their explanatory value, since there is no single playing style that would have made musical sense for every timbre. It is not possible, for example, to reproduce the modulations of a complex *Dubstep* synthesizer on a double bass.

The test sounds were as follows:

1) an electrically amplified bass guitar playing a typical *Soul* and *Funk* bass line;
2) a pulse-wave synthesizer playing a lead figure typical of *Techno* and *House*;
3) a sine-wave sub-bass playing an Afro-Caribbean bass line;
4) a plucked double bass playing a walking bass figure;
5) an overtone-rich *Dubstep* bass with complex modulations;
6) a percussive sine-wave sub-bass of constant pitch, in the style of the Roland TR-808 kick drum;
7) a bowed double bass;

8) a square-wave synthesizer bass typical of *House*.

4.1.3 Demographics

Participants were recruited through German Facebook groups concerned with contemporary popular dance music. Consumers of specific styles were deliberately addressed in order to obtain responses that were as style-independent as possible. Given the type of stimuli selected, it was especially important to minimize stylistic pre-judgement. Participants were able to name up to three preferred styles for club visits.

	n/124
Tropical	59
Hip Hop	43
Techno	32
Elektro	27
Drum & Bass	24
Dubstep & Trap	24
House	21

Table 2: Participants' Stylistic Preferences for Attending Dance Events

The overrepresentation of *Tropical* scene participants is presumably attributable to the greater willingness to participate within the author's own social and professional environment. The participants comprised 26.6% women and 66.1% men; 7.2% identified as diverse or preferred not to provide this information. Participants ranged in age from 20 to 63 years, with an arithmetic mean of 33.95 years.

4.1.4 Results

4.1.4.1 Preference for Bass

Participants were asked to rate the lows, mids, and highs on a seven-point scale according to their subjective preference in the club context. The results confirmed the assumption that the bass range is of particular importance in this setting. A Kruskal–Wallis test showed significantly different distributions across all three frequency ranges, with $p < .001$. Using a dichotomous coding with bass = 0 and both mids and highs = 1, a Wilcoxon rank-sum test likewise confirmed, again with $p < .001$, that bass differs significantly from the other two frequency ranges. When the three ascending frequency ranges are instead coded as ordinal, a rank correlation quantifies the strength of the relationship as $\rho = .405$, with $p < .001$, indicating a clear preference for lower frequency ranges in the club context.

	Median	Mean	SD
Lows	7	6,30	1,140
Mids	5	5,23	1,255
Highs	5	4,99	1,434

Table 3: Preference for Specific Frequency Ranges in the Club Context

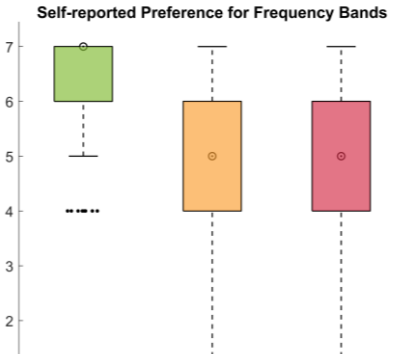


Figure 35: Preference for Frequency Ranges

Both the rating of the low-frequency range and the degree of agreement in this rating clearly exceed those for the mid and high frequency ranges. A test for correlations with dichotomously coded stylistic preferences, age, and gender reveals no strong or significant relationships. The exception is followers of the *Techno* scene, who show an even stronger affinity for the bass range, with a Spearman correlation of 0.257 and a significance level of $p = .004$. Frequency of club attendance also correlates with bass affinity. This effect has a strength of $\rho = .293$ and is highly significant ($p < .001$).

It may therefore be assumed that, across scene, age, and gender boundaries, the bass range holds a particularly prominent status among club-goers.

4.1.4.2 Analysis of the Stimuli

Starting from Sottek's model of hearing, the stimuli were first processed in MATLAB in such a way that loudness was represented linearly according to critical bandwidth. To this end, a filter bank consisting of 24 Chebyshev band-pass filters was created, corresponding to the critical bands of Sottek's auditory model.

.

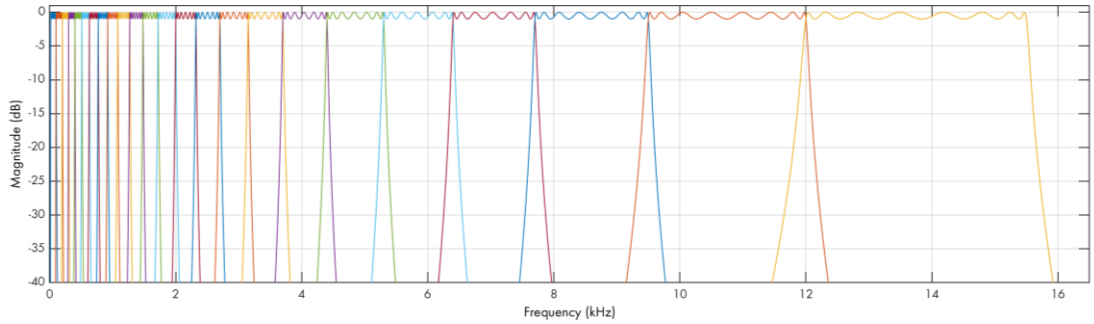


Figure 36: Bark-scale-compliant filter bank, logarithmic representation

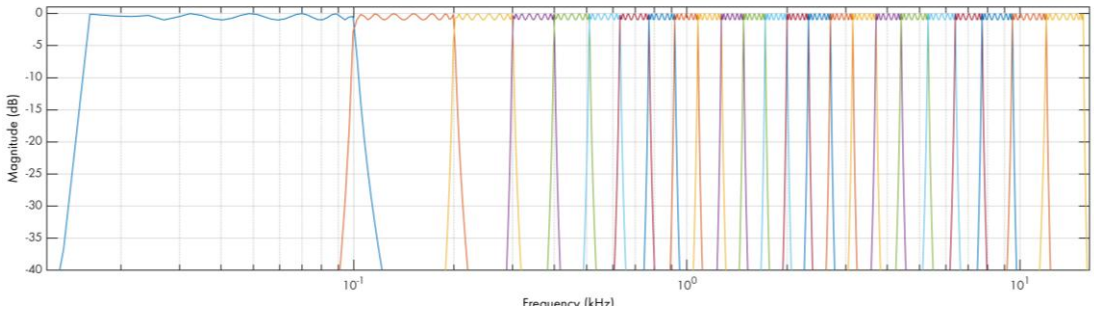


Figure 37: Bark-scale-compliant filter bank, linear representation

For each critical band, the integrated level in dB was measured and converted into a linear quantity using the db2mag command. These values could then be correlated with the fatness ratings of the stimuli.

Sound Stimulus	Median	Fatness		Treble Emphasis		Bassness		Refinement		Fullness		Clarity		Pleasantness	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Electric Bass	5	5,11	1,264	2,17	1,077	6,18	1,044	5,11	1,264	5,61	1,087	3,98	1,562	5,98	1,032
Double Bass, Bowed	5	4,66	1,266	3,28	1,29	4,51	1,416	3,75	1,365	5,37	1,269	4,13	1,547	4,59	1,599
Double Bass, Plucked	4	4,45	1,41	2,98	1,097	5,41	1,379	3,77	1,53	4,75	1,429	3,88	1,458	4,78	1,545
Sine-Wave Sub-Bass, Melody	5	5,18	1,403	1,73	1,049	6,19	1,102	2,77	1,161	5,52	1,417	2,28	1,335	4,65	1,385
Sine-Wave Sub-Bass, Percus-sion	6	5,62	1,647	1,41	0,857	6,46	1,269	2,13	1,312	5,69	1,68	1,8	1,173	4,37	1,798
Dubstep	4	3,94	1,722	4,77	1,592	3,66	1,606	2,96	1,611	4,56	1,756	4,65	1,63	2,2	1,431
Pulse Wave	3	2,89	1,536	6,02	0,962	2,16	1,183	3,61	1,497	3,3	1,578	5,16	1,308	2,31	1,281
Square Wave	5	3,88	1,245	4,54	1,118	3,67	1,429	4,37	1,183	4,23	1,317	4,86	1,301	4,47	1,244

Table 4: Perceptual Evaluation of the Test Sounds in the Online Survey

Since an analysis of the medians is of only limited value here due to the low resolution of the scale, and since the conditions for treating the perceptual measures as metric are fulfilled, the arithmetic means are considered at this point. The assumption made here - that the underlying variables are metric in nature - appears plausible not least because the medians correspond to the rounded arithmetic means.

4.1.4.3 Analysis of Fatness and Other Timbre Impressions

When examining the correlations between timbre impressions and critical bands, a large number of significant relationships becomes apparent. As expected, there is a positive relationship between the height of the critical band and treble emphasis, as well as a negative relationship between the height of the critical band and the bassness of the test sounds.

It is also noteworthy that fatness and bassness follow a similar trajectory, yet are not identical. The two parameters correlate highly significantly, but only with a Spearman correlation strength of 0.619.

		Spectral Centroid	Treble Emphasis	Bassness	Refinement	Fullness	Clarity	Pleasantness
Fatness	ρ	-0,411	-0,518	0,619	-0,069	0,643	-0,189	0,513
	p	<0,001	<0,001	<0,001	0,030	<0,001	<0,001	<0,001

Table 5: Online Survey: Correlates of Fatness with Other Parameters

Particular attention is, of course, due to fatness. It correlates with the two lowest critical bands at ρ = .357 for Bark 1 and ρ = .280 for Bark 2, with $p < .001$ in both cases. For critical bands 3 through 24, however, the correlations tend to become increasingly negative (see Table 6).

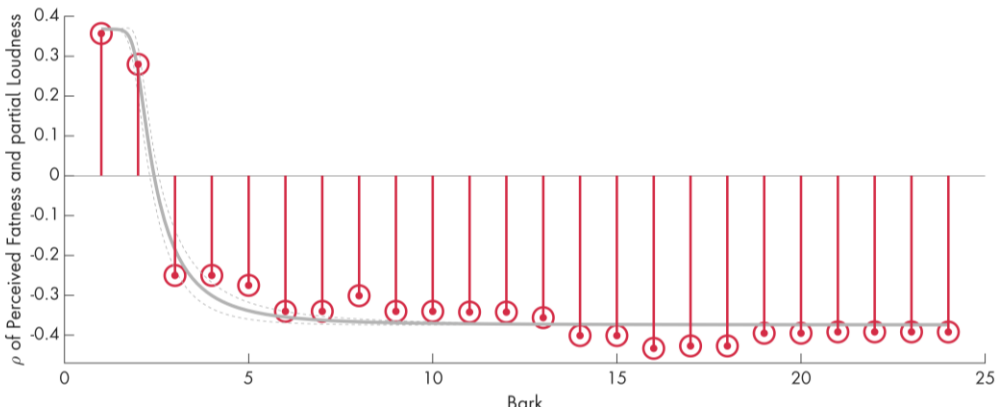


Figure 38: Rank-correlation strength of the parameter fatness by critical band, with regression line

It may therefore be assumed that fatness, like the parameters of sharpness and booming (Shin, Ih, Hashimoto, & Hatano, 2009, pp. 309-311) , depends on the partial loudness of the respective critical bands. Unlike these parameters, however, the fatness of a sound appears to depend on additional factors, since a simple linear model calculated in SPSS using the critical bands alone can explain only 24% of the variance in fatness. As expected, then, fatness shows a moderately strong negative correlation with high-frequency emphasis and a positive correlation with bassness. It also correlates, as

anticipated, with the spectral centroid. Yet the relatively modest strength of this relationship, at only $\rho = -.411$, once again underlines that frequency alone is insufficient for assessing fatness. The correlations with clarity, fineness, and pleasantness are highly significant, but too weak to warrant further consideration. The comparatively strong relationship with the parameter fullness, however, is of particular interest.

	FATNESS		TREBLE-EMPHASIS		CLARITY		TONALITY		FULLNESS	
BARK	ρ	p	ρ	p	ρ	p	ρ	p	ρ	p
1	0,357	<0,001	-0,503	<0,001	-0,442	<0,001	-0,257	<0,001	0,358	<0,001
2	0,280	<0,001	-0,411	<0,001	-0,152	<0,001	0,212	<0,001	0,338	<0,001
3	-0,250	<0,001	0,378	<0,001	0,281	<0,001	-0,085	0,008	-0,207	<0,001
4	-0,25	<0,001	0,449	<0,001	0,308	<0,001	-0,101	0,002	-0,257	<0,001
5	-0,275	<0,001	0,421	<0,001	0,243	<0,001	-0,166	<0,001	-0,249	<0,001
6	-0,340	<0,001	0,536	<0,001	0,387	<0,001	-0,082	<0,001	-0,304	<0,001
7	-0,340	<0,001	0,582	<0,001	0,410	<0,001	-0,166	<0,001	-0,307	<0,001
8	-0,301	<0,001	0,513	<0,001	0,410	<0,001	-0,123	<0,001	-0,244	<0,001
9	-0,340	<0,001	0,536	<0,001	0,387	<0,001	-0,082	0,01	-0,304	<0,001
10	-0,340	<0,001	0,582	<0,001	0,41	<0,001	-0,166	<0,001	-0,307	<0,001
11	-0,342	<0,001	0,000	<0,001	0,438	<0,001	-0,048	0,131	-0,302	<0,001
12	-0,342	<0,001	0,552	<0,001	0,438	<0,001	-0,048	0,131	-0,302	<0,001
13	-0,356	<0,001	0,598	<0,001	0,462	<0,001	-0,132	<0,001	-0,305	<0,001
14	-0,401	<0,001	0,675	<0,001	0,501	<0,001	-0,183	<0,001	-0,345	<0,001
15	-0,401	<0,001	0,675	<0,001	0,501	<0,001	-0,183	<0,001	-0,345	<0,001
16	-0,433	<0,001	0,705	<0,001	0,517	<0,001	-0,183	<0,001	-0,345	<0,001
17	-0,427	<0,001	0,703	<0,001	0,513	<0,001	-0,183	<0,001	-0,381	<0,001
18	-0,427	<0,001	0,703	<0,001	0,513	<0,001	-0,166	<0,001	-0,381	<0,001
19	-0,395	<0,001	0,673	<0,001	0,497	<0,001	-0,2	<0,001	-0,343	<0,001
20	-0,395	<0,001	0,673	<0,001	0,497	<0,001	-0,2	<0,001	-0,343	<0,001
21	-0,392	<0,001	0,663	<0,001	0,447	<0,001	-0,254	<0,001	-0,346	<0,001
22	-0,392	<0,001	0,663	<0,001	0,447	<0,001	-0,254	<0,001	-0,346	<0,001
23	-0,392	<0,001	0,663	<0,001	0,447	<0,001	-0,254	<0,001	-0,346	<0,001
24	-0,392	<0,001	0,663	<0,001	0,447	<0,001	-0,254	<0,001	-0,346	<0,001

Table 6: Spearman Rank-Correlation Coefficients of Timbre Properties and Critical Bands from the Online Survey

4.1.4.4 Note on the Comparability of Listening Conditions

The online survey conducted as part of this stage must be understood as purely exploratory preliminary work. As already noted, the comparability of the test sounds cannot necessarily be assumed; the same applies to the conditions under which the individual participants completed the survey on their respective playback systems. As Table 7 shows, participants took part under highly varied listening conditions. A relationship between playback situation and fatness ratings could be demonstrated using Cramer's V. Although the effect size is only 0.127, the approximate significance is below .001. A similarly small but likewise highly significant relationship exists between fatness ratings and participants' self-assessed quality of their audio system. Here, Spearman's correlation coefficient is 0.129, again with $p < .001$. This suggests that playback systems with only small diaphragms, or of low overall quality, often do not reproduce the bass range linearly, or exhibit a response curve that falls below an aurally appropriate curve particularly at low frequencies. The results of this stage should therefore be treated only as exploratory indications for the design of a psychoacoustic parameter of fatness.

	n	%		n	%
Headphones	66	53,6	Earbuds	3	2,4
			In-ear headphones	25	20,3
			Open-back headphones	14	11,4
			Closed-back headphones	24	19,5
Loudspeakers	55	44,7	Multimedia loudspeakers	39	31,7
			Hi-fi loudspeakers	13	10,6
			Studio monitors	3	2,4
			No response	2	1,6
			Total	123	100

Table 7: Online Survey: Overview of Listening Conditions

4.2 Listening Test

A second stage of the investigation served to move beyond the exploratory phase and to achieve greater comparability and a more targeted selection of stimuli. The aim was ultimately to develop weighting functions for the partial loudness of each critical band, while also examining the role of tonality and any further possible influences. The relationships between the individual factors and measured fatness were to be determined by means of regression.

4.2.1 Experimental Design

4.2.1.1 Construction of the Stimuli

For a further listening test under controlled conditions, 72 stimuli were constructed using subtractive synthesis. This was done with the synthesizer plug-in Carbon Electra 1.5 r45 in the DAW Steinberg Cubase Artist 9. Unlike in the first stage of the investigation, no "played" phrases were used; instead, all stimuli consisted exclusively of single tones with a duration of three seconds. The individual stimuli were normalized to –10 dB using the metanormalize function in Steinberg WaveLab and presented to the participants at 80 dB©. Playback was carried out through Event TR88 XL studio monitors with an extended linear bass response.

The stimuli differed in waveform, fundamental pitch, number and octave of oscillators, filtering, and the addition of high- and low-frequency noise. They can be divided into six groups of twelve sounds each.

Whereas sine waves contain no overtones, sawtooth waves exhibit a complete harmonic spectrum. Different mixtures of these waveforms therefore make it possible to construct sounds that are, in specific ways, particularly poor or particularly rich in overtones.

The pitches A and C were chosen as fundamentals in order to examine, even within the lowest critical band, whether frequency position within the band has an effect beyond the resolution of the critical bandwidths themselves. The lowest pitch, C1, has a frequency of 32.7 Hz and thus represents the lowest tone that the experimental loudspeakers can reproduce accurately. The pitch A1 (55 Hz) was chosen to ensure

distribution across the octave and, where necessary, to allow comparability with other studies, since octaves of concert A are used with particular frequency and have integer frequency values.

Low-pass filtering was carried out using the filter section of the Carbon Electra synthesizer. The cut-off frequency was 1 kHz, with a slope of 12 dB per octave. Filtering was applied only to those stimuli that used a sawtooth waveform. The reason for this was to allow a clearer differentiation of the extent to which timbral components in the higher critical bands influence perception in comparison with the considerably louder harmonic overtones at lower frequencies. In sounds that also contained a noise component, this filtering could, for technical reasons, be applied only to the tonal component rather than to the entire stimulus.

In order to examine the role of tonality in the formation of a perception of fatness, each group contained four sounds to which noise was added. In each group, two of these sounds contained high-frequency noise. For this purpose, a band-pass filter with cutoff frequencies of 770 Hz and 9500 Hz and a slope of 24 dB per octave was applied to 1/f noise. This corresponds to the range from 7 to 22 on the bark scale. Critical bands 23 and 24 were omitted, since otherwise the listening experience would have become too unpleasant for the participants.

In each group, a further two sounds were underlaid with low-frequency noise. For this purpose, a low-pass filter with a cutoff frequency of 770 Hz and a slope of 24 dB per octave was selected. This corresponds to critical bands 1 to 6.

4.2.1.3 Experimental Setup

In contrast to the online survey, the second stage of the investigation placed considerable emphasis on maintaining constant acoustic test conditions.

For this reason, all participants in the main part of the study completed the survey in the same recording studio and under identical conditions. During the experiment, participants sat in an armchair at a distance of 1.5 metres from the two stereo loudspeakers. The survey was automated by means of a MATLAB script. The 72 stimuli were presented to the participants in randomized order and were rated for fatness on a seven-point Likert scale using a wireless keyboard.

4.2.2 Conduct of the Listening Test

4.2.2.1 Pretest

Ten participants took part in the pretest in December 2018. Their ages ranged from 27 to 41 years; two were female and eight male. All participants either worked in nightlife themselves or frequently went dancing in discotheques. The pretest revealed the following problems::

4.2.2.2 The Problem of Significance in Regressions with Many Variables

In the linear regression based on the partial loudness values for each critical band, and without taking the noise component into account (see below), the explained variance of 39% is insufficient (see Table 8). Although the overall model is highly significant, the significance values for a large number of parameters are unsatisfactory (see Table 9). This is presumably due to the large number of factors introduced when all 24 critical bands are included. It therefore seems advisable to reduce the number of variables.

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	,644[a]	0,415	0,390	1,270

Table 8: Model Summary of the Linear Regression

Modell	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	T	Sig.
Constant	3,365	0,337		9,999	0,000
Bark 1	5,220	1,013	0,250	5,153	0,000
Bark 2	1,860	0,950	0,082	1,958	0,051
Bark 3	-3,023	1,017	-0,134	-2,972	0,003
Bark 4	-5,642	6,335	-0,089	-0,891	0,374
Bark 5	-3,754	1,286	-0,128	-2,920	0,004
Bark 6	-9,652	5,552	-0,173	-1,738	0,083
Bark 7	-2,063	11,035	-0,026	-0,187	0,852
Bark 8	-4,647	8,057	-0,076	-0,577	0,564
Bark 9	22,833	19,379	0,188	1,178	0,239
Bark 10	15,533	13,433	0,133	1,156	0,248
Bark 11	-3,692	13,467	-0,041	-0,274	0,784
Bark 12	-14,171	24,642	-0,106	-0,575	0,565
Bark 13	-0,945	22,003	-0,009	-0,043	0,966
Bark 14	-5,331	38,407	-0,042	-0,139	0,890
Bark 15	-19,061	41,833	-0,158	-0,456	0,649
Bark 16	27,067	75,873	0,212	0,357	0,721
Bark 17	-67,300	51,982	-0,463	-1,295	0,196
Bark 18	49,886	68,174	0,355	0,732	0,465
Bark 19	40,556	94,485	0,286	0,429	0,668
Bark 20	152,473	136,540	0,859	1,117	0,265
Bark 21	-53,471	186,734	-0,280	-0,286	0,775
Bark 22	-355,427	408,734	-1,667	-0,870	0,385
Bark 23	-194,575	360,234	-0,773	-0,540	0,589
Bark 24	461,672	694,190	1,373	0,665	0,506

Table 9: Pretest: Coefficients of the Linear Regression

As already observed in the online survey, the pretest also revealed a relationship between critical bands and correlation strength (siehe Figure 39).

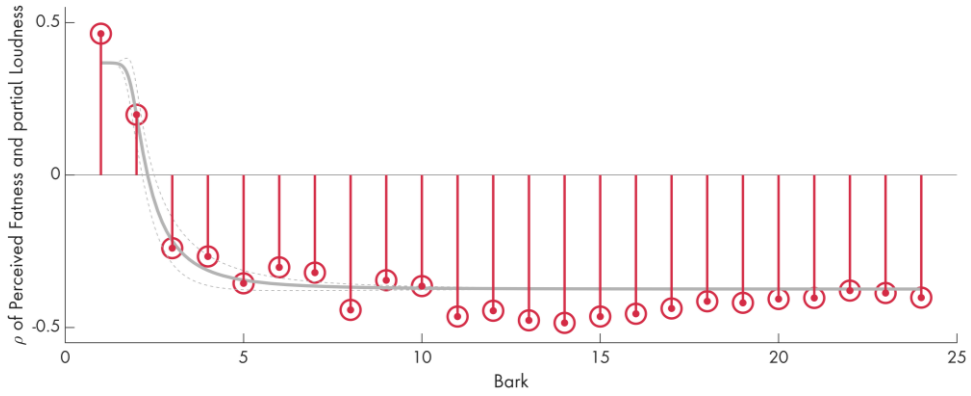


Figure 39: Correlation strength of the parameter fatness by critical band, with regression line)

In order to reduce the number of variables, it therefore seems advisable not to evaluate all critical bands of the bark scale individually, but instead to aggregate critical bands 1 and 2 on the one hand and critical bands 3 to 24 on the other, supplementing these aggregated groups, where appropriate, with their respective spectral centroid.

4.2.2.3 The Problem of Determining a Musically Robust Measure of the Relationship between Tonal Components and Noise

The effect of the noise component on the perceived fatness of a sound was to be examined using MathWorks MATLAB and IBM SPSS. During the analysis, however, it became apparent that the algorithm used by MATLAB for the signal-to-noise ratio did not produce results that could be interpreted meaningfully. Purely quasi-periodic sounds were often interpreted as strongly noise-like, especially when they were rich in overtones. This may be due to the short duration of the test sounds, as well as to the algorithm's orientation toward noise-control applications.

It was considered whether a dedicated algorithm should be programmed, for example according to DIN 45681:2005-03 (DIN 45681, 2005) or following the procedure proposed by M. Vormann (Vormann, Schick, Meis, Klatte, & Mellert, 1998) (Vormann, M., Verhey, Mellert, & Schick, 2000) zu programmieren. Both algorithms, however, likewise originate in the field of noise control, so that the uncertainty regarding their

effectiveness in the present musical context seemed disproportionate to the effort required.

The pretest data show that the presence of noise is relevant to fatness in Bark bands 1 and 2, but not in the bands above them. An analysis of covariance by means of a *t*-test shows no significant difference in variance between sounds with a high-frequency noise component and those without a noise component in explaining fatness. A correlation calculated using Cramer's V likewise yields only a slight, non-significant relationship between strong noise and measured fatness. Since the cumulative partial loudness values of Bark bands 3–24, however, are correlated with fatness at a strength of .428 and are significant at the 0.1% level, it may be assumed that loudness in these bands generally has a negative effect on fatness, regardless of how much tonal or non-tonal material is present in each case.

In order to examine the influence of noise in critical bands 1 and 2, and to keep the number of variables in the regression analysis low, additional test sounds were constructed. These had a fixed ratio of noise to quasi-periodic sound, determined on the basis of loudness in LUFS.

4.2.2.4 Revised Test Design

Because of the problems described in §§3.4.3.1 and 3.4.3.2, the experimental design was adjusted, above all through the modification and expansion of the test sounds. All sounds containing noise were removed from the existing blocks. Instead, five new blocks were constructed, combining different test sounds made from sine and sawtooth waves with noise. Each of these blocks contains eleven stimuli and is structured as follows:

	Low Pass-Filter 200Hz	
	24 dB/octave	48 dB/octave
Tonal sounds per type (1–5)	1	
	0,88	0,88

	0,8	0,8
	0,66	0,66
	0,5	0,5
	0,3	0,3

Table 10: Revised Block Construction for Assessing the Signal-to-Noise Ratio

Each block is based on a tonal test sound that was mixed with noise in fixed loudness ratios. This constructed signal-to-noise ratio is expressed as a value between 0 and 1. A value of 0 denotes pure noise, a value of 1 denotes a purely tonal sound, and a value of 0.5 indicates that noise and tone are equally loud. Loudness was measured in dB LUFS.

The noise used here is low-pass-filtered 1/f noise. The cut-off frequency is 200 Hz, meaning that the noise occurs only in the two lowest critical bands. For each noise-ratio value except 1, that is, the purely tonal condition, two variants were used: one with a filter slope of 24 dB/octave and one with a slope of 48 dB/octave (see Table 10) In addition, two further blocks were added:

1. Five sine-wave sounds differing only in their fundamental frequency, in order to examine the spectral centroid of the two lowest critical bands.
2. Six complex, high-frequency, overtone-rich control sounds entirely devoid of bass character.

The listening test was therefore conducted with 110 test sounds. For each of these test sounds, the following variables were measured technically:

1) partial loudness below 200 Hz, in LUFS;
2) partial loudness above 200 Hz, in LUFS;
3) spectral centroid below 200 Hz;
4) spectral centroid above 200 Hz.

The variable describing the tone-to-noise ratio was defined as described in §3.4.3.2, while the variable of perceptual acoustic fatness was obtained through a survey of 37 participants.

4.2.3 Hypothesen

The perceptual acoustic fatness of sounds of equal loudness can be expressed as a function of the summed partial loudness values of Bark bands 1 and 2 and of Bark bands 3 to 24, the spectral centroid of Bark bands 1 and 2 and of Bark bands 3 to 24, and the ratio of noise to tonal components within the sound. This function is to be determined by means of multivariate regression. Für die Koeffizienten $\beta_{0,}$ $\beta_{Loudness\ <200Hz}$, $\beta_{Loudness>200Hz}$, $\beta_{Centroid<200Hz}$, $\beta_{Centroid>200Hz}$ sowie β_{SNR} gilt also:

H_o :

$$\beta_0 = \beta_{Loudness<200Hz} = \beta_{Loudness>200Hz} = \beta_{Centroid<200Hz} = \beta_{Centroid>200Hz} = \beta_{SNR} = 0$$

H_1 :

$$\beta_0 \neq 0 \vee \beta_{Loudness<200Hz} \neq 0 \vee \beta_{Loudness>200Hz} \neq 0 \vee \beta_{Centroid<200Hz} \neq 0 \vee \beta_{Centroid>200Hz} \neq 0 \vee \beta_{SNR} \neq 0$$

4.3 Linear Model

A linear regression calculated in SPSS with the data described above yields the following model:

Model Summary[b,c]

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate	Durbin–Watson Statistic
1	,773[a]	0,597	0,597	1,828	1,523

a. Predictors: constant, SNR, dBLoudHigh, dBLoudLow, ZenLow

b. Dependent variable: Fatness

c. Weighted least-squares regression, weighted by Weight

Table 11: Model Summary: Linear Regression

Samples 52–56 were weighted more heavily in order to ensure a better representation of the spectral centroid. This sample group consists of pure sine tones that differ only in pitch and was weighted by a factor of 3.

Initial calculations showed that, although the influence of the spectral centroid of the higher critical bands on fatness is highly significant, its effect size is so small - on the order of 10^{-18} - that this variable was removed from the final linear model.

Der korrigierte R-Quadrat-Wert jenes Modells liegt mit 0,597 im guten, akzeptablen Bereich für ein kulturpsychologisches Modell.

The adjusted R-square value of this model, at 0.597, lies within a good and acceptable range for a cultural-psychological model. The Durbin–Watson value of 1.523 falls just within the acceptable range and suggests a low, though not entirely negligible, degree of autocorrelation.

ANOVA[a,b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	20147,257	4	5036,814	1508,079	,000[c]
	Unstandardized Residuals	13576,639	4065	3,340		
	Total	33723,896	4069			

a. Dependent variable: Fatness
b. Weighted least-squares regression, weighted by Weight
c. Predictors: constant, SNR, dBLoudHigh, dBLoudLow, ZenLow

Table 12: Analysis of Variance of the Linear Regression

An analysis of variance for the model (see Table 12) confirms that the overall model is significant at $p < .001$.

	Unstandardized Coefficients		Standardized Coefficients		
	Coefficient	Std. Error	Beta	T	Sig.
β_0	1,743	0,128		13,617	0,000
$\beta_{Centroid<200Hz}$	-0,013	0,001	-0,135	-10,468	0,000
$\beta_{Loudness<200Hz}$	0,080	0,002	0,394	34,279	0,000
$\beta_{Loudness>200Hz}$	-0,041	0,002	-0,235	-21,421	0,000
β_{SNR}	5,923	0,106	0,616	55,795	0,000

Table 13: Coefficients of the Linear Regression

The individual coefficients of the model are likewise significant at $p < .001$ throughout. None of the confidence intervals includes zero; it can therefore be assumed that each included coefficient makes a meaningful contribution to the model.

As Table 14 shows, there is no multicollinearity among the variables.

		Collinearity Statistics	
Modell		Tolerance	VIF
1	**CenLow**	0,600	1,667
	dBLoudLow	0,751	1,332
	dBLoudHigh	0,826	1,211
	SNR	0,812	1,232

Table 14: Variance Inflation Factors

Problematic aspects of the model concern the normal distribution of the dependent and independent variables, as well as the heteroscedasticity of the data. Both the Kolmogorov–Smirnov test and the Shapiro–Wilk test are significant for all variables. The

factors are therefore not normally distributed. Given the large number of 4,070 measurements, however, it may nevertheless be assumed that the regression procedure is sufficiently robust and can be applied successfully.

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
ZenLow	,095	4070	,000	,838	4070	,000
ZenHigh	,245	4070	,000	,644	4070	,000
dBLoudLow	,334	4070	,000	,420	4070	,000
dBLoudHigh	,252	4070	,000	,818	4070	,000
SNR	,319	4070	,000	,700	4070	,000

Table 15: Prüfung der Normalverteilung

The problems of normality and heteroscedasticity, as well as the possible issue of autocorrelation, can be addressed by means of bootstrapping. In this case, BCa bootstrapping with 10^6iterations was performed. Given the large number of data points and iterations, the regression can therefore be regarded as robust, with reliable confidence intervals. It may thus be assumed that none of the coefficients is equal to zero. The model is therefore significant, and the null hypothesis can be rejected.Die lineare The linear formula for the perceptual fatness of sounds of equal loudness is thus:

$$Fatness\ (in\ liph) = 1{,}743 + 0{,}080\ Loudness_{<200Hz} - 0{,}041\ Loudness_{>200Hz} + 5{,}923\ SNR$$

For the unit of perceptual fatness, the author proposes the term **“liph.”** It is derived from the Greek λίπος (*lípos*), meaning “fat,” and φωνή (*phoné*), meaning “sound” or “voice.” Perceptual fatness may therefore also be described as **lipophony**, with **liph** serving as the abbreviated unit.

4.4 Analysis of Contributing Factors

For the purposes of a more precise model, it is useful to question the linearity of the relationships and to perform a non-linear multivariate regression. The central issue here is whether a better explanation of variance can be achieved statistically in this way..

		Spectral Centroid < 200 Hz	Loudness (LUFS) < 200 Hz	Loudness (LUFS) > 200 Hz	SNR
Fatness	Spearman Correlation	-0.88	0.399	-0.385	.395
	Significance (two-tailed)	<0.001	<0.001	<0.001	<0.001

Table 16: Correlates of Fatness

Because of the large number of measurements (n = 4,070), all relationships are highly significant. The strong correlation between noise behaviour and perceptual fatness is particularly noteworthy, as it once again confirms the assumption concerning tonality.

4.4.1 Loudness > 200 Hz

In order to obtain a broader dispersion of values, the analysis of loudness in Bark bands 1 and 2 is best based on the dB LUFS values after conversion back to a linear scale.

The highest R^2 value is achieved by a cubic regression, at 0.322. Higher-order functions tend to produce overfitting, particularly in the gaps within the value continuum. The difference between the linear and quadratic models is minimal: a quadratic function yields an R^2 of 0.232, while a linear function reaches 0.231. All three regressions are reported as highly significant, although without bootstrapping not all Gauss–Markov assumptions are fulfilled. A significant influence of the respective variable has, however, already been demonstrated in §3.5. For the non-linear modelling, it therefore seems appropriate to consider a cubic relationship between loudness < 200 Hz and fatness.

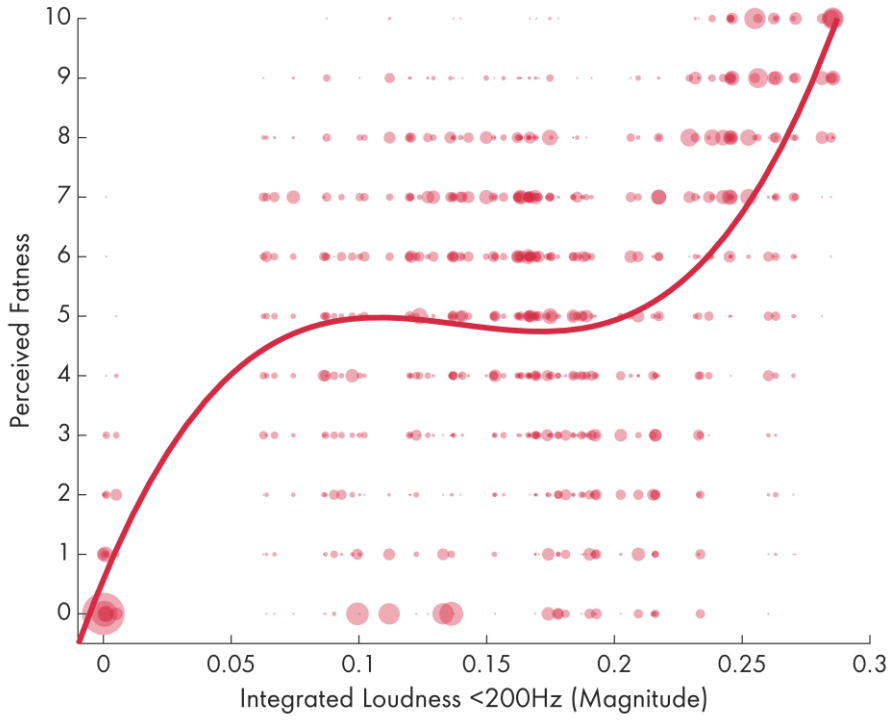


Figure 40: Regression Curve: Loudness < 200 Hz

4.4.2 Loudness >200Hz

For loudness in critical bands 3–24, too, there is no substantial difference between a quadratic function ($R^2 = .167$) and a linear function ($R^2 = .160$). For the purposes of modelling, however, a quadratic relationship is preferable.

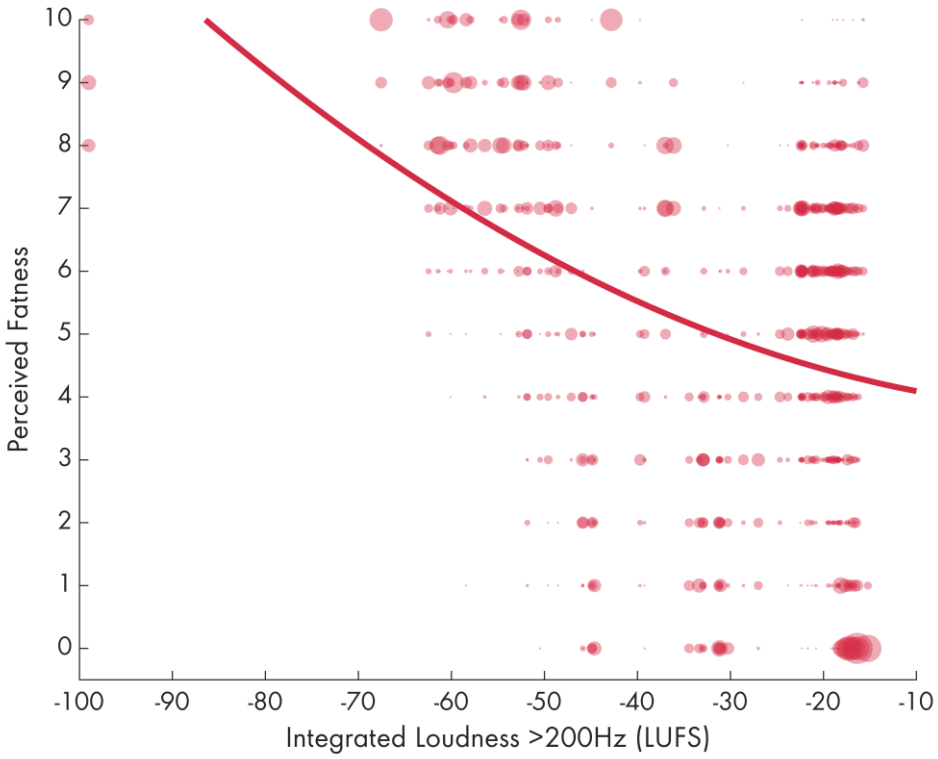


Figure 41: Regression Curve: Loudness > 200 Hz

4.4.3 Spectral Centroid < 200 Hz

The regression of the spectral centroid in the low critical bands suggests a negative quadratic relationship ($R^2 = 0.0851$). A cubic model offers no gain in explained variance, while a linear model leads to a substantial loss. The vertex of the curve indicates an optimum of fatness for the spectral centroid at 77.78 Hz. This corresponds exactly to the pitch D♯2. For the purposes of modelling, a quadratic relationship is therefore preferable.

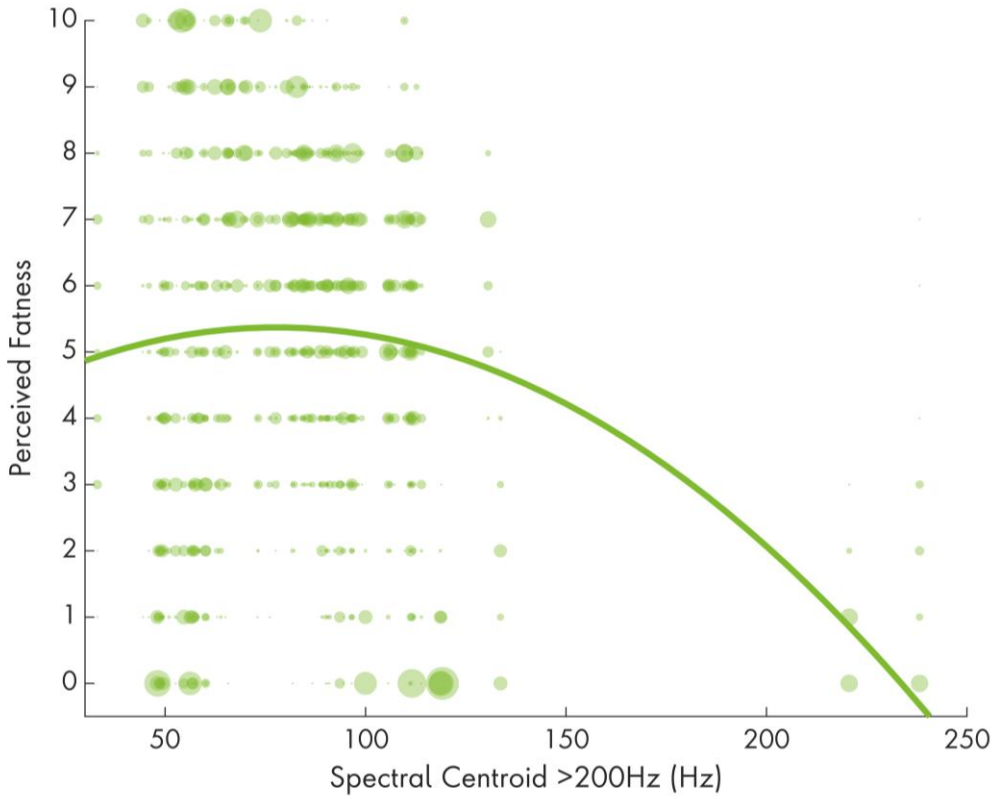


Figure 42: Regression Curve: Spectral Centroid < 200 Hz

4.4.4 Signal-to-Noise-Ratio <200Hz

Two points must be taken into account when modelling noise behaviour:

st, exploratory fitting of different function types yields a maximum $R^2$of .266, with simultaneous significance ($p < .001$), when a quadratic model is calculated. Second, both the strength of the correlation and the already observed fact that noise is irrelevant to fatness in the upper critical bands suggest that a weighted noise term should be modelled as a factor of the other variables in the lower critical bands.

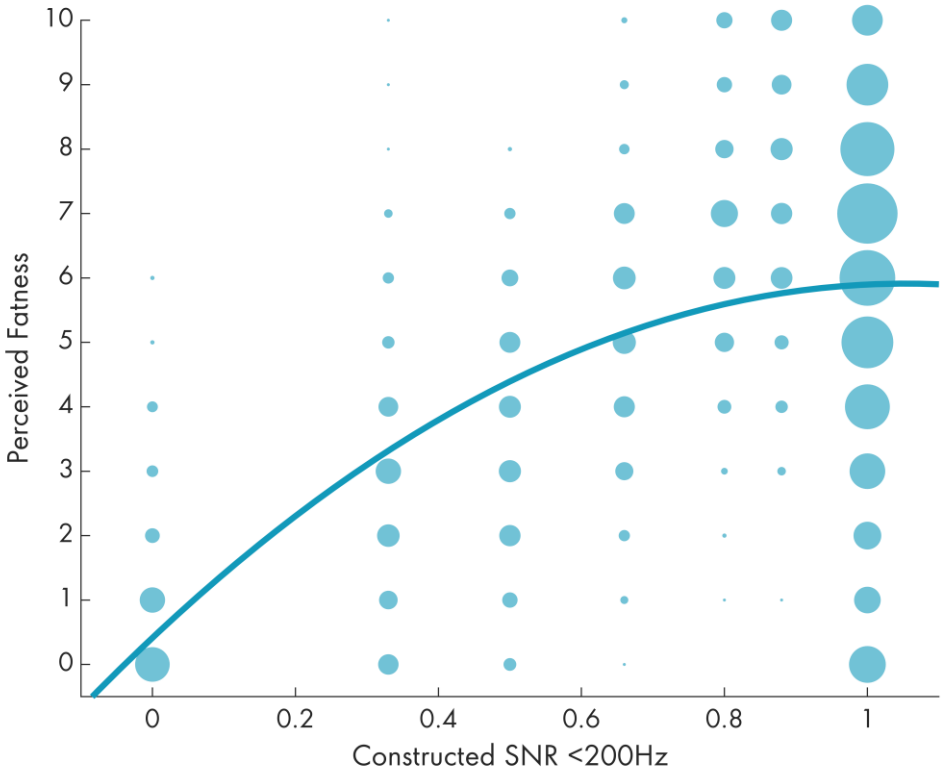


Figure 43: Regression Curve: Signal-to-Noise Ratio < 200 Hz

4.5 Non-linear Model

Ein Modell für die nicht-lineare Regression der perzeptiven akustischen Fettheit in Abhängigkeit von den untersuchten Variablen könnte also wie folgt aussehen:

$$Fatness = ((\beta_0 + \beta_1 \cdot 20log_{10}(Loudness_{<200Hz}) + \beta_2 \cdot 20log_{10}(Loudness_{<200Hz})^2 + \beta_3 \cdot 20log_{10}(Loudness_{<200Hz})^3 + \beta_4 \cdot Centroid_{<200Hz} + \beta_5 \cdot Centroid^2_{<200Hz}) \cdot (SNR^{\beta_6})) + \beta_7 \cdot Loudness_{>200Hz}$$

For the model to be significant, it must again be ruled out that the coefficients are equal to zero. In addition, the model must yield an increase in explained variance compared with the linear model presented in §3.5. The hypotheses are therefore as follows:

H_o:

$\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$

or $R^2_{linear\ model} \geq R^2_{non-linear\ model}$

H_1:

$\beta_0 \neq 0$ v $\beta_1 \neq 0$ v $\beta_2 \neq 0$ v $\beta_3 \neq 0$ v $\beta_4 \neq 0$ v $\beta_5 \neq 0$ v $\beta_6 \neq 0$ v $\beta_7 \neq 0$

and $R^2_{linear\ model} < R^2_{non-linear\ model}$

The assumptions of non-linear regression correspond to those of linear regression, although the former is both less robust and less informative, as well as more difficult to interpret. The assumptions set out in §3.6 - with the exception of the assumption of linearity - therefore also apply here, which is why the confidence interval is again determined by means of bootstrapping.

			95% Confidence Interval	
Coefficient	Estimate	Std. Error	Lower Bound	Upper Bound
β0	4,100	0,407	3,299	4,901

β1	65,297	3,650	58,119	72,476
β2	-288,223	34,289	-355,656	-220,791
β3	513,218	83,516	348,976	677,459
β4	-0,052	0,006	-0,063	-0,041
β5	0,000157	0,000018	0,00012	0,00019
β6	1,115	0,037	1,043	1,187
β7	-0,017	0,002	-0,021	-0,013

Table 17: Parameter Estimates of the Non-Linear Regression

As shown in Table 17, the bootstrap procedure yields significant estimates for the coefficients. None of the respective confidence intervals includes the value zero. Since, for procedural reasons, no significance value can be calculated for the overall model in non-linear regression, it is permissible to reject the null hypothesis on the basis of the significance of the individual coefficients.

The explained variance of the non-linear model, at $R^2 = .630$, exceeds that of the linear model ($R^2 = .597$) and thus accounts for an additional 3.3 percentage points of variance. Since, on the basis of the preliminary considerations in §3.6, there is no reason to assume overfitting, the non-linear function provides a genuine gain in explained variance. The second condition of the null hypothesis can therefore also be rejected.
A non-linear description of the musical-psychoacoustic parameter of perceptual fatness for sounds of equal loudness can thus be expressed as follows:

$$
\begin{aligned}
&Perceptive\ acoustic\ Fatness\ (in\ liph)\\
&\quad = \big((4{,}1 + 65{,}297 \cdot 20\ log_{10}(Loudness_{<200Hz})\\
&\quad - 288{,}223 \cdot 20\ log_{10}(Loudness_{<200Hz})^2\\
&\quad + 513{,}218 \cdot 20\ log_{10}(Loudness_{<200Hz})^3 - 0{,}052\\
&\quad \cdot\ Centroid_{<200Hz} + 0{,}000157 \cdot\ Centroid_{<200Hz}^2)\\
&\quad \cdot (SNR^{1{,}115})\big) - 0{,}017\ Loudness_{>200Hz}
\end{aligned}
$$

4.6 Discussion

The music-psychological examination of the phenomenon of "bass in modern dance music" has shown that:

a) Low frequencies occupy a special position within the frequency spectrum of discotheque sound reinforcement. This is supported both by studies of music clubs in the existing literature and by the self-reports of participants in the listening test. The phenomenon is independent of age, scene affiliation, and gender.

b) There exists an abstract, yet socially widely shared, understanding of what constitutes a fat bass in the sense of modern dance music. Significant mathematical models can be constructed for this phenomenon, and these models are capable of producing robust predictions. An explained variance of $R^2 = .63$may appear modest for a purely acoustic phenomenon; for complex cultural-psychological relationships, however, it represents an acceptable to good value. After all, even a socially shared understanding of the phenomenon does not preclude sources of dispersion, such as personal taste or momentary disposition.

c) Although the present investigation cannot provide a definitive definition of bass in the sense of modern dance music, it does substantially delimit this still scarcely researched phenomenon. It may be postulated that the fatness of a sound depends above all on the loudness of the lower critical bands, provided that these are tonal, that is, quasi-periodic. Non-periodic components, by contrast - that is, noise - are not perceived as fat. High-frequency components above 200 Hz make a negative contribution to the perception of fatness. There is no evidence that the fatness of a sound depends decisively on whether it occurs in a percussive or melodic playing mode, especially since these categories are, in electronically produced popular music, no longer sharply separable in any case.

5. Application-Oriented Fatness Model

In the preceding chapters, bass was described first in purely qualitative terms and then in purely quantitative terms. This provides an understanding of what fatness is and how it has become increasingly established. Yet the description of the music remains abstract, and the modelling of the perceptual quantity remains detached from concrete musical practice. In order to understand, compare, and contextualize the broad stylistic range of the music discussed here, additional measures are needed - measures capable of rendering its phenomena analytically visible. Similarly, the abstract measures developed in Chapter 4 offer insight into the phenomenon, but for several reasons they are not suitable for the practical analysis of music.

A fatness model that yields meaningful results under the conditions of real musical practice must therefore connect these two domains. On the one hand, it requires a robust and justifiably relevant data basis that represents the field under investigation as comprehensively as possible. On the other, it requires mathematical modelling grounded in the considerations developed in both areas.

The preliminary fatness model developed in Chapter 4 consequently has several limitations with regard to practical applicability:

1. Because the signal-to-noise ratio was predetermined by construction, it cannot be calculated from measurement data.
2. Because integrated loudness was used, it is not possible to measure time windows short enough to capture musically relevant events.
3. The test sounds used were constructed on the basis of musically grounded assumptions. For statistical modelling according to the principles of machine learning, however, a data basis is needed that covers the full range of all relevant parameters within the relevant domains of popular dance music.

5.1 Requirements for a Fatness Model for Musical Sounds

An application-oriented fatness model must therefore meet the following additional requirements:

1. It must operate immanently to the music itself. In other words, it must be based exclusively on objectifiable measurement results that can be obtained from digitized recordings of music.
2. It must be able to capture the overall fatness of complex musical sounds and make it comparable with that of other complex musical sounds.
3. It must also be able to localize fatness within the temporal unfolding of a musical piece. This must be done at a temporal resolution that can be interpreted in musically meaningful terms. Requirements 2 and 3 may also be fulfilled by two separate models derived from the same data basis.

To this end, the measurement of tonality and the question of temporal resolution must be reconsidered in particular.

5.1.1 Considerations Regarding Tonality

In the preliminary model, it was possible to determine the signal-to-noise ratio of test sounds constructed with a fixed proportion of tonal and atonal components (see §4.2.2.3). An application-oriented fatness model, however, must be able to generate predictions on the basis of measurements intrinsic to the music itself. Tonality therefore requires closer consideration. Psychoacoustics offers a range of spectral parameters that must be measured and analyzed for this purpose. Particular attention must be paid to ensuring that what is measured is the noise component of a timbre, rather than the general noise floor of a recording.

5.1.2 Considerations Regarding Temporal Resolution

The time windows used for measuring momentary fatness must be small enough for the measured fatness to be assigned to rhythmic events. This means that, even in faster tracks, the model must still allow at least one measurement at the level of sixteenth notes.

The preliminary fatness model includes the spectral centroid. Moreover, the investigation of the signal-to-noise ratio requires the measurement of further spectral quantities. On the one hand, the accuracy of these measures benefits from the presence of several periods of a given wavelength. On the other hand, the bass range relevant here is characterized by particularly long wavelengths. It follows that the window length must be chosen so as to be short enough for the musical context, yet long enough to permit the accurate measurement of spectral quantities.

The tempo distribution in a representative sample of dance-music tracks (see §5.2) lies above 71 BPM in 95% of cases and below 145 BPM in 95% of cases. Outliers at the lower end fall only slightly below 70 BPM. Outliers at the upper end belong entirely to the *Drum & Bass* style complex, for which one could also argue that they should be interpreted in half-time.

A relevant tempo range of 70 BPM - for example in *Roots Reggae* or *Trap* - to 145 BPM, as in *Trance*, can therefore be assumed here. A sixteenth note at 145 BPM has a duration of approximately 100 ms. This should consequently be taken as the minimum window length.

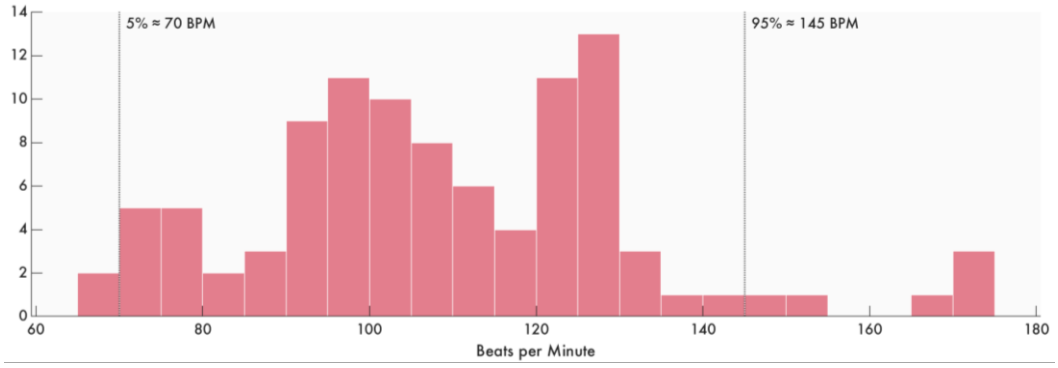


Figure 44: Distribution of Tempos in a Representative Sample of Popular Dance Music

When comparing methods for measuring the spectral centroid, one recurring tendency becomes apparent: with very low tones and short measurement windows, some methods erroneously identify the octave or double octave. In a comparison of the available procedures, the Audio Feature Extractor introduced in MATLAB in 2018 proved to be the method that stabilized at the shortest window length and most closely matched the measurements obtained in the preceding experiments. The older MATLAB measurement routine, as well as methods from the IOSR toolbox, were therefore discarded. In this way, valid spectral measurements in the bass range can be ensured at a temporal resolution of 50 ms.

Since the shortest loudness measure defined by R 128, Momentary Loudness, requires a minimum window length of 400 ms, these measures are no longer suitable for continuing the modelling. The applicability of C-weighted sound-pressure level in dB© must therefore be examined. Since the listening setup had already been measured in dB©, precise calibration of the measurement instrument is readily possible. For this purpose, a 1 kHz test tone was generated and, like the stimuli, normalized to –23 LUFS.

The measured values of this SPL measurement at a temporal resolution of 50 ms correlate strongly with the R 128 measurement of the test tones ($r = .83$, $p < .001$). Although the SPL measurement correlates less strongly with fatness ($r = .38$, $p = .001$) than the R 128 measurement ($r = .49$, $p < .001$), it may be assumed that the higher temporal resolution, together with the inclusion of further psychoacoustic measures, can yield an additional gain in explained variance.

5.1.3 Considerations Regarding the Data Basis

In order to identify measures capable of describing popular dance music comprehensively, it is necessary to assemble an appropriate sample of tracks that meets the following criteria::

1. In accordance with the requirements of supervised learning (cf. §3.3), the sample must cover both the full range of perceived fatness and the full range of possible input features.

2. The scope of popular dance music described in Chapter 2 must be represented within this sample, subject to the requirements set out under point 1. Particular preference should be given to style-defining tracks. The relevance of each track must be justified.
3. In order to account for historical developments, the tracks should ideally be available as pressings of the original master, or at least as corresponding contemporary masters. Otherwise, there is reason to assume that remasters, which have become common since the digitization of music media, would distort the data basis. This is suggested by a study by Hjortkaer and Walther-Hansen. (Hjortkaer & Walther-Hansen, 2014, p. 38)
4. n the case of vinyl pressings, attention must also be paid to their material condition. To avoid disturbances such as noise caused by dust deposits in the grooves, or impulses caused by scratches and other damage, only pressings graded commercially as VG (*Very Good*) or better are suitable.
5. A sufficiently balanced distribution across styles and years of release must be ensured.

For this purpose, a sample of 100 tracks was compiled. A large proportion of these came from the author's own collection. Additional tracks were borrowed from other collections, and numerous recordings were acquired specifically for the purposes of this study.

Particularly in the case of purchased vinyl records, it was at times necessary to balance relevance against budgetary constraints. For example, the Wailers' "Simmer Down," discussed in Chapter 2, was replaced by the equally relevant "Wear You to the Ball" by the Paragons. Whereas "Simmer Down" - if available at all in suitable quality - costs well over €150, an early pressing of "Wear You to the Ball" is already part of

the author's collection. Both tracks are equally suitable for representing the *Ska* era of the Studio One label.

The records in question were acquired through the international platform Discogs. Particularly in the case of the many imports from the United Kingdom and the United States in the summer of 2020, the restrictions caused by the SARS-CoV-2 pandemic made themselves felt.

Unfortunately, in many musicological publications it remains common practice to use the musical data basis without justification or discussion. Often, only stylistic groups are mentioned, while concrete tracks appear, at most, as examples in the discussion.

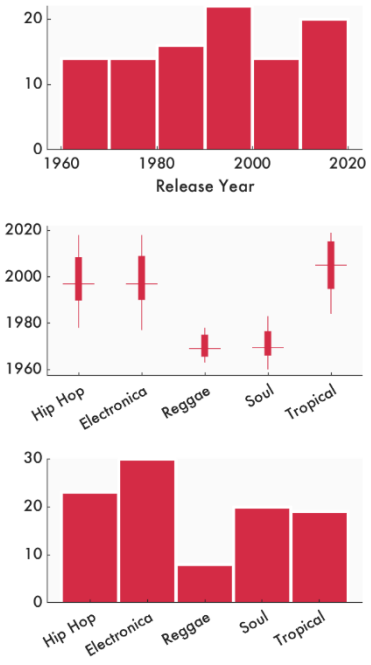


Figure 45: Temporal and Stylistic Distribution of the Music Sample

Since such an approach not only creates an impression of arbitrariness in the sample, but also compromises validity and reliability, §5.2 presents a corresponding sample of 100 popular dance-music tracks and justifies their relevance.

5.2 A Representative Sample of Popular Dance Music

Figure 46: Die Vinyl-Tonträger des Musik-Samples

5.2.1 Tracks 1-25

01	2Life Crew – Me so Horny		
Style:	Hip Hop / Miami Bass	Year	1989
Label:	Luke Skywalker Music	Medium	Maxi

The relevance of the *Miami Bass* sound is discussed in detail in §2.7.4. The recording used here is a typical U.S. pressing on 12-inch vinyl at 45 rpm. The track cemented both the commercial breakthrough of *Miami Bass* and that of its best-known protagonists. This is evidenced by its 30-week run on the *Billboard Hot 100* and its four weeks at number one on the rap charts. (Kaufmann, 2019)

02	Afrika Bambaataa – Planet Rock		
Style:	Hip Hop / Electro Funk	Year	1982
Label:	Tommy Boy	Medium	Maxi

As set out in detail in §2.7.2, "Planet Rock" represents one of the foundational moments in the modern production aesthetics of dance music. Bambaataa's early *Electro-Funk* had a decisive influence on the development of both *Hip Hop* and electronic dance music.

03	Age of Love - Age of love (Watch out for Stella Club Mix)		
Style:	Electronica / Trance	Year	1992
Label:	React	Medium	Maxi

This remix by Jam & Spoon epitomizes, perhaps more than almost any other recording, the developments that contributed to the formation of *Trance* as an *EDM* style in the early 1990s. Owing to its considerable crossover potential, it reached chart positions in both the United Kingdom and Germany. Later reissues, such as the 1997 version, were also commercially successful. The renowned club-culture magazine *Groove* named it the "best track of 1992". (Hoffmann H. , Charts From the Past: Die besten Tracks 1992 (Dezember 1992), 2017)

Although the pressing used here is a German original from 1992, with the relevant mix occupying the entire A-side, the recording sounds surprisingly "thin." This is presumably due to the playback speed of 33 rpm, which is unusual for *EDM*. Since 33-rpm *Hip Hop* pressings of the same age do not exhibit this problem, it is possible that more relevant pressings of the track exist.

04	Althea & Donna – Uptown Top Ranking		
Style:	Reggae / Disco Reggae	Year	1977
Label:	Joe Gibbs	Medium	Single

This mainstream crossover hit from the Jamaican Joe Gibbs label, based on the riddim of Alton Ellis's *Rocksteady* classic "I'm Still in Love with You," is typical of late-1970s *Reggae*. Elements of *Roots Reggae* and *Disco* merge here into what would shortly thereafter come to be known as *Dancehall Reggae*. The toasting of the two young performers reflects both Jamaican versioning culture and the rise of rapped vocal delivery in New York. "Uptown Top Ranking" reached number one on the UK Singles Chart in December 1977 (The Official UK Charts Company; Bradley, 2003, pp. 311-313)

The recording used here is a contemporary Jamaican single pressing.

05	Aretha Franklin - Respect		
Style:	Soul (Southern Soul)	Year	1967
Label:	Atlantic Records	Medium	Single

Aretha Franklin's version of Otis Redding's "Respect" is widely regarded as one of the greatest pop songs of all time, as evidenced, for example, by its placement at number five in *Rolling Stone* magazine's all-time ranking. (Rolling Stone, 2003) As an anthem of the American civil-rights and feminist movements, the track remained culturally relevant for a long time. (Brown, 2018) It is typical of a late Atlantic or *Southern Soul* production and, in the author's assessment, continues to enjoy considerable popularity on suitable dance floors. The recording used here is a contemporary German single pressing.

06	Augustus Pablo – King Tubby meets Rockers Uptown		
Style:	Reggae / Dub	Year	1973
Label:	Island Records	Medium	Single

King Tubby's relevance to the production techniques of *Dub* has already been discussed in §2.5.3. This track, made together with the likewise highly respected Augustus Pablo, is one of Tubby's best-known productions. The recording used here is a contemporary British licensed pressing on Island Records.

07	Avicii - Levels (Original Mix)		
Style:	Electronica / EDM	Year	2011
Label:	Universal	Medium	Digital

This track by the Swedish producer Avicii, who died in 2018, is regarded as one of the defining recordings of early American-style *EDM*. It is based on a sample from Etta James's "Something's Got a Hold on Me" and was certified platinum in eleven countries, in some cases multiple times. (Murray, 2018)

08	Barrington Levy – Here I Come		
Style:	Tropical / Early Dancehall	Year	1984
Label:	Time 1	Medium	Maxi

Barrington Levy is one of the key artists of the first *Dancehall* generation. His style bridges the *Disco Reggae* of the 1970s and the *Dancehall* style of the 1990s. Produced by Jah Screw, "Here I Come (Broader Than Broadway)" is among his best-known and most influential songs. Beyond Jamaican music, Levy's classic hits also exerted a significant influence on New York *Hip Hop* and British *Jungle*, as evidenced by numerous collaborations, samples, and remixes. (Stolzoff, 2000, p. 170; Brathfisch, 2003, p. 279; Who Sampled: Here I Come (Broader Than Broadway))

09	Bee Gees – Staying Alive		
Style:	Soul / Disco	Year	1977
Label:	RSO	Medium	Single

As the title song of the cult film *Saturday Night Fever*, probably no other track embodies the late phase of the *Disco* era as vividly, as already discussed in §2.6.5..

10	Bruno Mars – 24k Magic		
Style:	Hip Hop / RnB	Year	2016
Label:	Atlantic Records	Medium	Digital

The track discussed in §2.9.3 combines influences from *Disco Funk* and *Old-School Hip Hop*, ranks among the most internationally successful *R&B* tracks of the 2010s, and was certified platinum - sometimes multiple times - in all key markets. Although "24K Magic" is not Bruno Mars's most successful track, it is preferable here to "Uptown Funk," since both its sonic aesthetic, particularly its synth bass, and its year of release make it a better complement to the sample. (Billboard Magazine)

11	Bucket Heads – The Bomb		
Style:	Electronica / House	Year	1994
Label:	Universal	Medium	Maxi

"The Bomb!" was produced by Kenny Dope of the prolific production collective Masters at Work. With its opulent *Disco* borrowings, the track illustrates the transformation of *House* in the 1990s through the possibilities of digital sampling. "The Bomb!" appears in numerous dance-music publications' best-of lists, including the British magazine *Mixmag*'s ranking of essential *Rave* tracks. (Holbrok, 2019)

12	Buju Banton – Champion		
Style:	Tropical / Dancehall	Year	1994
Label:	Penthouse	Medium	Single

Buju Banton is regarded as one of the most influential Jamaican vocalists of the past thirty years. This is due both to his distinctive voice and to his successful balancing

act between gangsterism and Rastafarianism. More than twenty years after its release as a single and on the critically acclaimed album *'Til Shiloh*, "Champion" remains one of the staples of the genre and is widely regarded as a defining example of the influential 1990s *Dancehall* style. (Brathfisch, 2003, p. 50; Mazurkiewicz, 2012, pp. 4-6)

Buraka Som Systema – Kalemba (Wegue Wegue)

13

Style:	Tropical / Tropical Bass (Koduro)	Year	2008
Label:	Sony BMG	Medium	Digital

The Portuguese-Angolan formation Buraka Som Sistema was among the first acts in the field of *Tropical Bass* to popularize African club sounds in Europe. The Angolan style *Kuduro* combines electronic dance music with African *Kizomba* and *Zouk*, as well as elements of *Baile Funk* and *Dancehall*. "Kalemba" thus foreshadows the eclectic trajectory of tropical club music in the second decade of the twenty-first century and helped establish *Bass Music* in an African context. (Sheridan, 2018, pp. 1-4)

---

14 CamelPhat & Elderbrook - Cola

Style:	Electronic / House / Techhouse	Year	2017
Label:	Defected	Medium	Digital

"Cola" is one of the most relevant *EDM* tracks of recent years. It achieved chart placements in key markets on both sides of the Atlantic, received a Grammy nomination, and spent more than five months at number one in the sales charts of Beatport, an internationally important music retailer for DJ music. (Leights, 2017)

15	Candido – Jingo		
Style:	Soul / Disco (Latin Disco)	Year	1977
Label:	Salsoul	Medium	Maxi

The song “Jingo-lo-ba” by the Nigerian percussionist Babatunde Olatunji had already been successfully taken up by Santana in 1969. This version by the Afro-Cuban pioneer Cándido Camero de Guerra, released on the Salsoul label, is regarded as one of the few formative underground *Disco* hits of the late 1970s and influenced generations of *House* producers. It also stands as an exemplary case of the influence of Latin American music on modern dance music. (Contreras, 2020)

16	Cardi B - I Like It (feat. Bad Bunny & J Balvin)		
Style:	Hip Hop / Trap	Year	2018
Label:	Atlantic Records	Medium	Maxi

The highly successful track “I Like It” embodies both the sonic world of modern *Hip Hop* and the increasing fusion of tropical and African American music. A detailed analysis can be found in §2.5.7.

17	Rufus & Chaka Khan - Ain’t nobody		
Style:	Soul	Year	1983
Label:	Warner	Medium	Maxi

With its arpeggiated synthesizers, “Ain’t Nobody” represents a *Soul* production in the midst of the digital transition. Already commercially successful at the time of its release, the track remains part of the canon of relevant popular music, as evidenced not least by the steady stream of stylistically updated cover versions and reworkings, for example by LL Cool J or Felix Jaehn. (Whitburn, 2006, p. 505; Secondhand Songs, 2021)

18	Charles Wright & the Watts 103rd Street Rhythm Band - Express Yourself		
Style:	Soul / Funk	Year	1970
Label:	Warner	Medium	Single

"Express Yourself" features one of the most distinctive bass riffs of *Pre-Disco Funk*. At the time of its release, the track reached number three on the *Billboard Hot 100*. (Billboard Magazine, 1970) Its continuing relevance is demonstrated by numerous samples and cover versions - not least N.W.A.'s *Gangsta Rap* adaptation - as well as by almost 50 million plays on Spotify, a streaming platform founded only in 2006. (Who Sampled, 2021; Spotify, 2021)

19	Chubby Checker – The Twist		
Style:	Soul / Rhythm & Blues (Twist)	Year	1961
Label:	Ariola	Medium	Single

The immense relevance of "The Twist" for the development of modern dance and club culture is discussed in detail in §2.4.1. The recording used here is a contemporary German licensed pressing rather than the Parkway original. Given its age, it can be assumed that it is not a remaster.

20	Culture – See dem Come		
Style:	Reggae / Roots Reggae	Year	1977
Label:	Joe Gibbs	Medium	Maxi

This production from Joe Gibbs's 16-track studio is typical of the modernized *Roots Reggae* sound of the late 1970s. Culture were among the most influential Jamaican bands of the period and also attracted numerous listeners within the British *Punk* scene. Alongside "Two Sevens Clash," "See Dem Come" is one of their greatest hits. (Brathfisch, 2003, pp. 119-121,190; Stolzoff, 2000, p. 191; Bradley, 2003, pp. 311-312)

21	Cybotron – Clear		
Style:	Electronica / Proto-Techno / Electrofunk	Year	1983
Label:	Fantasy	Medium	Maxi

The relevance of Juan Atkins's *Techno* precursor "Clear" to the development of electronic dance music is discussed in §2.8.2.

22	Cypress Hill – Insane in the Brain		
Style:	Hip Hop / Sample Hip Hop / Boom Bap	Year	1993
Label:	Columbia	Medium	Maxi

"Insane in the Brain" illustrates the transition between *Sample Hip Hop* and *Boom Bap* and may be assigned to both categories. Long sampled phrases are combined with one-shot drum samples. The track was among the first mainstream hits of West Coast *Hip Hop*, was one of the best-selling singles in the United States in 1993 (Billboard Magazine, 1994) , and remains a relevant *Hip Hop* classic today.

Figure 47: Selected recordings, 1990s *Hip Hop* 12-inch singles: Snoop Doggy Dogg – "What's My Name" (83), Pete Rock & CL Smooth – "T.R.O.Y." (68), and Cypress Hill – "Insane in the Brain" (22)

23	D'Banj – Oliver Twist		
Style:	Tropical / Afrobeats / Afrohouse	Year	2012
Label:	G.O.O.D. Music / Mercury	Medium	Maxi

“Oliver Twist” is regarded as the starting point of the highly productive Lagos–London axis and of the rise of West African and Afro-European music culture as a fashionable presence in the Global North. The track opened the global market to numerous West African producers and performers. (Solanke, 2012; Onanuga, 2019, p. 23) Musically, “Oliver Twist” blends influences from *Afrobeats*, *Hip Hop*, and British *House*, with its tempo oriented more toward the latter.

24	DJ Snake & Lil Jon - Turn Down for What		
Style:	Electronica / Trap (Twerk Bass)	Year	2014
Label:	Mercury	Medium	Digital

The highly successful club hit “Turn Down for What” was the best-selling single in the United States in 2014. Stylistically a mixture of modern *Hip Hop* and electronic production, the track consists almost entirely of build-ups and bass drops (Sloan N. &., 2020, p. 58).

25	Daddy Yankee – Gasolina		
Style:	Tropical / Reggaetón	Year	2004
Label:	Universal Music	Medium	Digital

“Gasolina” embodies the consolidation of *Reggaetón* as a style. A detailed analysis can be found in §2.7.6..

5.2.2 Tracks 26-50

26	Damian Marley - Welcome to Jamrock		
Style:	Tropical / Dancehall (Conscious Dancehall)	Year	2005
Label:	Ghetto Youths	Medium	Single

With “Welcome to Jamrock,” Damian Marley, son of Bob Marley, achieved one of the greatest mainstream successes by a *Reggae* artist in the twenty-first century. The Grammy-winning track is based on Ini Kamoze’s “World-A-Reggae Music” and updates it within the sonic aesthetic of the late *Conscious Dancehall* era. (Reggaeville, 2021) This recording is the most recent vinyl release in the sample, since the single remained the leading medium in the international *Dancehall* scene for considerably longer than in other music scenes. The version used here is a Jamaican pressing for the international market.

27	David Guetta - When Love Takes Over (feat. Kelly Rowland)		
Style:	Electronica / EDM	Year	2009
Label:	Astralwerks	Medium	Digital

“When Love Takes Over” fused European electronic music with African American *R&B*, initiating a development that would, for the first time, firmly establish electronic music in the U.S. mainstream.(siehe Abschnitt 2.8.5)

28	Digital Mystikz - Anti War Dub (feat. Spen G)		
Style:	Electronica / Dubstep	Year	2006
Label:	DMZ	Medium	Digital

As a counterpoint to the more overtly spectacular American *Brostep*, “Anti War Dub” embodies the cerebral, formative phase of *Dubstep*. Digital Mystikz belong to the first generation of British *Dubstep* producers. In the literature, this track is frequently cited as style-defining, particularly with regard to the influence of Jamaican-British *Dub* on *Dubstep*. (Zuberi, 2015; Rietveld, 2015, p. 212; Härter, 2008, pp. 276-279)

29	Donna Summer - I feel Love		
Style:	Soul / Disco	Year	1977
Label:	Casablanca	Medium	Single

With “I Feel Love,” producer Giorgio Moroder achieved the first electronic *Disco* hit and anticipated the emergence of *House* (siehe 2.5.6).

30	El General - Pu Tun Tun		
Style:	Tropical / Latin Dancehall / Proto-Reggaetón	Year	1991
Label:	Gold Disc	Medium	Maxi

In the early 1990s, El General established a Spanish-language variant of *Dancehall* in the Hispanophone world from his base in Panama. His music is regarded as especially influential for the generation of musicians that would develop *Reggaetón* a decade later. (Twickel, 2009, p. 99; Marshall, Placing Panama in the Reggaeton Narrative, 2009, p. 79)

31	Eve – Who’s that Girl?		
Style:	Hip Hop / Club Hip Hop	Year	2001
Label:	Interscope	Medium	Maxi

“Who’s That Girl?” was one of the major international hits of 2001 and remained relevant well beyond that moment. It is a club-oriented *Hip Hop* track typical of the turn of the millennium, marked by strong Latin influences. (Huey, 2021; Cision, 2021)

32	50 Cent – P.I.M.P.		
Style:	Hip Hop / Gangster Rap / Club Hip Hop	Year	2003
Label:	Interscope	Medium	Digital

With highly successful hits such as “In da Club” and “P.I.M.P.,” rapper 50 Cent - with support from Dr. Dre and Eminem - established a form of radio-compatible

Gangsta Rap whose production was uncompromisingly oriented toward the club. This production style was widely imitated in the years that followed. (McCarthy & Petruso, 2014, pp. 69-71)

33	Fisher - Losing It (Extended Mix)		
Style:	Electronica / Techhouse	Year	2018
Label:	Catch & Release	Medium	Digital

"Losing It" is an example of the hybrid style *Tech House*, which combines elements of *House* and *Techno*. It is regarded as the dominant cross-scene *EDM* track of 2018 and 2019 within the field of *EDM*. (Liesenhoff, 2019)

34	Flux Pavilion – I can't Stop		
Style:	Electronica / Dubstep / Brostep	Year	2010
Label:	Circus Records	Medium	Digital

With "I Can't Stop," the English producer Joshua Steele entered the top tier of international electronic DJs in 2010. In the United States in particular, the track became widely known through *Hip Hop* figures Kanye West and Jay-Z. With regard to the American *EDM* variant *Brostep*, it is considered highly influential. (Jeffries, 2021)

35	Gang Starr – Full Clip		
Style:	Hip Hop / Boom Bap	Year	1999
Label:	7 Grand Records	Medium	Maxi

„"Full Clip" distills the essence of the Brooklyn *Boom Bap* sound associated with Gang Starr producer DJ Premier. Premier created instrumentals not only for his own formation, Gang Starr, but also for numerous other major figures in the scene, and is regarded as the most influential *Hip Hop* producer of the 1990s and beyond (Young, 2009, p. 82). A more detailed classification can be found in §2.7.5.

36	Grandmaster Flash & the Furious Five – The Message		
Style:	Hip Hop / Oldskool	Year	1982
Label:	Sugarhill	Medium	Maxi

"The Message" represents an important milestone in production technique, but above all in its socially critical subject matter. Musically, the track anticipates both the move away from the concept of the *Hip Hop* track as *Disco Dub* and the later sonic aesthetic of *Boom Bap*. A more detailed discussion of Grandmaster Flash & The Furious Five can be found in §2.7.2. Since "The Adventures of Grandmaster Flash on the Wheels of Steel" can be considered dance music only in a broader sense, "The Message" stands here for the influence of the group and for this creative phase of the Sugarhill label.

37	Hector Rivera – At the Party		
Style:	Soul / Latin Soul / Boogaloo	Year	1966
Label:	Barry's	Medium	Single

Emerging from the South Bronx, a stylistic mixture of *Soul* and Latin influences conquered American radio stations for several years: *Boogaloo*. Pete Rodriguez's "I Like It Like That" is regarded as style-defining, but an original pressing is prohibitively expensive. "At the Party" follows the conventions of the *Latin Soul* era just as clearly and was already available as an original pressing in the author's collection. (Flores, 1999, pp. 1-3)

38	Heptones – Mama (please let me go)		
Style:	Reggae / Rocksteady	Year	1968
Label:	Studio One	Medium	Single

"Mama" by The Heptones, the trio led by Leroy Sibbles, is a typical Studio One recording from the *Rocksteady* era. A more detailed analysis can be found in §2.5.2. The recording used here is presumably a contemporary Jamaican pressing.

39	High Contrast – Racing Green		
Style:	Electronica / Drum & Bass	Year	2004
Label:	High Contrasting	Medium	Digital

"Racing Green" by the Welsh producer Lincoln Barrett, also known as High Contrast, anticipates the development of *Drum & Bass* in the early twenty-first century. This substyle, later also known as *Liquid Funk*, condenses the modern, uniform *Drum & Bass* beat from the formerly more playful diversity of *Jungle* breakbeats. (Murphy, 2016)

40	Inner City – Big Fun		
Style:	Electronica / Techno	Year	1988
Label:	10 Records	Medium	Maxi

"Big Fun" by Inner City is part of the compilation *Techno! The New Dance Sound of Detroit*, discussed in §2.8.2, and may be regarded as the genre's first minor crossover hit.

41	J Balvin – Mi Gente		
Style:	Tropical / Reggaetón	Year	2017
Label:	Scorpio	Medium	Digital

The global club hit "Mi Gente" embodies the sound of modern *Reggaetón* and helped establish it beyond Latin America. (Heikes, 2018, pp. 13,37) The track contains elements of U.S. *Trap*, but also evokes pre-Columbian sounds that Colombian *Electrónica Selvática* had helped bring back into relevance - although the sample in

question is taken from the Bengali hit “Heila Duila Nach,” rather than from South American siku music.

42	James Brown – Papa’s got a brand new Bag		
Style:	Soul / Funk	Year	1965
Label:	King Records	Medium	Single

With “Papa’s Got a Brand New Bag,” James Brown established *Funk* and, with it, the loop-based structure of modern popular dance music. A detailed analysis can be found in §2.6.1. The recording used here is the original pressing on King Records.

43	John Holt – A love I can feel		
Style:	Reggae / Early Reggae	Year	1970
Label:	Studio One	Medium	Single

The classic “A Love I Can Feel” is a typical example of the fully developed *Reggae* style at Studio One. A detailed discussion is provided in §2.5.2 (Notation 10). The recording used here is a contemporary Jamaican pressing.

44	Justin Hinds & The Dominoes – Carry go bring come		
Style:	Reggae / Ska	Year	1963
Label:	Treasure Isle	Medium	Single

“Carry Go Bring Come” by Justin Hinds & The Dominoes remained at number one in the Jamaican charts for several weeks and is arguably the greatest and most representative Treasure Isle hit of the *Ska* era. (Brathfisch, 2003, p. 212) The significance of both the style and the label is discussed in §2.5.2. The recording used here is a contemporary Jamaican pressing.

Figure 48: Selected recordings, *Reggae* 7-inch singles: Augustus Pablo – "King Tubby Meets Rockers Uptown" (6), Justin Hinds & The Dominoes – "Carry Go Bring Come" (44), and John Holt – "A Love I Can Feel" (43)

45	Marshall Jefferson – Move your Body		
Style:	Electronica / Techno	Year	1986
Label:	Boy Records	Medium	Maxi

"Move Your Body" is typical of early Chicago *House*. Its musical structure and its relevance to club culture are discussed in detail in §2.8.1 (Notation 22). The recording used here is a contemporary Spanish pressing.

46	Kiesza - Hideaway		
Style:	Electronica / House	Year	2014
Label:	Island Records	Medium	Digital

The *Deep House* track "Hideaway" represents the return to the electronic music of the 1990s that is characteristic of 2010s *House*. The track was commercially highly successful not only in the United Kingdom, but also quickly established itself internationally, both in the mainstream and in clubs. (Billboard Magazine, 2014; The Official UK Charts Company, 2014)

47	Koffee - Toast		
Style:	Tropical / Dancehall	Year	2017
Label:	Koffee Music / Columbia	Medium	Digital

The Grammy-winning song “Toast” by *Reggae* singer Koffee is one of the greatest local and international successes in recent Jamaican music history. Produced by members of the Major Lazer collective, the track combines elements of *Conscious Dancehall* with the sonic aesthetic of American *Trap* music. (Stein, 2019; Cooper A. , 2020)

48	Kollektiv Turmstrasse - Holunderbaum		
Style:	Electronica / Minimal	Year	2008
Label:	Musik gewinnt Freunde	Medium	Digital

Kollektiv Turmstrasse are representatives of the commercially successful return to Basic Channel’s *Techno* minimalism. Around 2010, this sound was formative for many electronic dance floors worldwide, before being superseded by the maximalism associated with David Guetta. (Gietzelt, 2017; Resident Advisor, 2021)

49	Konstantin Sibold - Mutter		
Style:	Electronica / Minimal	Year	2016
Label:	Running Back	Medium	Digital

“Mutter” combines the production paradigms of *Trance* and *Minimal*, thereby embodying the contemporary spirit of *Techno* productions without *House* borrowings. The track was voted track of the year 2016 by the club-culture magazine *Groove* (Döringer, 2017).

50	Kool and the Gang - Jungle Boogie		
Style:	Soul / Funk	Year	1975
Label:	Polydor	Medium	Single

“Jungle Boogie” embodies the beginning of the transition from the various forms of *Funk* toward the style of *Disco.* (Wilke, 2017, pp. 69-70)

5.2.3 Tracks 51–75

51	Kraftwerk - Transeuropa Express		
Style:	Electronica	Year	1977
Label:	Kling Klang	Medium	Single

A detailed analysis of Kraftwerk's significance, and of "Trans-Europe Express" itself - which reappears in "Planet Rock" (2) as a recreated sample - can be found in §2.6.3.

52	Leftfield - Not forgotten		
Style:	Electronica / House / Progressive House	Year	1991
Label:	Outer Rhythm	Medium	Maxi

Although "Not Forgotten" does not yet fully conform to the paradigm of progressive electronic music, it is often cited as the first *Progressive House* track. It is regarded as especially influential for later British *EDM* productions and far beyond. (Hamhuis, 2017, p. 10)

53	M-Beat – Incredible (ft. General Levy)		
Style:	Electronica / Jungle	Year	1994
Label:	Renk	Medium	Maxi

The role played by "Incredible" in the early phase of *Jungle* and *Drum & Bass* is discussed in detail in §2.8.4 (Notation 23).

54	Macklemore & Ryan Lewis - Thrift Shop feat. Wanz		
Style:	Hip Hop / Boom Bap	Year	2013
Label:	Macklemore LLC	Medium	Digital

The highly successful and enduring club hit “Thrift Shop” combines the musical paradigm of classic *Boom Bap Hip Hop* with the contemporary sonic aesthetic of *Trap*. It is emblematic of the transformation of African American music over the past decade. (Markman, 2013; Fox, 2013) *Billboard* lists “Thrift Shop” as number one on its decade-end *Hot R&B* chart for the 2010s (Billboard Magazine, 2019).

55	Magic System – 1er Gaou		
Style:	Tropical / Zouglou	Year	1999
Label:	Next Music	Medium	Digital

Magic System’s sleeper hit “1er Gaou” is generally regarded as one of the decisive condensation points of an internationally successful and influential West African pop music. A more detailed classification can be found in §2.7.6..

56	Major Lazer - Watch Out For This (Bumaye) (feat. The Flexican, FS Green, Busy Signal)		
Style:	Tropical / Moombhaton	Year	2013
Label:	Mad Decent	Medium	Maxi

Watch Out for This” is the iconic track of the tropical-electronic hybrid style *Moombahton*. The internationally highly successful track combines massive sub-bass frequencies with *Reggaetón* rhythms and the catchy vocals of Jamaican singer Busy Signal. (Jackson, 2013)

57	Maleek Berry - Kontrol (Extended)		
Style:	Tropical / Afro Beats	Year	2016
Label:	Berry’s Room	Medium	Digital

The increasing fusion of African American mainstream conventions with elements of Nigerian *Afrobeats* can be heard in “Kontrol” (see Notation 20). The track is among the most-streamed Nigerian songs overall (Mustapha, 2021; Nigerian Tribune, 2018).

58	Manu Dibango – Soul Makossa		
Style:	Soul / Disco / Afro Beat	Year	1972
Label:	Fiesta	Medium	Maxi

"Soul Makossa" is one of the best-known examples of global *Funk* adaptations feeding back into the early American *Disco* canon. The track blends *Afro-Funk* with elements of Cameroonian *Makossa* (Brunner, pp. 88-89).

59	Maurizio - M7		
Style:	Electronic / Minimal	Year	1997
Label:	Maurizio	Medium	Maxi

Moritz von Oswald's early productions are regarded as exceptionally influential for subsequent generations. This influence is evident both in the principles of *Minimalism* and in the broad adoption of the conceptual world of *Dub* pioneer King Tubby. (Oehmen, 2011)

Since the better-known productions under the alias Basic Channel command extremely high prices on the second-hand vinyl market, the original pressing of "M7," released under the alias Maurizio and already held in the author's collection, was included in the sample instead.

Figure 49: Selected recordings, *EDM* 12-inch singles: Reprazent – "Brown Paper Bag" (73), Marshall Jefferson – "Move Your Body" (45), and Maurizio – "M7" (59)

60	MHD – Afro Trap Part.7 (La Puissance)		
Style:	Tropical / Afrotrap	Year	2016
Label:	Artside	Medium	Maxi

"La Puissance" is arguably the best-known representative of *Afro Trap*, a genre that originated in France (see Notation 21). It is the product of a long-standing influence of Francophone West Africa on the French *Hip Hop* scene, coinciding with the latter's breakthrough into the French mainstream. The reciprocal influence of this Paris-born mixture of *Trap* and *Coupé-Décalé* on West Africa is evident (Hammou, 2020, pp. 8-10).

61	Miami Sound Machine - Conga (Dance Mix)		
Style:	Soul / Disco / Latin Disco	Year	1985
Label:	Epic	Medium	Maxi

With "Conga," Gloria Estefan established Latin American *Salsa* music as a legitimate candidate for hybridization with *Disco*, *Funk*, and later African American styles, thereby paving the way for artists such as Jennifer Lopez and Luis Fonsi. (Poey, 2014, pp. 79-82) Since the track was internationally successful, the version used here is the club mix from a continental European pressing.

62	Michael Jackson – Billie Jean		
Style:	Soul / Disco / Funk	Year	1982
Label:	Epic	Medium	Single

"Billie Jean" is among the most frequently discussed tracks in any assessment of the compositional genius of the controversial King of Pop. With an electric bass part that, like an arpeggiator, plays a rhythmically uniform yet tonally compelling sequence, minimalist drums, and synthesizer sounds that were avant-garde for their time, producer Quincy Jones anticipated the near-complete digitization of African

American music. “Billie Jean” is one of the most successful and most highly decorated pop songs of all time. (Capetola, 2019, pp. 80-81; Toberrelli, 2009, pp. 228-230)

63	Nas – If I ruled the World (Imagine That) (feat. Lauryn Hill)		
Style:	Hip Hop / Boom Bap	Year	1995
Label:	Columbia	Medium	Maxi

Based on two *Old-School Hip Hop* tracks by Kurtis Blow and Whodini, this track marks the transition from *Boom Bap* toward the emerging club sound. This is also reflected thematically in its fusion of social critique with more individual and commercial visions. “If I Ruled the World” not only brought Nas, already an exceptionally important rap lyricist at the time, onto dance floors for the first time; it also marked the beginning of the solo career of Fugees rapper Lauryn Hill. (Mickey, 2017; Tawney, 2021)

64	Naughty by Nature – Hip Hop Hooray		
Style:	Hip Hop / Sample Hip Hop	Year	1992
Label:	Tommy Boy	Medium	Maxi

With the hits “O.P.P.” and “Hip Hop Hooray,” Naughty by Nature established American ghetto culture within the mainstream. Raw yet radio-compatible beats culminate here in one of the catchiest choruses in pop history. The track belongs to the transitional phase between *Sample Rap* and *Boom Bap* and uses samples from several *Soul* recordings (Flick, 1993; Ducker, 2018).

The recording used here is an American repressing of the original master, presumably from the late 1990s.

65	Notorious B.I.G. – Hypnotize		
Style:	Hip Hop / Club Hip Hop	Year	1997
Label:	Bad Boy Records	Medium	Maxi

Produced by Sean "Puff Daddy" Combs, "Hypnotize" is typical of the early era of *Club Hip Hop*. Heavy drums meet catchy samples from the *Disco* era. Together with the polished raps of "Biggie Smalls," this mixture appealed to the mainstream and the niche alike. Despite its age, the posthumously released track has lost little of its relevance for the dance floor. (Peterson, 2007)

66	Parliament Flashlight		
Style:	Soul / Funk	Year	1976
Label:	Casablanca	Medium	Maxi

According to *Funk* chronicler Rickey Vincent, Bernie Worrell's synthesizer bass on "Flash Light" marked the beginning of the "electronic age of modern African American music" (Vincent R. , 1996, pp. 244-246), see §2.6.1.

67	Paul van Dyk - For An Angel (PvD E-Werk Club Mix)		
Style:	Electronica / Trance	Year	1998
Label:	MFS	Medium	Maxi

Paul van Dyk is regarded as one of the pioneers of *Trance*. In its role as a genre classic, "For an Angel" has been reissued several times in revised versions. The version used here is the internationally most successful remix from 1998. The track is discussed in greater detail in §2.8.5 (Notation 26).

68	Pete Rock & CL Smooth - They Reminisce Over You (T.R.O.Y.)		
Style:	Hip Hop / Sample Hip Hop / Jazz Hip Hop	Year	1992
Label:	Elektra	Medium	Maxi

From two bars of a saxophone solo by Tom Scott and a heavy drum loop, Pete Rock created one of the most characteristic instrumentals of late *Sample Hip Hop* (Williams, 2007, p. 38)) The duo's rootedness in the rap paradigm of the 1980s is also evident in the fact that the DJ/producer is named before the vocalist(, as in Jazzy Jeff & The Fresh Prince or Eric B. & Rakim) (Johnson, 2007, p. 477).

69	Phyllis Dillion - Don't stay away		
Style:	Reggae / Ska	Year	1967
Label:	Treasure Isle	Medium	Single

Phyllis Dillon was the defining female vocalist of the early Treasure Isle label. "Don't Stay Away" has an unusual tempo situated between *Ska* and *Rocksteady*, but it remains one of the most representative recordings for both the artist and the label.

The recording used here is a contemporary Jamaican single.

70	The Prodigy – Out of Space		
Style:	Electronica / Happy Hardcore / Rave	Year	1992
Label:	XL Records	Medium	Maxi

his Prodigy production combined *Reggae* samples from Max Romeo with breakbeats at what was still a comparatively early stage - a combination that would later become a common feature of British electronic dance music. After several respectable successes in the British charts, such as "Charly," the formation around producer Liam Howlett established itself internationally with "Out of Space" as one of the most important *EDM* acts of the 1990s. (Günther, 2019)

71	Ray Charley – Hit the Road Jack		
Style:	Soul / Rhythm & Blues	Year	1961
Label:	HMV Pop / EMI	Medium	Single

The international success of "Hit the Road Jack" anchored danceable Southern *Rhythm & Blues* far beyond the American mainstream and prepared the way for the transition toward *Soul* music (Lydon, 2004, p. 204ff). This is the oldest track in the sample; it is available here as a contemporary British pressing in excellent condition.

Figure 50: Selected recordings, *Soul*/7-inch singles: Ray Charles – "Hit the Road Jack" (71), Hector Rivera – "At the Party" (37), and The Contours – "Do You Love Me" (20)

72	Reese and Santonio - The Sound (Smoothe Mix)		
Style:	Electronica / Techno	Year	1987
Label:	KMS	Medium	Maxi

This style-defining *Techno* production by Kevin Saunderson is discussed in §2.8.2. The recording used here is the original U.S. pressing.

73	Reprazent - Brown Paper Bag (Full Rap Remix)		
Style:	Electronica / Drum & Bass	Year	1997
Label:	Talkin' Loud	Medium	Maxi

"Brown Paper Bag" is the lead single from *New Forms*, the album by Reprazent, the DJ collective centred around *Drum & Bass* star Roni Size. Its high production standard and sophisticated *Jazz* borrowings helped establish *Drum & Bass*, now emancipated from *Jungle*, both as a mainstream phenomenon and as a critical favourite

(Diver, 2010) The version used here is the vocal mix from the original limited-edition double maxi-single

---

74	Rick Ross - Blowin Money Fast (B.M.F.) (feat. Styles P)		
Style:	Hip Hop / Trap	Year	2010
Label:	Def Jam	Medium	Digital

"B.M.F." corresponds to the production paradigm of early Southern *Trap*, which grew out of the sonic aesthetic of *Crunk*. All the typical elements of the style are present in this track: the slow tempo, hi-hat rolls, sustained sine-wave kick drums, and minimal harmonic context. (DJ Mag, 2013)

75	Rihanna - Work (feat. Drake)		
Style:	Hip Hop / RnB / Dancehall	Year	2015
Label:	Roc Nation	Medium	Digital

"Work" is one of the many *R&B* hits from the second half of the 2010s that prominently incorporate elements of Afro-Caribbean music. The instrumental of the duet can be described as minimalist, harmonic *Dancehall*; fittingly, the lyrics are written in Jamaican Patois (Rani, 2016). The distinctive sonic features of this commercially extremely successful club hit are discussed in §2.9.3 with reference to Notation 25.

5.2.4 Tracks 76-100

76	Run DMC – My Adidas		
Style:	Hip Hop / Oldskool	Year	1985
Label:	Def Jam	Medium	Maxi

The prominent role played by Run-DMC and their music - especially "My Adidas" - in establishing *Hip Hop* as a commercial youth culture is discussed in detail in §2.7.3.

Figure 51: : Selected recordings, 1980s *Hip Hop*: 2 Live Crew – "Me So Horny" (1), Sugarhill Gang – "Rapper's Delight" (86), and Run-DMC – "Walk This Way / My Adidas" (76)

77	Sam & Dave – Soul Man		
Style:	Soul / Southern Soul	Year	1967
Label:	Bellaphon (Stax / Atlantic)	Medium	Single

"'Soul Man' epitomizes the Stax sound as much as any record." The song remains the most successful single released by Stax, the most influential *Southern Soul* label. Written by Isaac Hayes, the track already shows tentative borrowings from James Brown's *Funk*. At the same time, the musical distance from the far more modern-sounding productions emerging in the North at the same moment is unmistakable (Bowman, Soulsville U.S.A. - The Story of Stax Records, 2011, pp. 202-203).

The recording used here is a German repressing from 1983, released as part of Bellaphon's Oldies series. Since remastering was not yet common at that time, it can likewise be assumed that this is not a remaster.

78	Sean Paul – Like Glue

Style:	Tropical / Dancehall	Year	2001
Label:	K-Licious Music	Medium	Single

"Like Glue," performed over Tony Kelly's successful "Buy Out" riddim, is one of three internationally successful singles from Sean Paul's album *Dutty Rock*. In the early 2000s, this album played a decisive role in the crossover of Caribbean music into the African American mainstream (Hope, 2006, p. 22; Jackson, 2012; Brathfisch, 2003, p. 384).

The track follows the sonic aesthetic and typical clave pattern of 1990s *Dancehall* (Notation 17). The recording used here is an original Jamaican single, released one year before the international release as part of a riddim selection.

79	Shimon & Andy C - Bodyrock		
Style:	Electronica / Drum & Bass	Year	2001
Label:	RAM Records	Medium	Digital

"Bodyrock" was the first purely instrumental *Drum & Bass* track to achieve notable mainstream success in the United Kingdom. With its hard synthesizer basses and shuffle rhythm, unusual for *EDM*, the track is regarded as a much-imitated blueprint for the substyle *Clownstep* (Jenkins, 2016; Anderson-Rich, 2018).

80	Skrillex - Bangarang (feat. Sirah) (Original Mix)		
Style:	Digital / Dubstep (Brostep)	Year	2011
Label:	Big Beat Records	Medium	Digital

"Bangarang" is the commercially most successful and most prototypical production by the U.S. *EDM* superstar Skrillex. Through his mainstream adaptation of British *Dubstep*, Skrillex became one of the defining producers of American electronic music in the 2010s. A discussion of the track's production and sonic aesthetic can be found in §2.8.4 (cf. Figure 11).

81	Sly & The Family Stone - Thank You (Falenttinme Be Mice Elf Agin)		
Style:	Soul / Funk	Year	1969
Label:	Epic	Medium	Single

Larry Graham's slap-bass technique and its significance for *Funk* music are discussed with reference to "Thank You" in §2.6.1 (see Notation 12).

The recording used here is a German pressing from 1970.

82	Snap! - The Power		
Style:	Electronica / Hip House	Year	1990
Label:	Ariola	Medium	Maxi

The internationally successful German dance production "The Power" combines *EDM* and *Hip Hop* elements at an early stage. It may thus be understood as anticipating the later emergence of *Breakbeat Electronica* styles. The version used here is the world-market version featuring vocals by Turbo B., rather than the earlier version successful in Germany, which used legally unresolved samples. This version quickly came to be perceived as the "standard" version (Blatt, 1990). The recording used here is a German 12-inch maxi pressing.

83	Snoop Doggy Dogg – Who Am I? (What's My Name?)		
Style:	Hip Hop - G-Funk	Year	1993
Label:	Death Row Records	Medium	Maxi

The reason two tracks by the American rapper Snoop (Doggy) Dogg are included in this selection lies in the choice of producers. With "Who Am I?," Dr. Dre brought the *G-Funk* style he had created to global prominence and established himself as the most important *Hip Hop* producer on the U.S. West Coast (Diallo, 2007, p. 327) Of particular note is the track's characteristic synth bass, modelled on *P-Funk*.

84	Snoop Dogg – Drop it like it's Hot (feat. Pharrell)		
Style:	Hip Hop / Club Hip Hop	Year	2004
Label:	Geffen	Medium	Maxi

The second Snoop Dogg track was produced ten years later by Pharrell Williams and belongs to the sonic world of a different generation (Diallo, 2007, p. 329)Apart from its sustained tonal kick drums, the track is marked by a staccato minimalism typical of early-2000s *Club Hip Hop*. In a recent list of the most important music producers of the twenty-first century, *Billboard* ranked Pharrell Williams at number two, not least because of this creative phase (Billboard Magazine, 2021).

85	Soul II Soul - Back to Life (Jam)		
Style:	Electronica / UK Soul Sound	Year	1989
Label:	Epic	Medium	Maxi

"Back to Life" is the most important song of the British soul sound-system era and is discussed in §2.8.4. The recording used here is the club mix from the original British 12-inch pressing.

86	Sugarhill Gang – Rapper's Delight		
Style:	Hip Hop / Oldskool	Year	1978
Label:	Metronome (Sugarhill)	Medium	Maxi

The emergence and relevance of "Rapper's Delight" have already been discussed in detail in §2.7.2. The recording used here is a German licensed pressing from 1979.

87	The Beginning of the End - Funky Nassau		
Style:	Soul / Funk	Year	1971
Label:	Alston Records	Medium	Single

"Funky Nassau" combines American *Funk* with subtle influences from Caribbean *Junkanoo* music. The Bahamian band deliberately sought to sound modern and American, rather than conforming to the tourist cliché of tropical islanders, and therefore recorded in Florida. This may also help explain why "Funky Nassau" achieved commercial success in the United States and entered the canon of classic *Funk* music. (Rommen, 2011, pp. 3, 186, 203)

The recording used here is a U.S. pressing on the original Alston label.

88	The Contours - Do you love me		
Style:	Soul / Rhythm & Blues	Year	1962
Label:	Gordy	Medium	Single

As described in §2.4.3, "Do You Love Me" marks the beginning of the transition from *Rhythm & Blues* to *Northern Soul*, particularly with regard to James Jamerson's bass playing.

89	The Jackson 5 - Want you Back		
Style:	Soul / Northern Soul	Year	1969
Label:	Motown	Medium	Single

The already highly successful debut single "I Want You Back" combines a distinctive Motown bass line, doubled by the piano, with a desexualized *Funk* aesthetic. This led both to major mainstream success, culminating in Michael Jackson's arguably unique career, and to the enduring relevance of the track itself. (Cooper & Schurk, 2012) This relevance is reflected in the large number of *Hip Hop* tracks from virtually every era that have sampled "I Want You Back": the sample archive WhoSampled.com currently lists 87 samples between 1986 and 2020 . (WhoSampled.com)

90	The Rock Steady Crew - (Hey You) The Rocksteady Crew		
Style:	Hip Hop / Elektrofunk	Year	1983
Label:	Atlantic (Charisma)	Medium	Single

he Rock Steady Crew was originally one of the most prominent and talented first-generation breakdance groups. Through the films *Wild Style* and *Beat Street*, as well as through contacts in Afrika Bambaataa's circle and their subsequent admission into the Zulu Nation, they secured a record deal. This form of *Electro-Funk* as breakdance pop was typical of the early-1980s mainstream commercialization of *Hip Hop* culture. Riding the breakdance wave, the track became an international commercial success, including in Europe. (Osumare, 2002, pp. 32-33).

The recording used here is a contemporary U.S. licensed pressing on Atlantic Records.

91	The Supremes - Can't Hurry Love		
Style:	Soul / Northern Soul	Year	1966
Label:	Motown	Medium	Single

The girl group The Supremes, centred around Diana Ross, was among the most important acts on the Motown label. Their number-one hit "You Can't Hurry Love" remains one of their best-known songs. The simple but effective Jamerson bass line foregrounds his one-finger playing technique, known as the "hook," and is one of the most iconic bass lines in the history of popular music (Ribowsky, 2009, pp. 254-255).

92	Tony Rebel - If Jah		
Style:	Reggae / Dancehall	Year	1997
Label:	Flames Records	Medium	Maxi

Tony Rebel is regarded as a pioneer of the "Cultural Riddim Shift" (Brathfisch, 2003, p. 421) or "Rastafari Renaissance" (Stolzoff, 2000, p. 113),): the return of *Dancehall* to Rastafari themes and *Roots Reggae*, which was a major factor in Jamaican dance music of the 1990s. "If Jah" exemplarily combines a *Dancehall* beat with a *Reggae* arrangement and devout Rastafari lyrics, and stands as one of the genre's major crossover hits. Among other things, it was translated into Spanish and long served as the unofficial anthem of the Jamaican national football team. (Brathfisch, 2003, pp. 421-422)

93	U-Roy & John Holt - Wear you to the Ball		
Style:	Reggae / Rocksteady (DJ Dub)	Year	1964
Label:	Treasure Isle	Medium	Single

In the version used here, "Wear You to the Ball" is a very early *DJ Dub* from the formative phase of *Rocksteady*. The recording had previously been released by The Paragons, John Holt's vocal trio, and was then reissued with added toasting by U-Roy, the "Father of Deejaying" (Brathfisch, 2003, pp. 377, 533-534).

It is not only a typical recording from this phase of the Treasure Isle catalogue, but also an example of the beginnings of speech-based vocal practices in modern dance music, from which later rap- and deejay-centred styles would emerge.

94	Usher - Yeah! (feat. Lil Jon & Ludacris)		
Style:	Hip Hop / Crunk	Year	2003
Label:	Arista	Medium	Digital

This mainstream-compatible adaptation of the Southern *Hip Hop* style *Crunk* is probably the most successful track of 2004. It topped both *Billboard*'s year-end chart and the U.S. airplay charts, and also reached the top of the charts in all key European markets (Hicks, 2019; Vineyeard, 2005; Westhoff, 2011, p. 160ff).

With its cutting synth leads, sine-wave basses, and TR-808 drums, “Yeah!” anticipated the development of *Trap* and *Twerk Bass* and remains a relevant club track.

95	Vybz Kartel - Romping Shop (feat. Spice)		
Style:	Tropical / Dancehall	Year	2009
Label:	Tad’s Records	Medium	Digital

With “Romping Shop,” a relevant *Dancehall* track once again entered the U.S. mainstream several years after the Sean Paul era (Seitaram, 2021; Serwer, 2016).

The track is built on the instrumental basis of Ne-Yo’s *R&B* hit “Miss Independent,” whose harmonic and sonic vocabulary is translated into a Jamaican *Dancehall* context. “Romping Shop” is thus typical of *Dancehall* of its period: both beat and bass follow a clave-based pattern, while the borrowings from contemporary U.S. *R&B* are unmistakable.

96	Wamdue Project - King Of My Castle		
Style:	Electronica / House	Year	1998
Label:	Strictly Rhythm	Medium	Digital

The version usually referred to as the original version - in contrast to the 2009 version - is, strictly speaking, a remix by Roy Malone. In this form, “King of My Castle” is one of the most internationally successful *House* tracks of the 1990s (Smith D. , 2021).

A digital version was used here, since, due to the SARS-CoV-2 pandemic, two ordered copies could not be delivered from the United States.

97	Wayne Smith - Sleng Teng		
Style:	Tropical / Dancehall / Digital Dancehall	Year	1985
Label:	Witty (Jammys)	Medium	Maxi

With this track, producer King Jammy founded *Digital Dancehall* and tropical bass music. The track is discussed in greater detail in §2.7.6.

Figure 52: Selected recordings, *Reggae* 12-inch singles: Barrington Levy – "Here I Come" (8), Culture – "Jah Jah See Dem a Come" (20), and Wayne Smith – "Under Mi Sleng Teng" (97)

98	Whispers – It's A Love Thing		
Style:	Soul / Funk	Year	1980
Label:	Solar	Medium	Maxi

"It's a Love Thing" is a typical *Disco Funk* track of its period. The Worrell-inspired synthesizer basses are the reason for its inclusion in this sample (Hamilton, 1981). Unlike "And the Beat Goes On," "It's a Love Thing" was not a global hit, but it did reach number two on the *Billboard Hot R&B* chart as well as top-20 positions in several European countries, making it sufficiently relevant for the present sample (Billboard Magazin, 2021). The recording used here is a U.S. pressing from the author's collection.

99	Wiley, Stefflon Don & Sean Paul - Boasty (feat. Idris Elba)		
Style:	Tropical / Dancehall / UK Rap	Year	2019
Label:	BMG	Medium	Digital

The illustrious collaboration “Boasty” illustrates the fusion of *Hip Hop*, electronic music, and *Tropical Bass* at the end of the 2010s (White J. , 2021, p. 263).

100	Zion Train - Follow like Wolves		
Style:	Electronic / Dub	Year	1994
Label:	Universal Egg	Medium	Single

“Follow Like Wolves” combines borrowings from sound-system *Dub* with elements of *Acid House* and *Progressive House*, bringing together two of England’s major music scenes and laying important groundwork for *Jungle*, *Big Beat*, and *Dubstep* (Larkin, 2000, p. 437).

The recording used here is the original Universal Egg release No. 1.

5.3 Online Survey

The 100 tracks selected in this way were evaluated, among other things, for their fatness by 68 participants in an online listening experiment conducted in autumn 2020. A subset of the participants consisted of 37 professional DJs and music journalists from the fields of *Hip Hop*, *EDM*, and *Tropical*. Their expertise, in distinction from that of non-professional scene-goers, can be empirically demonstrated.

5.3.1 Experimental Setup

5.3.1.1 Original Experimental Setup

Originally, a second listening experiment was planned in a standardized studio setting. For this purpose, a sufficiently large group of dance-music-oriented participants would have been recruited.

addition, this study would have been conducted in mono rather than stereo in order to avoid possible comb-filter effects (Dickreiter, Dittel, Hoeg, & Wöhr, 2008, p. 356). The study would have consisted of two parts:

1) **Evaluation of test tones, as in the first listening experiment:** Here, however, the test tones would have been generated dynamically and automatically in MATLAB during the survey. This would have ensured greater continuity in the data and better coverage of the data space of dance music. The latter would have been determined through an analysis of the dance-music sample described in §5.2.
2) Evaluation of 30-second excerpts from the tracks described in §5.2, with participants asked to assess their perceptual fatness.

5.3.1.2 Probleme des Infektionsschutzes

The research project *Bass Drop!* was finalized shortly before the outbreak of the SARS-CoV-2 pandemic in Germany. With the declaration of an “epidemic situation of national significance” by the German Bundestag on 25 March 2020, the conditions for both qualitative and quantitative research changed fundamentally. (Presse- und Informationsamt der Bundesregierung, 2020)

Initially, it was merely apparent that disruptions to international shipping routes - particularly from the United Kingdom, Canada, and the United States - were significantly slowing the compilation of the music sample. By late summer 2020, however, there was still no sign of any fundamental easing of the pandemic situation.
Under these conditions, empirical research requiring the physical presence of participants would have been neither ethically nor practically feasible, nor compatible with the regulations of the University of Hamburg.
Conducting the study would in any case have entailed an avoidable health risk for everyone involved. Participant recruitment had already proven difficult in the preceding experiment, and it was reasonable to assume that this difficulty would be further intensified by SARS-CoV-2. Since the author's studio is not a facility of the University of Hamburg, a complex risk assessment would have been required, the outcome of which would have been uncertain given the confined spatial conditions of the studio. (Universität Hamburg, 2021)
For these reasons, it became necessary to switch to an empirical methodology that did not require physical attendance.

5.3.1.3 Practical Constraints

Der Wechsel von einer Präsenz-Befragung zu einem Online-Hörtest warf hingegen zwei neue Probleme auf:

1. the absence of a standardized and acoustically measured test environment; and
2. the long duration of the test, or rather the question of whether participants could divide the test into sections of manageable length..

5.3.1.4 Copyright Problems in the Digital Sphere

While German copyright law allows researchers to make copyrighted music publicly accessible for scholarly purposes for up to five minutes and up to 75% of the work (Kreutzer, 2020), the servers of most suitable services are not located in Germany.

oreover, the management of potential copyright infringements in the digital sphere increasingly relies on artificial intelligence and content-ID systems, which frequently produce false positives (Lester & Pachamanova, 2017, pp. 53, 57-59). These systems are also geared toward the profit interests of rights holders and platforms, and do not account for national exceptions for empirical research. Since “misguided enforcement actions” repeatedly occur even in comparable cases of fair use (Depoorter, 2013, pp. 320-321)), it is therefore preferable to use a provider that is copyright-compliant even without relying on the premise of a research exception..

5.3.1.5 Revised Experimental Design

In order to respond to the conditions of the SARS-CoV-2 pandemic in accordance with the principles of ethical research, the planned listening experiment in a recording studio was replaced by an online experiment.
With regard to the refined assessment of test sounds, it must unfortunately be noted that this can only be carried out validly under acoustically standardized listening conditions. This part of the study therefore had to be omitted. The subsequent calculations are thus based on the data already collected..

The evaluation of the music tracks, by contrast, can be conducted as an expert study. It may be assumed that individuals who regularly and professionally assess dance music according to club-specific criteria possess the expertise required to translate the sonic impression of their own monitoring environment into an expected sound image in the discotheque context.
The survey on the fatness of complex musical pieces from the field of popular dance music is therefore conducted with a group of at least 30 DJs, music journalists, or other dance-music professionals. In order to test the assumed expertise of this group, a control group of at least 30 regular discotheque-goers, or clubbers, is surveyed at the same time. In both groups, care is taken to achieve as balanced a distribution as possible across the contemporary style groups *Hip Hop*, *Electronica*, and *Tropical*.

In order to reduce the duration of the experiment to an acceptable length, a 35-second excerpt was selected from each of the 100 tracks, intended wherever possible to

correspond to the acoustic climax of the production. To determine this passage, each track was first low-pass filtered as shown in Figure 38, and the maximum of integrated loudness was then identified. Since, in numerous tracks, this climax occurs immediately before or after a longer pause, the excerpt was shifted by 30 seconds in the appropriate direction where necessary.

This procedure ensured both that the fully instrumented main section or bass drop was included in the sample, and that the sample did not consist largely of irrelevant, bass-free passages.

From these excerpts, 40 randomized rotations were generated in order to exclude any influence of presentation order. These were then automatically assembled into PCM wave files. Automatic stimulus numbering was generated in MATLAB using text-to-speech, in order to provide participants with the clearest possible orientation. The resulting stimulus files have a duration of approximately 65 minutes.

To improve participant compliance, this still very long experiment was designed so that participants could divide it into sections at their own discretion. Since the online survey tool used previously, SoSciSurvey, does not offer this function, the survey was conducted using cloud-based shared spreadsheets in Google Sheets. The stimulus files were made available via Mixcloud. Unlike many other services, Mixcloud pays royalties under the comparatively liberal British regulations governing copyright on the internet. This provided the desired protection against takedowns in the digital sphere. (Perez, 2020; Mixcloud)

To ensure that participants' responses represented valid judgments of the perceptual fatness of bass, the order of the survey items was designed with priming in mind. Before fatness was assessed, participants were first asked to rate liking, that is, their preference for the specific track presented (Brattico, Bogert, & Jacobsen, 2013, pp. 3, 5-6), taste, that is, their preference for the style of the track presented (Brattico, Bogert, & Jacobsen, 2013, pp. 12-13) , and perceived modernity. On the one hand, this was intended to prevent fatness from being misunderstood as a judgment of taste or production quality; on the other, it made it possible to test the assumed expertise and objectivity of the professional group. All these judgments were collected using eleven-

point Likert scales. Participants were asked to use the scale as continuously as possible (cf. the experimental instructions in the appendix).

5.3.2 Implementation and Demographics

The survey was conducted between 22 September 2020 and 12 October 2020. Participants were recruited via the social media platform Facebook. A pretest with six participants had previously confirmed the feasibility of the study and led only to minor clarifications in the experimental instructions. Most participants came from the author's network of DJs, producers, and music journalists from various styles, built up over twenty years of involvement in dance music. Additional participants, particularly clubbers from the field of electronic music, were recruited through online communities associated with the respective styles.

	Total	DJs	Clubber
N	68	37	31
Age Ø	38,16	40,45	35,41
Experience Ø	-	19,62	-

Subgroups

Table 18: Distribution of the Respondent

The complete absence of women among the professional participants is regrettable. Even targeted recruitment of female DJs and repeated deadline extensions did not improve the low response rate in this group.

The generally low completion rate of 68 successful participations out of 128 recruitments, approximately 53%, is presumably attributable to the long duration of the experiment. Nevertheless, owing to the high level of interest, the intended participation quotas were exceeded. The near-even distribution of DJs across styles is welcome, as is their largely long-standing professional experience.

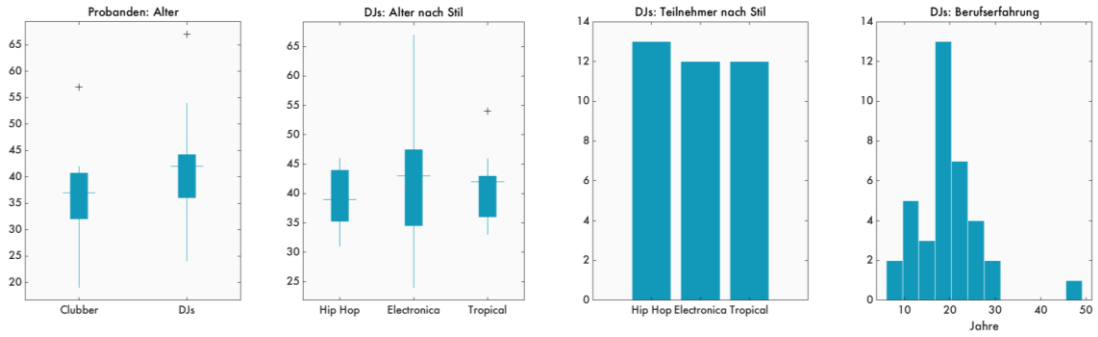


Figure 53: Stage 3 of Data Collection, Demographic Data (Age, Age by Genre, n by Genre, Experience)

A consideration of the DJs' self-reported stylistic preferences (Figure 54) reveals four particularly noteworthy patterns:

1) The boxplots for the *Hip Hop* and *Tropical* DJs are very similar. Although other styles partly correspond more closely to the median taste, both groups show a high degree of agreement in their strong preference for their respective style.
2) *EDM* DJs, by contrast, display a markedly more heterogeneous taste profile. This is evident in particular from the high standard deviations across all styles. It may suggest that the field of electronic dance music could be subdivided more precisely. In addition, a relative postference can be observed for both historical and recent tropical music.
3) Historical dance-music styles receive higher ratings in every group than the respective group's main style. Among *Hip Hop* and *Tropical* DJs, *Reggae* receives the highest median rating; among electronic DJs, *Soul* corresponds most closely to the median taste.

This may be explained by the fact that the historical tracks in the sample have remained relevant for so long precisely because, over an equally long period, they have proven capable of corresponding to the changing meta-tastes of different scenes. This is also supported by a correlation between taste and year of release of $r = -.471$, with $p < .001$.

The pairings of *EDM* with *Soul*, and of *Hip Hop* with *Reggae*, can be explained by the rootedness of *Hip Hop* in *Reggae* and *Dancehall* culture. The exceptionally strong preference of *Tropical* DJs for *Reggae* may even suggest that, for them, *Tropical* and *Reggae* do not constitute separate genres.

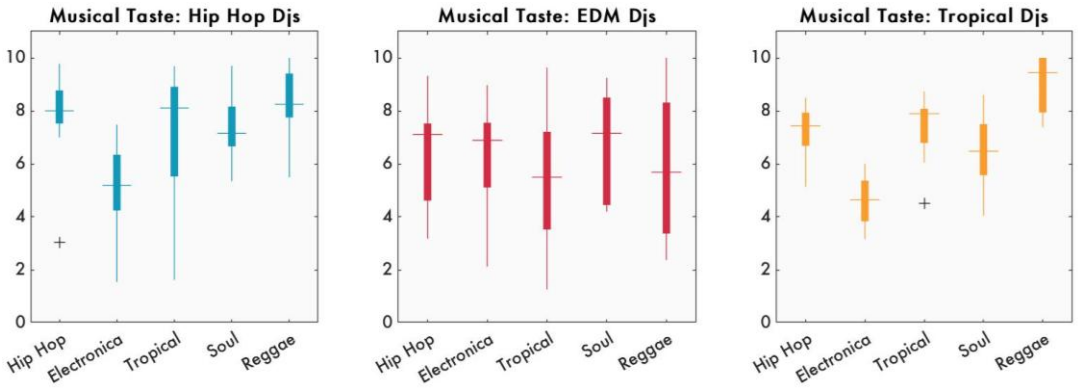


Figure 54: Musical Taste of Professionals by Scene

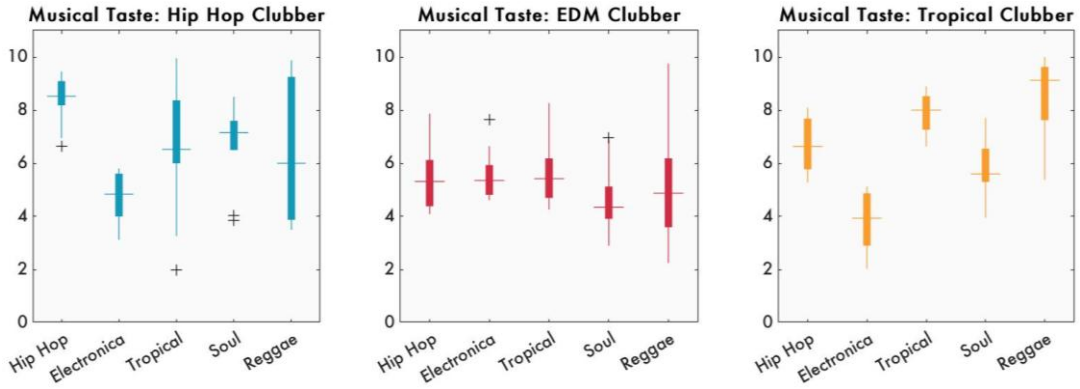


Figure 55: Musical Taste of Clubbers by Scene

4) In the subsample of clubbers (Figure 55) , stronger dispreferences become apparent, especially among followers of *Hip Hop* and *EDM*. This suggests that DJs tend to approach music more eclectically. In the *Tropical* scene, by contrast, the taste ratings of DJs and clubbers are very similar. This allows for the assumption that, in mainstream scenes such as *Hip Hop* and *EDM*, passive participation requires less engagement with music than active participation. In less popular scenes such as *Tropical*, this discrepancy appears to diminish.

Overall, the stylistic taste profile corresponds to expectations. DJs in all three styles show a convincing preference for their own style and for styles associated with it. A tendency toward musical eclecticism is particularly evident among *Hip Hop* and *EDM* DJs, although it is also present, to a somewhat lesser extent, in the *Tropical* field.

5.3.3 Analysis of Expertise

Beyond the question of genre attribution, the validity of an expert survey naturally depends on the expertise of the participants. In the present case, this expertise consists in the ability to assess the relevant sonic properties of a broad stylistic field of dance music as independently as possible from personal taste.

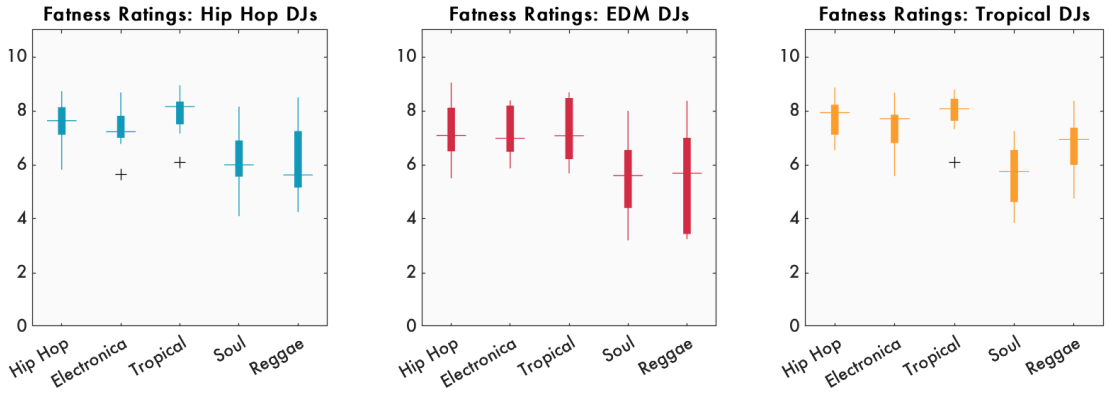


Figure 56: Fatness ratings of professionals by scene and style

Support for this expertise can be found in the fact that the fatness judgments appear considerably more homogeneous than the taste judgments, although the *EDM* DJs once again show a higher degree of disagreement.

This assumption of expertise can be tested as follows: first, a correlation coefficient is calculated for each participant between their fatness judgments and their taste judgments. This coefficient can then be examined for target-group specificity by means of an analysis of variance.

	n	Mean	SD	StdErr	95% Confidence Intervall		Mini-mum	Maxi-mum
					Lower Bound	Upper Bound		
Clubber	31	0,3689	0,2414	0,0434	0,2803	0,4574	-0,1138	0,7091
DJs	37	0,1517	0,2565	0,0422	0,0662	0,2372	-0,5884	0,5927
Total	68	0,2507	0,2708	0,0328	0,1852	0,3163	-0,5884	0,7091

ANOVA

Correlation coefficient: fatness vs. taste

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0,796	1	0,796	12,753	0,001
Within Groups	4,117	66	0,062		
Total	4,913	67			

Table 19: Analysis of Variance of Professional Expertise

The ANOVA suggests that the two groups differ highly significantly with regard to the relationship between taste and judgments of fatness. A violation of the assumption of homogeneity of variance is not indicated, given a Levene statistic of 0.819. Since the Pearson product-moment correlation can also be calculated for dichotomous variables such as group membership, a corresponding test of this relationship yields $r = -.402$and $p = .001$. Here, clubbers were internally coded as 0 and DJs as 1.

It may therefore be assumed that DJs and other dance-music professionals make more professionally objective judgments with regard to sonic criteria such as perceptual fatness. The following calculations can therefore be based on the responses of the 37 participating DJs.

5.3.4 Fatness vs. Time

The assumption that fatness is a positive quality in popular dance music, one that has been successively optimized over the course of its development, can be tested by means of regression analysis. If this assumption is correct, it should be possible to calculate a significantly monotonically increasing fatness as a function of time.

Using the arithmetic mean of the expert group's fatness judgments as the basis, the following prediction function is obtained by means of logit regression:

$$f(x) = \frac{1}{0.11085 + exp\,(-(-63.42 + 0.033632 * x))}$$

Both the overall model and the individual coefficients are highly significant at the $p < .001$level. $R^2$is .20.

The assumption can therefore be supported. The relationship between release year and fatness is also clearly visible in the graphical representation.

The predicted trajectory of fatness reaches a value of 9 in the year 2132 and approaches the maximum value of 9.0209 asymptotically, becoming effectively constant in the year 3061. The confidence interval for such long-range predictions is, however, large; for the year 2132, it amounts to ±0.6. A further increase in the fatness of dance-music production is therefore to be expected, although it will likely proceed far more gradually than in previous decades.

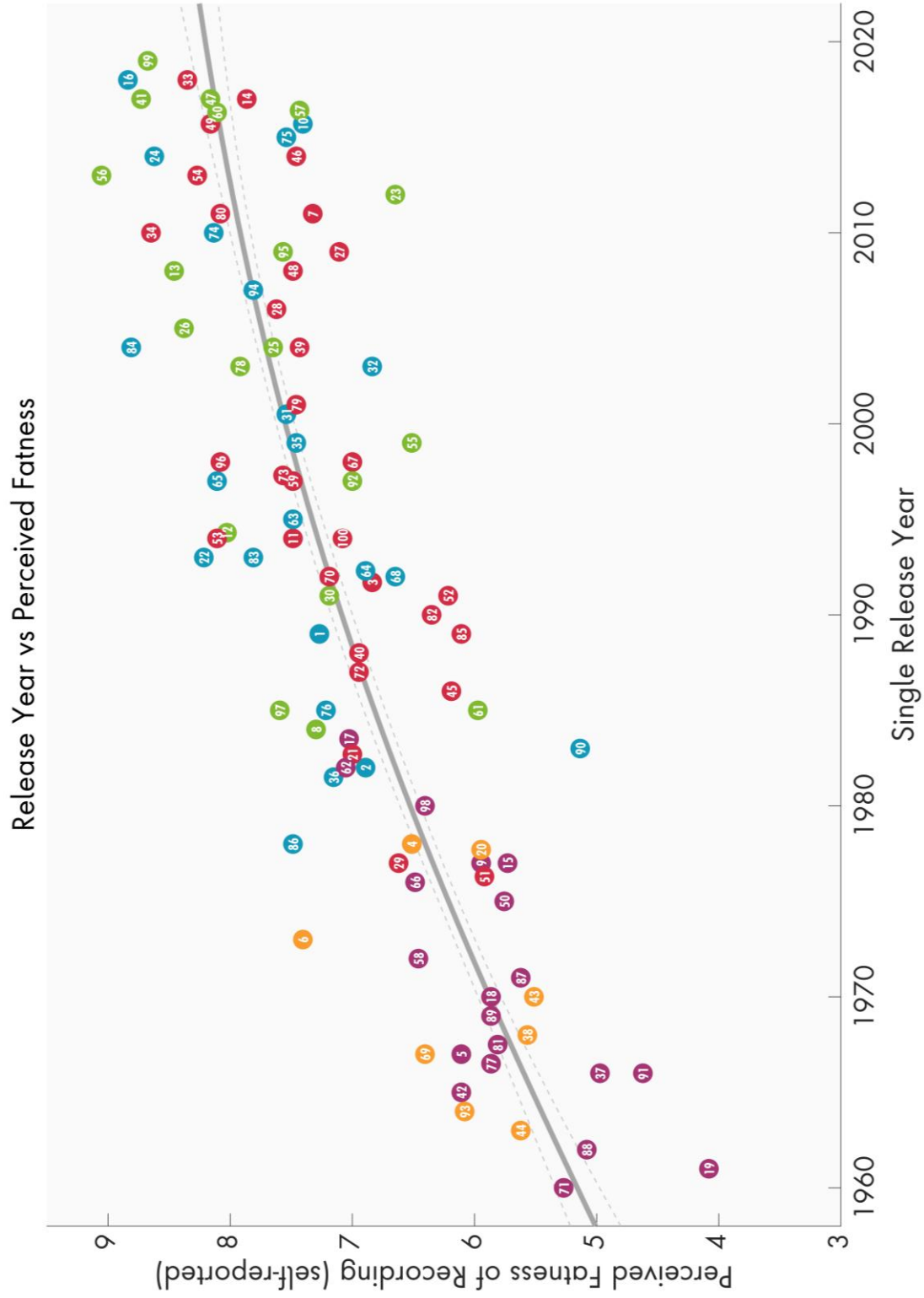


Figure 57 Release Year vs. Perceived Fatness (Professionals) / Regression

5.4 Momentary Fatness

5.4.1 Requirements

The requirements for momentary fatness are, as postulated above, as follows:

1. Momentary fatness must be based on a music-immanent calculation. Behavioural data or constructed values, such as the SNR in Chapter 4, may be used only as training data.
2. It must provide a temporal resolution well below the formal level, allowing musical structures at the event level to be captured, meaningfully analysed, and compared.
3. It must yield meaningful, significant, and plausible predictions for actual musical sounds from the field of dance music.
4. If momentary fatness or its derivatives prove unsuitable for making integrated fatness predictions for complex sounds at the formal level - or if their explained variance declines substantially in this context - then, in addition to the short-term measure of momentary fatness, a further model of integrated fatness must be developed as a long-term measure.

5.4.2 Analysis of Contributing Factors

In order to model momentary fatness, it is first necessary to examine the relationships between the individual measured features and the reported fatness perceptions of the test sounds. Since many of the measured values do not meet the criterion of normal distribution, a non-parametric correlation is calculated first. Table 20 highlights several relationships that are both significant and strong.

Feature	ρ	r	Feature	ρ	r
SPL	0,146	0,127	Spectral Flux	-0,224	0,018
SPL < 200Hz	0,219	0,022	Spectral Flux < 200Hz	-0,168	0,080
SPL > 200Hz	-0,375	< 0,001	Spectral Flux > 200Hz	-0,721	< 0,001
Centroid	-0,385	< 0,001	Spectral Kurtosis	0,323	0,001
Centroid < 200Hz	-0,26	< 0,001	Spectral Kurtosis < 200Hz	0,241	0,11
Centroid > 200Hz	-0,254	0,007	Spectral Kurtosis > 200Hz	0,156	0,105
SNR	0,287	0,002	Spectral Roll-Off	-0,385	< 0,001
SNR < 200Hz	0,321	0,001	Spectral Roll-Off < 200Hz	-0,268	0,005
SNR > 200Hz	0,300	0,001	Spectral Roll-Off >200Hz	0,378	< 0,001
Fluctuation	-0,406	< 0,001	Spectral Skewness	0,187	0,05
Fluctuation < 200Hz	-0,446	< 0,001	Spectral Skewness<200Hz	0,238	0,012
Fluctuation > 200Hz	-0,494	< 0,001	Spectral Skewness>200Hz	0,153	0,111
Spectral Crest	0,334	< 0,001	Spectral Slope	-0,034	0,722
Spectral Crest < 200Hz	0,285	0,003	Spectral Slope < 200Hz	-0,050	0,601
Spectral Crest > 200Hz	0,292	< 0,001	Spectral Slope > 200Hz	0,359	< 0,001
Spectral Entropy	-0,445	< 0,001	Spectral Spread	-0,474	< 0,001
Spectral Entropy < 200Hz	-0,359	< 0,001	Spectral Spread <200Hz	-0,273	0,004
Spectral Entropy > 200Hz	-0,334	< 0,001	Spectral Spread >200Hz	-0,170	0,076
Spctral Flatness	-0,206	0,031	Harmonic Ratio	0,311	< 0,001
Spctral Flatness < 200Hz	-0,108	0,262	Harmonic Ratio < 200Hz	0,363	< 0,001
Spctral Flatness > 200Hz	-0,104	0,279	Harmonic Ratio > 200Hz	0,263	0,013

Table 20: Correlates of Professional Fatness Ratings

5.4.2.1 Loudness Factors

As expected, there is no relationship with overall loudness, since normalization by integrated loudness was performed prior to evaluation.

The relationship between the sound-pressure level of the two lowest critical bands and perceived fatness is less clear than hoped, which can be attributed to the unfavourable distribution of values. A further survey using dynamically generated, normally distributed stimuli would have provided more insight into the range between 30 and 70 dB©, but, as discussed in §5.3.1.1, this could unfortunately not be realized under comparable listening conditions because of the SARS-CoV-2 pandemic.

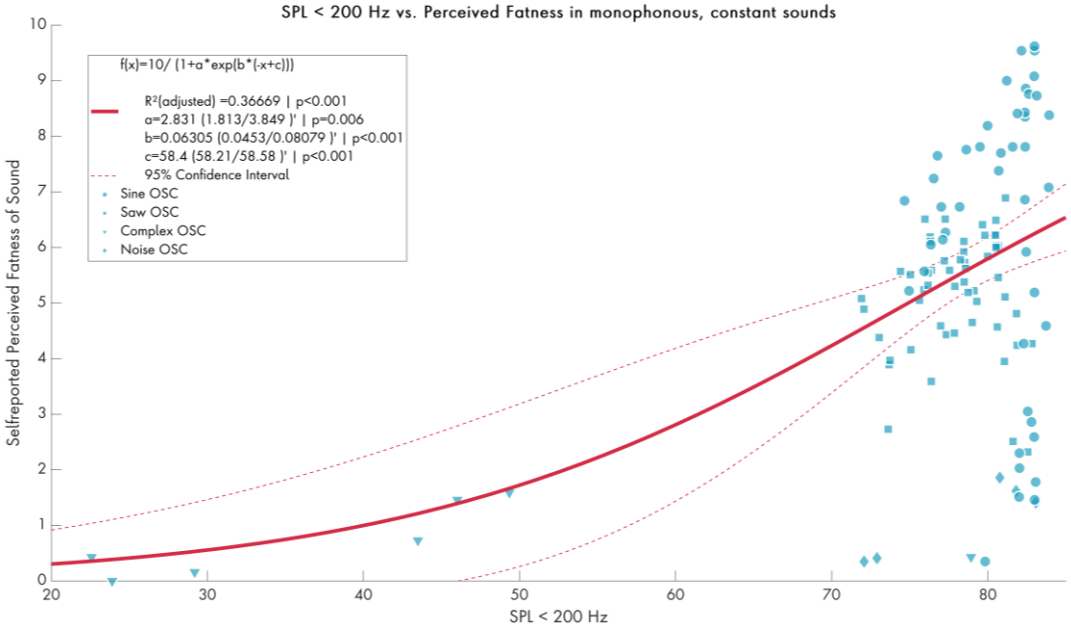


Figure 58: SPL < 200 Hz vs. Fatness, Regression

Nevertheless, the expected positive relationship is evident and also becomes clear in a logit regression. This form of modelling is used here because it appears best suited to representing, in simplified form, the principle of neural processing, with a minimum threshold and a maximum action potential. The R^2value clearly exceeds the corresponding ρvalue. The shape of the curve corresponds to the expectation that no fatness can be perceived in the absence of low-frequency sound-pressure components. High values tend to produce a stronger perception of fatness, but also a degree of dispersion

that must be attributed to further factors. Particularly interesting is the strong correlation between the standardized regression residuals and the constructed signal-to-noise ratio ($\rho = -.5871, p < .001$).

Given the pronounced right-skewness of the distribution, a logarithmic transformation of the data appears methodologically appropriate. In the transformed data, however, no significant logit regression can be calculated, since the gaps in the data are too large. Moreover, the trend reverses, predicting a negative relationship between sound pressure in the lower critical bands and fatness. This result can therefore be rejected as invalid..

Since the relationship between tonality below 200 Hz and the fatness of a sound has already been demonstrated, it is reasonable to correct the regression of sound pressure in this range for the SNR value. Since none of the available statistical applications allows non-linear regressions with robust weighting, bootstrapping, and additional factor weighting, this was done by excluding all stimuli with a noise component of at least 50%. This group is identical to the stimuli whose harmonic ratio below 200 Hz is less than 0.5. The noise-adjusted influence of sound pressure in the two lowest critical bands is shown in Figure 59.

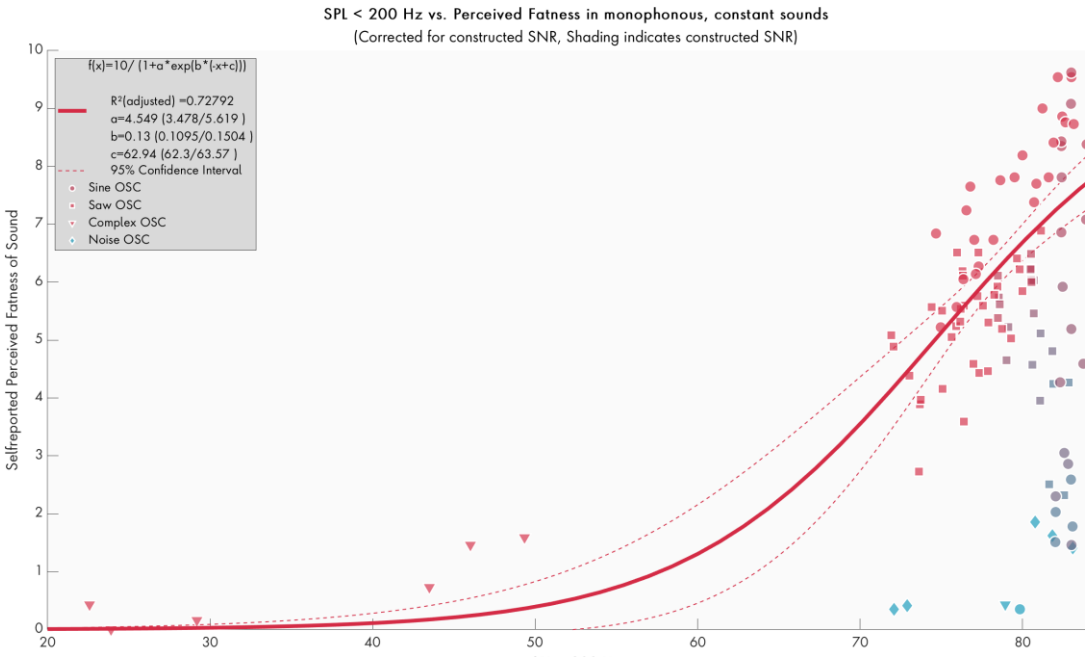


Figure 59: SPL < 200 Hz vs. Fatness, Adjusted for SNR / Regression

A comparison of the measurement ranges of the stimuli with those of the music sample reveals a good degree of overlap (Figure 60). In the representative excerpts from complex sounds, too, most measured values fall within the range between 70 and 80 dB©. The sound-pressure level below 200 Hz should therefore be considered as a component of the complex fatness model.

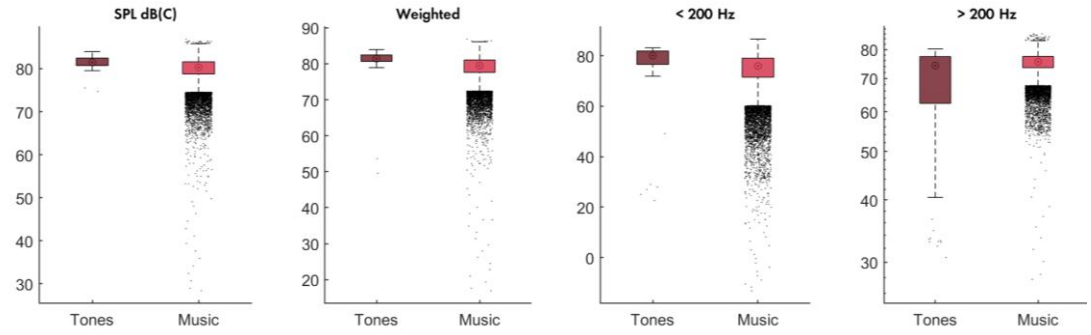


Figure 60: Measurement Ranges of the Sound-Level Measurements

As expected, the sound-pressure level in the higher critical bands correlates negatively and highly significantly with the measured fatness of the sounds. A logit regression supports this impression. It can be observed that the relationship becomes more unambiguous the lower the sound-pressure component in Bark bands 3–24 is. At high sound-pressure levels above 200 Hz, the result becomes more diffuse.

.

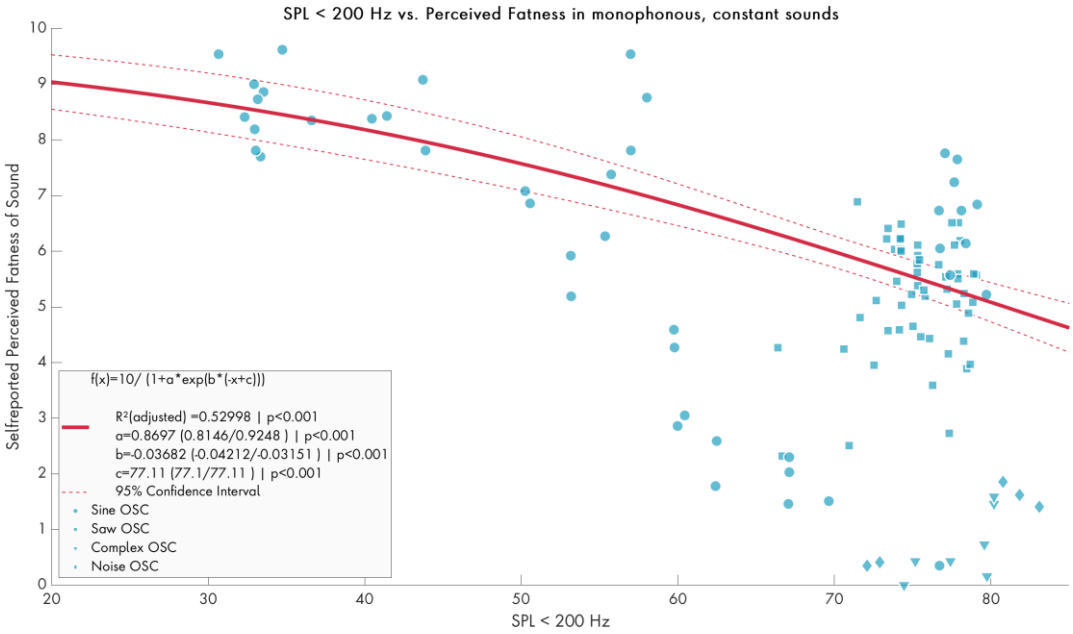


Figure 61: SPL > 200 Hz vs. Fatness, Unweighted / Regression

If this regression is then weighted by harmonic ratio - again, in this case, by excluding all values with a harmonic ratio below 0.5 - a clearer pattern once more emerges.

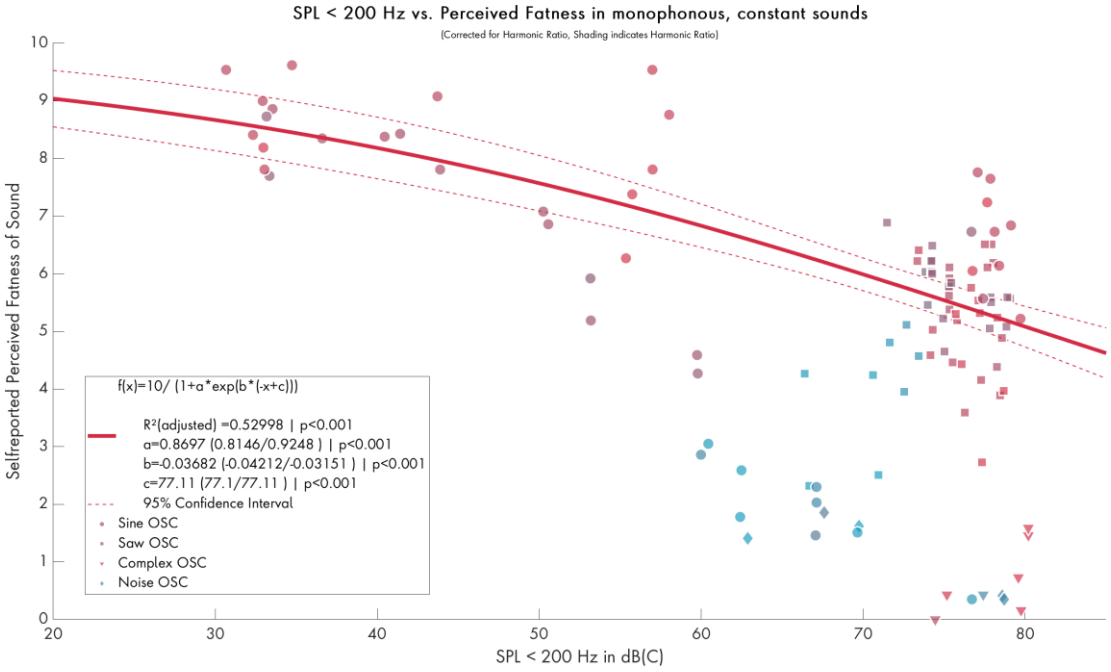


Figure 62: SPL > 200 Hz vs. Fatness, Weighted by HR / Regression

This relationship, however, appears less clear-cut than the one observed for sound-pressure level below 200 Hz. Relevant correlations of the residuals exist only with SPL < 200 Hz ($r = .359$, $p < .001$). The sound-pressure level above 200 Hz should therefore also be considered for the modelling of momentary fatness.

5.4.2.2 Pitch Factors

The findings from the preliminary model suggest that fatness is influenced, among other factors, by the spectral centroid. The correlations of the partial centroids in the respective frequency bands show very similar patterns. In addition, the rank-correlation coefficient of the aggregate centroid approximately corresponds to their sum. This suggests modelling the relationship using the aggregate centroid rather than the centroid below 200 Hz alone.

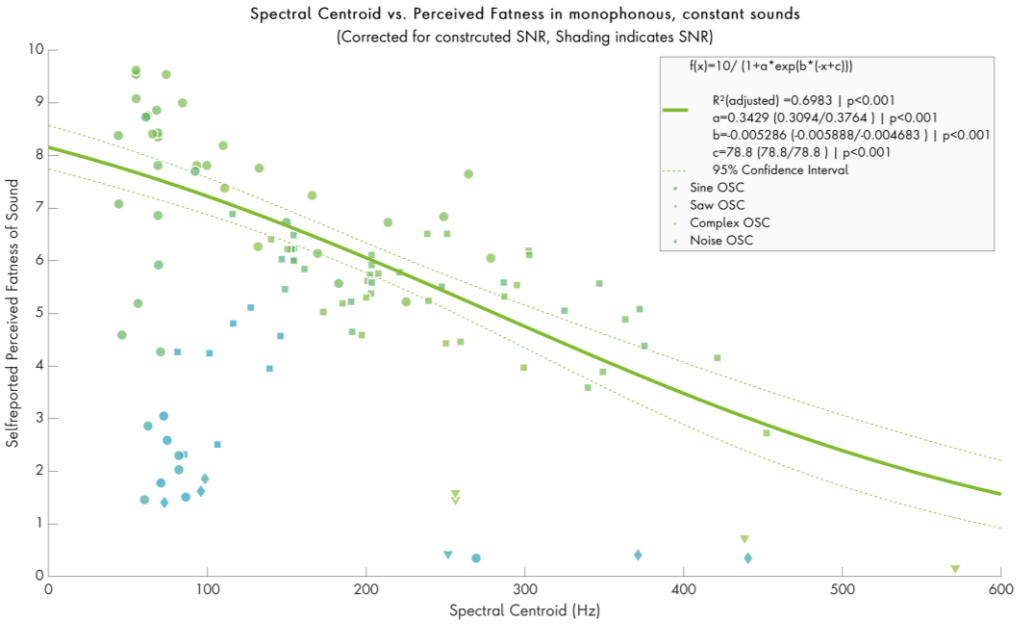


Figure 63: Spectral Centroid vs. Fatness, Adjusted for SNR

A model in which fatness decreases continuously corresponds to expectations. Moreover, overfitting at the lower end is not to be expected, since the data range is bounded by the lower threshold of hearing.

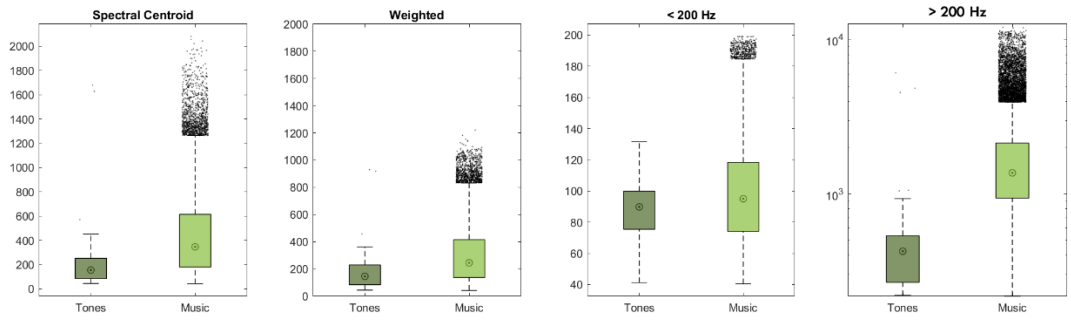


Figure 64: Comparison of the Measurement Ranges of the Spectral Centroid

The residuals correlate in particular with the constructed signal-to-noise ratio ($\rho = -.6238, p < .001$), as indicated by the shading in Figure 63, and with spectral spread above 200 Hz ($\rho = -.7374, p < .001$). To a lesser extent, the residuals correlate with harmonic ratio below 200 Hz ($\rho = -.1992,\ p = .037$) and spectral entropy ($\rho = -.2408, p = .011$).

When considering the measurement ranges, however, the discrepancy between the ranges of the aggregate centroid for the test tones and those for the music sample is striking. Because of the considerably greater dispersion in the music tracks, a systematic underestimation is to be expected. The measurement ranges below 200 Hz correspond much more closely. It therefore seems advisable to consider the centroid of this frequency band once again (Figure 65).

Although the R^2value is considerably lower here, both regressions are significant at the $p < .001$level. Both features should therefore be considered as potential predictors in the modelling of momentary fatness.

he quadratic dependence of fatness on the spectral centroid, postulated in §4.4.3 with a maximum at 77.78 Hz, is not confirmed in the weighted analysis and can therefore be rejected..

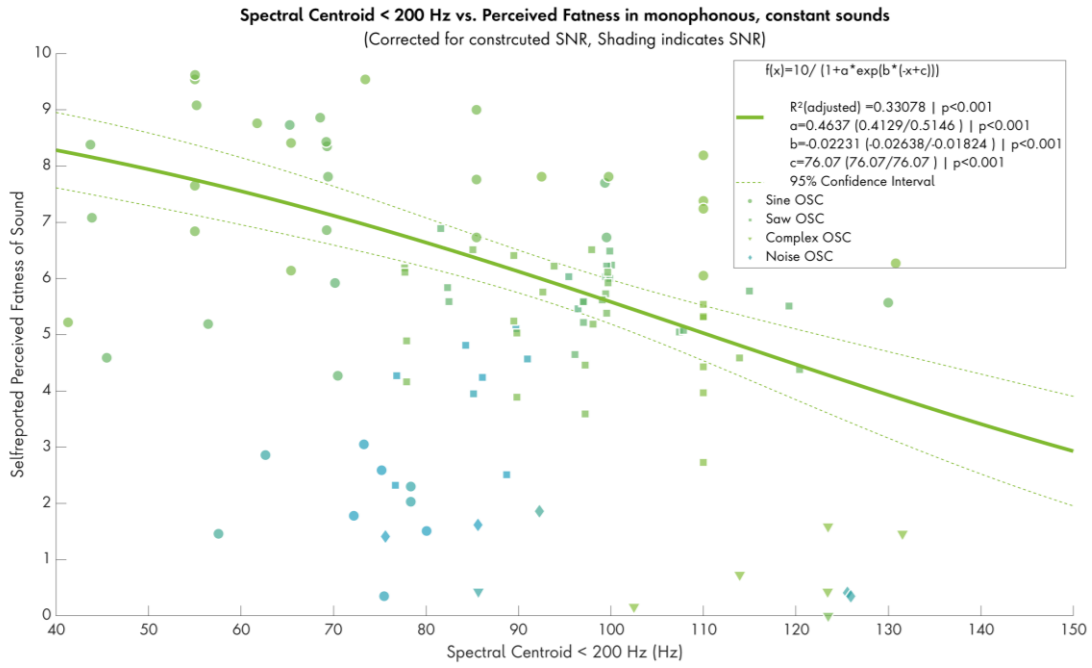


Figure 65: Spectral Centroid < 200 Hz vs. Fatness, Weighted by SNR

5.4.2.3 Tonality Factors

On the basis of the preceding observations, conventional procedures for measuring acoustic noise appear poorly suited to assessing the noise component of timbres. Their fields of application lie in noise control and signal processing, where they are designed to separate purely periodic signals from relatively constant background noise. It is therefore advisable first to compare the corresponding spectral analyses with the constructed signal-to-noise ratio.

When considering the correlates and measurement ranges, it is initially striking that the two measures from which an explanation of the noise component might be expected - namely the measured signal-to-noise ratio and spectral flatness - correlate only weakly with the constructed SNR. Their correlations with fatness are also unexpectedly weak and, in the case of spectral flatness, almost absent. In the case of SNR, this is compounded by an unfavourable correspondence between the measurement ranges, so that neither feature should be considered for the modelling of momentary fatness.

	Correlation with SNR (constructed)		Correlation with Fatness	
	ρ	p	ρ	p
Signal to Noise Ratio	-0,255	0,007	0,287	0,002
Signal to Noise Ratio < 200Hz	-0,219	0,021	0,321	0,001
Signal to Noise Ratio > 200Hz	0,12	0,21	0,3	0,001
Harmonic Ratio	0,786	< 0.001	0,311	0.001
Harmonic Ratio < 200Hz	0,783	< 0.001	0,363	< 0.001
Harmonic Ratio > 200Hz	0,680	< 0.001	0,236	0,13
Spectral Flatness	0,43	0,657	-0,206	0,031
Spectral Flatness < 200Hz	0,011	0,906	0,087	0,365
Spectral Flatness > 200Hz	-0,33	0,733	0,104	0,279
Spectral Spread	-0,88	< 0.001	-0,244	0,018
Spectral Spread < 200Hz	-0,878	< 0.001	-0,168	0,08
Spectral Spread > 200Hz	-0,669	< 0.001	-0,721	< 0.001
Spectral Entropy	-0,049	0,612	-0,445	0,001
Spectral Entropy < 200Hz	-0,663	< 0.001	-0,402	< 0.001
Spectral Entropy > 200Hz	-0,329	< 0.001	-0,334	< 0.001

Table 21: Correlates of Tonality Parameters and Perceived Fatness

	HR		HR <200Hz		sEntropy		sEntropy <200Hz		SSpread	
	ρ	p	ρ	p	ρ	p	ρ	p	ρ	p
HR	1	0								
HR<200Hz	0,363	<0.001	1	0						
sEntropy	0,146	0,129	-0,564	<0.001	1	.0				
sEntropy <200Hz	0,1	0,3	-0,576	<0.001	0,956	<0.001	1	0		
sSpread	0,36	<0.001	0,392	<0.001	-0,861	<0.001	-0,821	<0.001	1	0
sSpread <200Hz	0,315	0.001	0,639	<0.001	-0,698	<0.001	-0,696	<0.001	0,591	<0.001

Table 22: Correlates among the Tonality Parameters

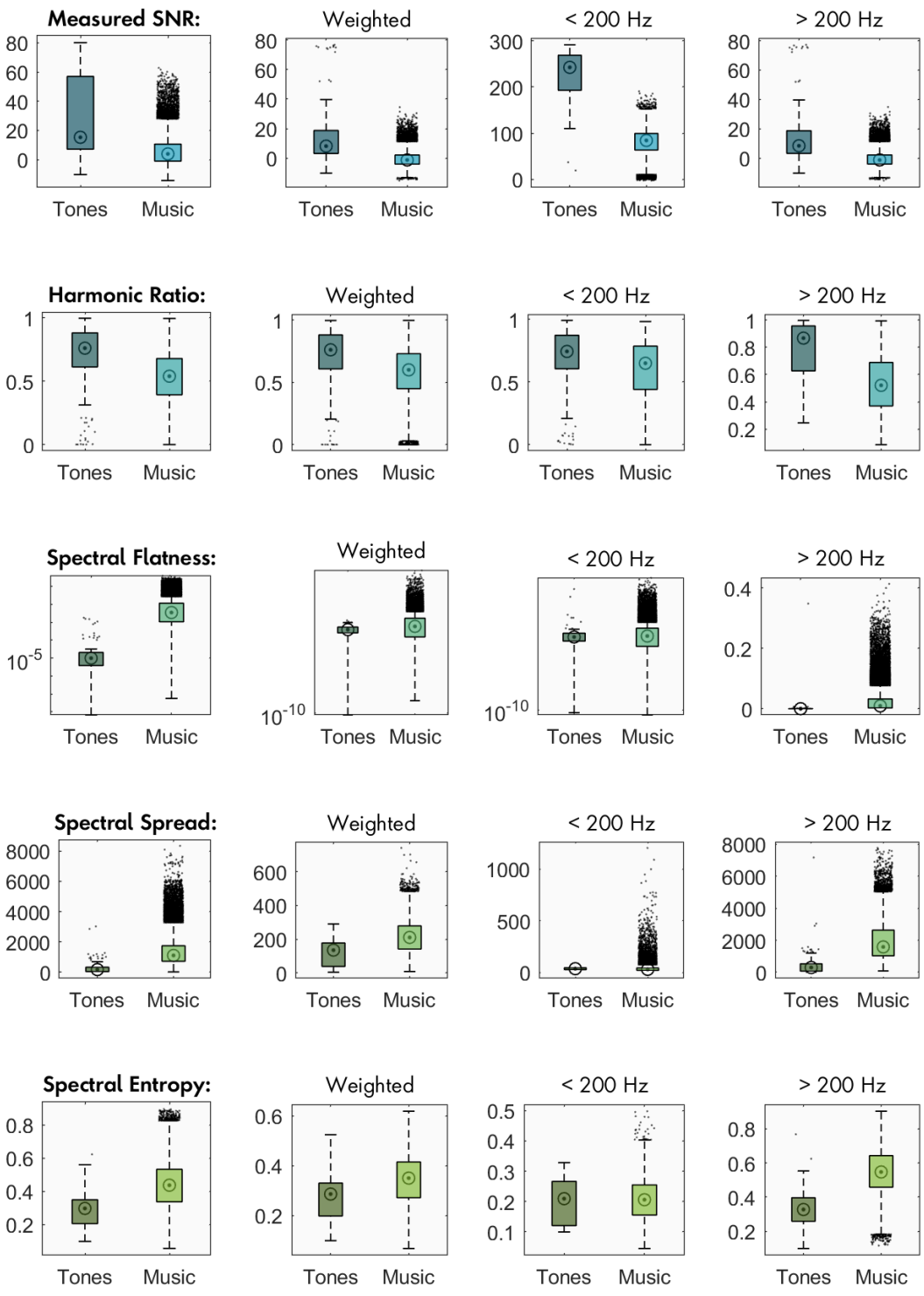


Figure 66: Comparison of the Measurement Ranges of the Measured Tonality Parameters

Spectral spread, by contrast, correlates extremely strongly with the constructed SNR across all frequency bands. For the total signal and for the upper bands, it correlates

weakly but significantly with fatness, while the measurement ranges correspond insufficiently. Although the measurement range and the SNR correlation are suitable in the two lowest critical bands, no significant correlation with fatness can be demonstrated there. Spectral spread is therefore also excluded from the list of factors..

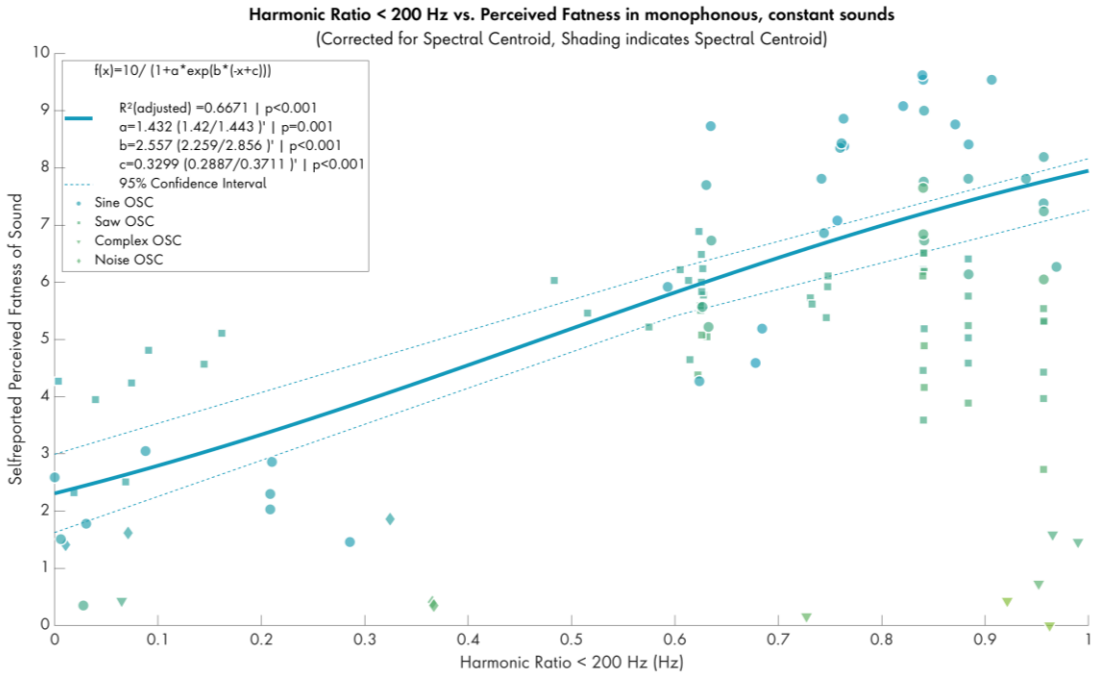


Figure 67: Harmonic Ratio vs. Fatness, Weighted by Spectral Centroid)

The harmonic ratio and spectral entropy both show promising correlations below 200 Hz with SNR and fatness. Their measurement ranges also appear sufficiently similar. While a logit regression can be calculated significantly for the harmonic ratio, with an adjusted $R^2$of .667 and a significance level of $p < .001$ (Figure 67the coefficients of spectral entropy are not significant (Figure 68). The inclusion of the harmonic ratio of the two lowest critical bands therefore appears warranted.

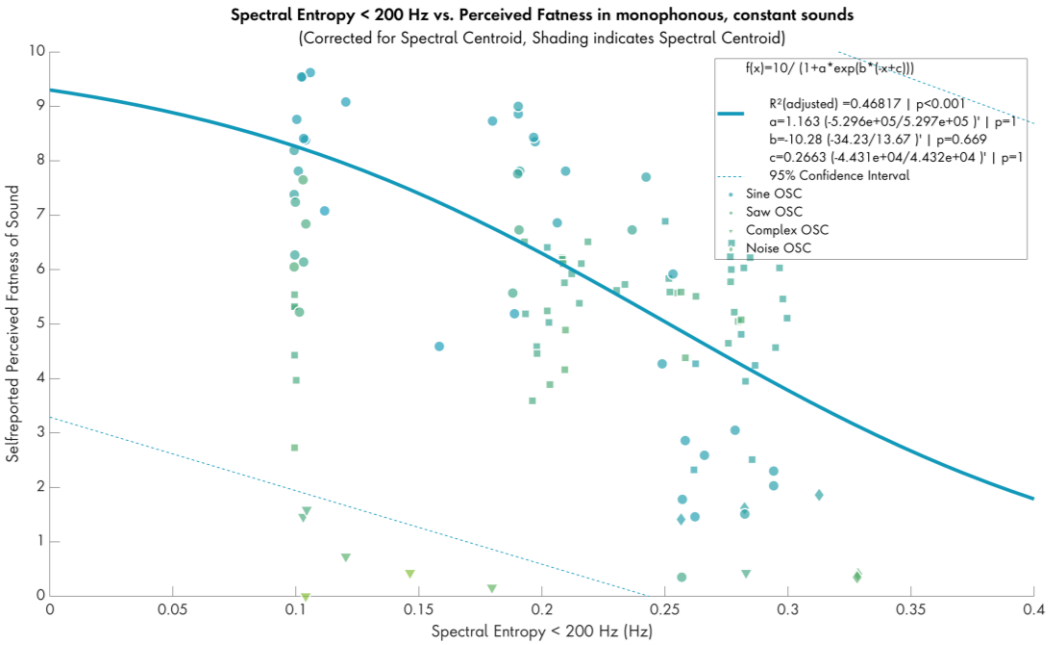


Figure 68: Spectral Entropy vs. Fatness, Weighted by Spectral Centroid

The measurements of spectral crest correspond sufficiently only in the two lowest critical bands. Neither a logit regression nor any other common model form can be calculated significantly.

5.4.2.4 Factors of Spectral Distribution

If we consider the remaining measured values that show conspicuous correlations, all of them are variables related to the spectral distribution of energy.

With regard to the fluctuation measures and spectral flux above 200 Hz, it is striking that the measurement ranges diverge widely despite logarithmic projection. The same applies to the spectral roll-off point for both the total signal and the higher frequency bands. It can be assumed that, in this specific experimental setup, these variables merely measure the presence of high-frequency components that do not occur in monophonic bass tones. They are therefore not suitable for modelling fatness.

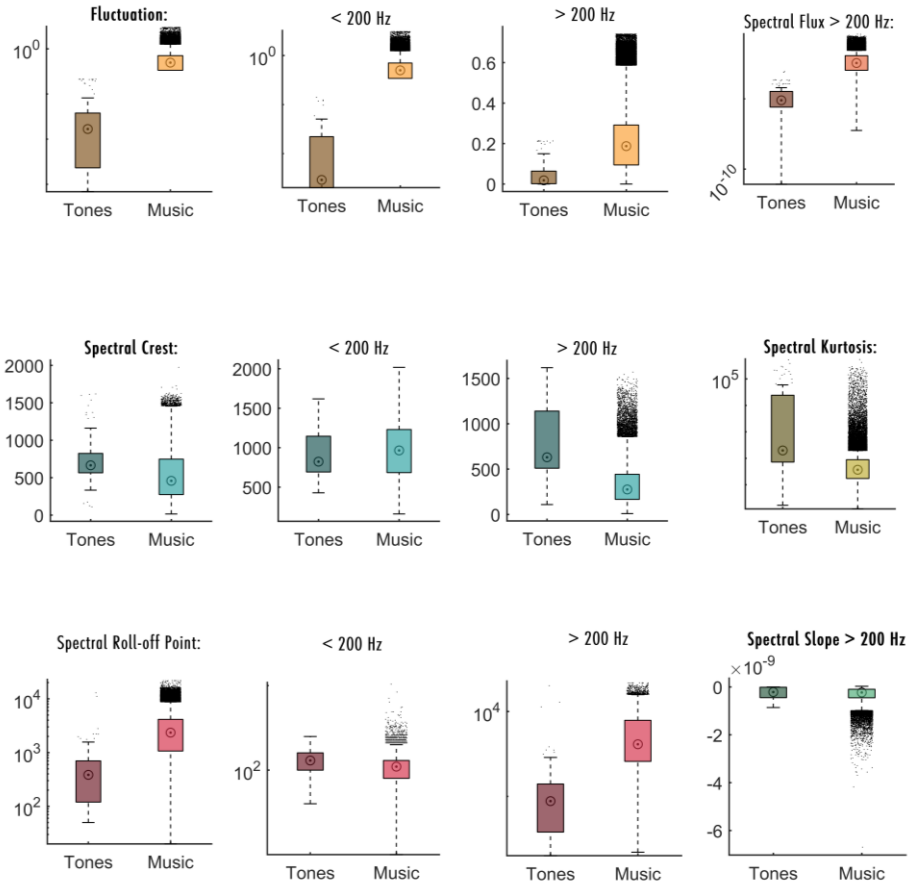


Figure 69: Measurement Ranges of Further Spectral Parameters[19]

The spectral roll-off point of the two lowest critical bands shows a better correspondence between measurement ranges, but correlates only weakly and at the very margin of significance. Although a regression calculation can be performed, it closely resembles the calculation of the centroid, while showing slightly weaker significance and explained variance. It can therefore be omitted from the model in favour of the spectral centroid. This decision is further supported by a strong Spearman

[19] For the sake of clarity, this figure does not use a strictly consistent colour coding.

correlation between the spectral centroid and the roll-off point, each below 200 Hz ($\rho = .635$, $p < .001$), as well as by the apparently discrete value distribution of the roll-off point.

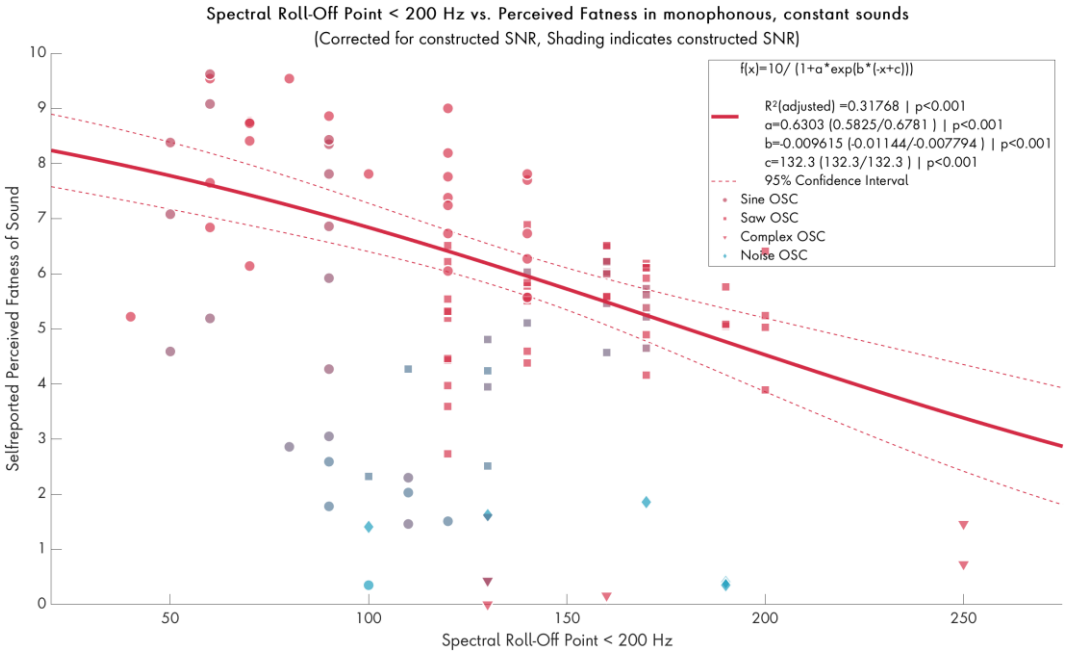


Figure 70: Spectral Roll-Off Point < 200 Hz vs. Fatness, Weighted by Constructed SNR

The spectral slope of the upper critical bands shows a good correlation with fatness; here, too, however, it appears to measure the proportion of high-frequency content only indirectly. Also striking are the low values in the 10^{-9}range. Given its orientation toward high-frequency spectral components, spectral slope does not appear suitable for modelling fatness.

Spectral kurtosis likewise shows only a moderate correspondence between the measurement ranges. Even after logarithmic transformation, no meaningful and significant regression can be calculated.

5.4.3 Modelling

On the basis of these considerations regarding the individual factors, together with the findings from the preliminary model, the following variables are to be included in the modelling:

1. SPL < 200Hz
2. SPL > 200Hz
3. spectral centroid < 200 Hz
4. harmonic ratio < 200Hz

These are first transformed accordingly, using the logit regressions described above, and then entered into a preliminary model function. This model function corresponds to a complete third-order polynomial. It is calculated repeatedly using the Multivariate Polynomial Regression Tool (Cecen, 2021) , with the term showing the highest *p*-value removed successively at each step - that is, the term least likely to make a meaningful and reliable contribution to the model.

The only term that becomes significant is the interaction between SPL < 200 Hz and HR < 200 Hz.

Thus, if the transformed weighted sound-pressure level of a sound is given by

$$l(x) = \frac{10}{1 + (4.5487 * exp\, 0.13^{(-SPL_{<200Hz}(x)+62.9366)})}$$

and the transformed harmonic ratio of the same sound is given by

$$h(x) = \frac{10}{1 + (1.4317 * exp\, 2.5575^{(-HR(x)+0.3299)})}$$

then its momentary fatness can be described as follows:

$$Fat_{mom}(x) = a * l(x) * h(x)$$

After inserting the coefficient, this yields:

$$Fat_{mom}(x) = 0.14689 * l(x) * h(x)$$

For both the coefficient $a$and the overall model, the *p*-values are well below .001 (3.6×10^{-71} and 1.3×10^{-79}, respectively). With an adjusted $R^2$of .773, this regression produces a substantial gain in explained variance compared with the .62 achieved by the preliminary model.

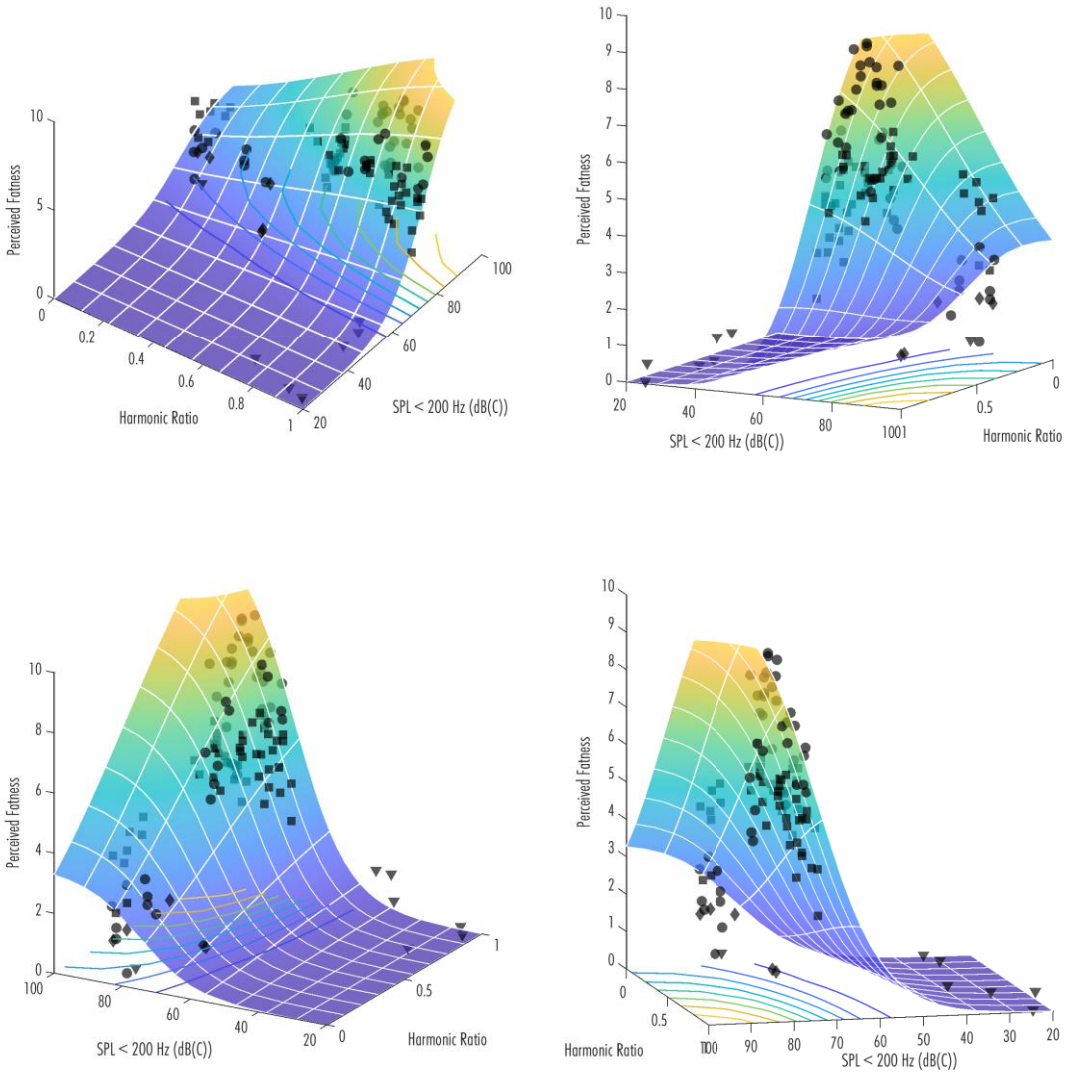


Figure 71: Graph of the Momentary Fatness Function

The residuals of this regression are only approximately normally distributed. The Kolmogorov–Smirnov test does not reject the assumption of normality ($p = .200$), whereas the more sensitive Shapiro–Wilk test does reject it ($p = .025$). Owing to the use of bootstrapping and to the extremely favourable *p*-values, which fall below the required

threshold by several orders of magnitude in all cases, the statistical inference can nevertheless be regarded as sufficiently robust.

A test for heteroscedasticity suggests that no heteroscedasticity is present. Neither the Breusch–Pagan test ($p = .303$), nor the modified Breusch–Pagan test ($p = .372$), nor the White test ($p = .475$) is significant. The White test is particularly relevant here, since normality of the residuals cannot be assumed without qualification.This model of momentary fatness can be calculated significantly for all coefficients. It is considerably more elegant than the preliminary model and provides a substantially greater explanation of variance. The model of momentary fatness can therefore be accepted.

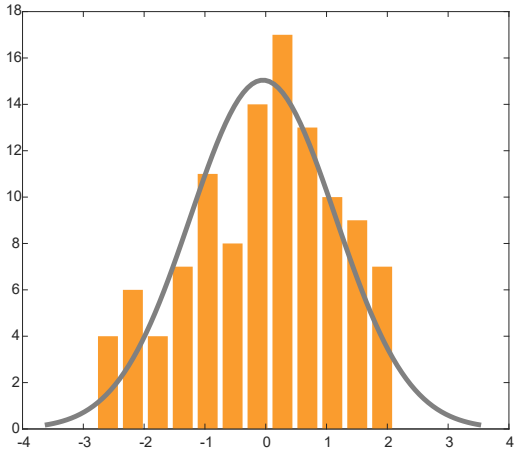


Figure 72: Histogram of the Regression Residuals of Momentary Fatness

5.4.4 Diskussion

With the present model of momentary perceptual fatness, it is possible to temporally localize and quantify those passages of music that are capable of eliciting a sensation of fatness.

In Cypress Hill's "Insane in the Brain" (22), the smoothed fatness curve plausibly describes the bass activity. Kick drum and bass play a one-bar loop consisting of two different figures: one comprising a single event, for example at 50 seconds, and one comprising three events, for example at 65 seconds. These can be clearly identified in the fatness curve. The basic shapes are also present in the raw data of harmonic ratio and sound-pressure level, but not with the same clarity.

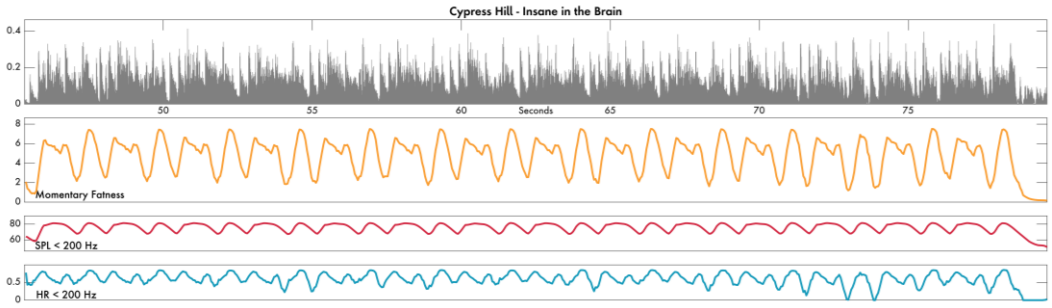
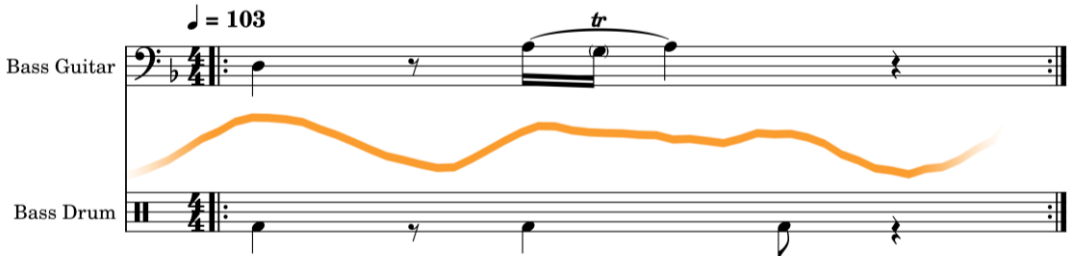


Figure 73: Cypress Hill, "Insane in the Brain" (22), Fatness Curve



Notation 31: Cypress Hill, "Insane in the Brain," Bass and Kick Drum, with Fat_{mom} Curve

Even the fact that the lower note D♯ presumably sounds slightly fatter than A♯ can be read from the fatness curve, as can the influence of the kick drum placed after the bass trill, for example at 75 seconds.

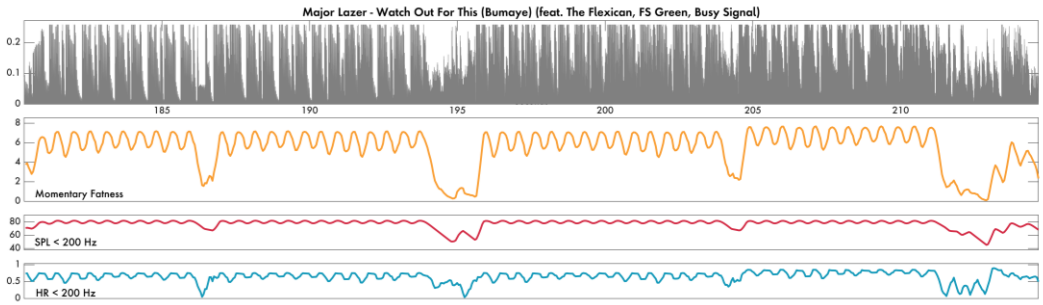


Figure 74: Figure 74: Major Lazer, "Watch Out for This" (56), Fatness Curve

In "Watch Out for This (Bumaye)" (56), too, the predicted fatness curve behaves as expected. The heavily compressed sine-wave basses produce extremely high fatness values and are thus delineated much more clearly than by SPL or HR alone. The fatness prediction also decreases in quieter passages, as expected, without losing measurement sensitivity. At 195 seconds, the model correctly identifies that the lowest note of the

horn figure moves into the bass range. At 213 seconds, plausible fatness is assigned to an electric-bass glissando.

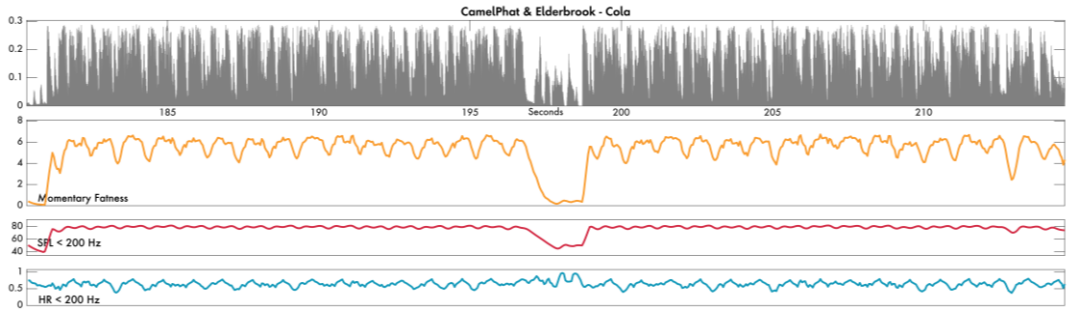


Figure 75: CamelPhat & Elderbrook, "Cola" (14), Fatness Curve

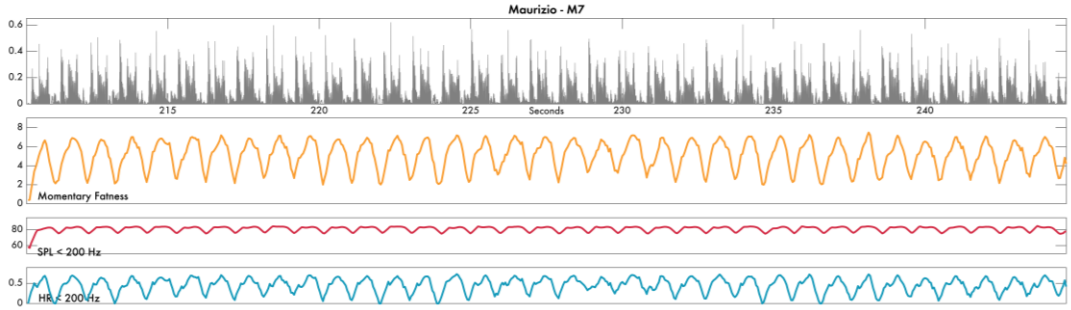


Figure 76: Maurizio, "M7" (59), Fatness Curve

The analysis of electronic dance music likewise behaves as expected. In both "Cola" (14) and "M7" (59), the minimalist forms of the four-to-the-floor beat are reflected in the fatness curve. Momentary fatness thus captures the same structures in both tracks, despite the fact that they were released twenty years apart and belong to different substyles.

It has therefore been shown that the present model of momentary fatness can be applied meaningfully and plausibly to all three domains of dance music: *Hip Hop*, electronic dance music, and *Tropical* dance music. There are therefore no substantial grounds for questioning the validity of the momentary fatness model for modern popular dance music.

With regard to historical dance-music styles, momentary fatness likewise appears to yield meaningful and plausible results. For example, the notation of the bass line in

John Holt's "A Love I Can Feel" (Notation 10) can also be plausibly reconstructed from the fatness curve.

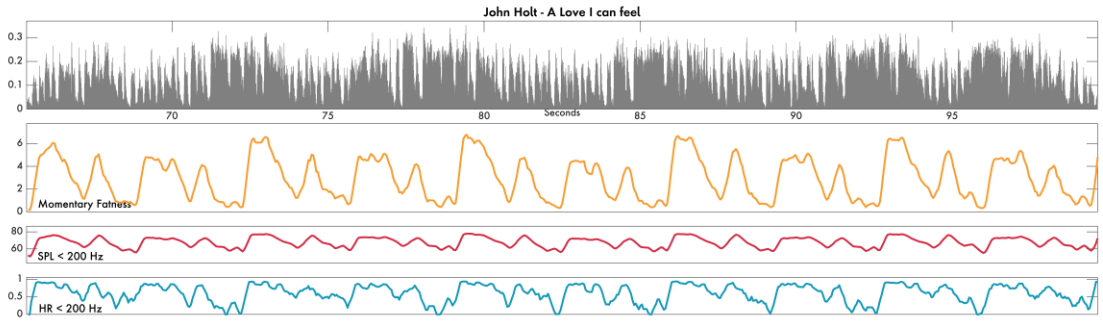


Figure 77: John Holt, "A Love I Can Feel" (43), Fatness Curve

In James Brown's style-defining *Funk* hit "Papa's Got a Brand New Bag" (42) (Notation 11) both loop structures and larger formal structures can likewise be identified. This applies in particular to the bass figure and to the break between 42 and 48 seconds.

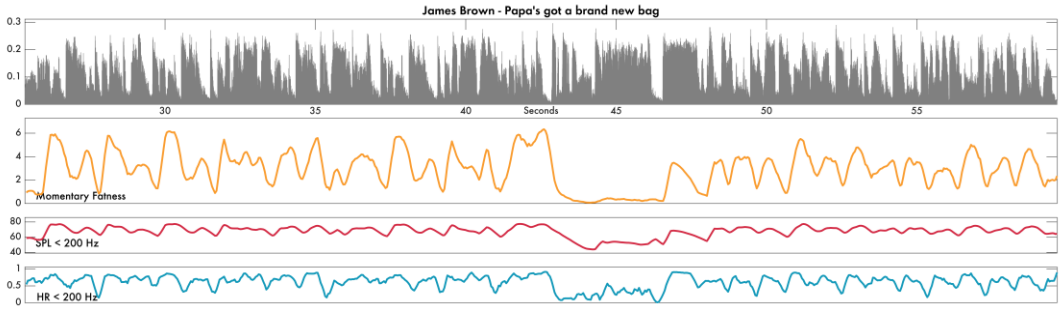


Figure 78: James Brown, "Papa's Got a Brand New Bag" (42), Fatness Curve

In the Salsoul *Latin Funk* adaptation of "Jingo" (15), the distinctive shape of the continuous kick drum can be discerned - a pattern that would become the basis for countless later *Disco* and electronic productions. Particularly interesting here, however, is the entrance of the electric bass at 215 seconds, which can be clearly traced. This, too, suggests that fatness contains information about musical form at both the loop level and the track level.

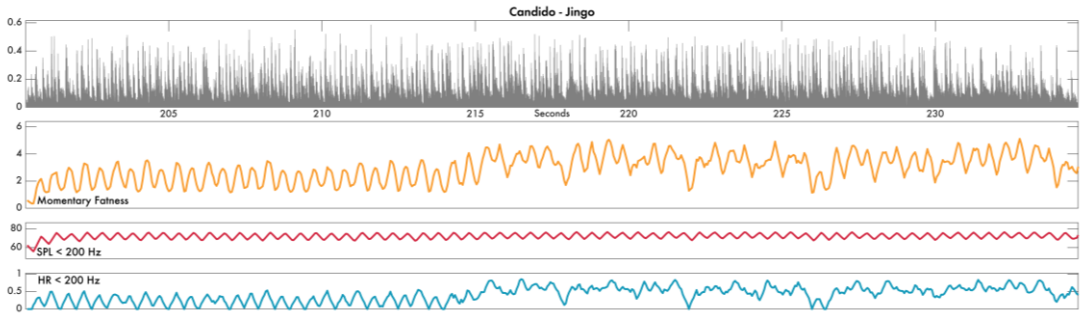


Figure 79: Candido, "Jingo" (15), Fatness Curve

It may therefore be assumed that the model of momentary fatness can also be validly applied to historical dance-music styles.

The earlier assumption that fatness presupposes tonality must therefore be further specified: fatness presupposes harmonicity. In this respect, the requirement is not merely the absence of aperiodic signal components, but also the specific configuration of the tonal components in relation to the momentary fundamental oscillation.

Two qualifications, however, must be made:

1. In test tones of equal loudness, and with a division into two frequency bands, pitch directly influences the sound-pressure levels assigned to the respective frequency bands. In this respect, the sound-pressure level of the two lowest critical bands does appear suitable here for representing the influence of "depth." It remains possible that, using a sample which - as originally intended - takes different loudness levels into account (cf. §5.3.1.1), a model based on the spectral centroid and the weighted sound-pressure level of the total signal would yield even better predictions. It is also conceivable that the frequency band relevant to fatness depends on the fundamental oscillation and should shift together with it. This could further improve the validity of the model.
2. A single-stage regression calculation of the complete model could not be calculated significantly, even when the known coefficients were included as initial beta values, whether in MATLAB (Curve Fitting Toolbox), SPSS, or Python (NumPy / Pandas). A future examination of whether this might

be possible using SciPy and TensorFlow in Python, or the Optimization and Machine Learning toolboxes in MATLAB, appears worthwhile. This, too, could further improve the quality of the model.

Nevertheless, it can ultimately be stated that the present model of momentary fatness must be regarded as statistically significant and musically valid, and should therefore be accepted. Moreover, it fulfils all the requirements postulated above:

- It can be calculated immanently from the music itself, since it is based on weighted sound-pressure level and harmonic ratio, both of which can be obtained from arbitrary digitized sounds using MATLAB or other tools.
- With a window length of 50 ms, it clearly exceeds the requirement of ≤ 100 ms. As Figure 73 to Figure 79 clearly show, this resolution is suitable in practice for meaningfully analysing musical events.
- On the musical side, the selected data basis rests on a demonstrably representative and documented sample of the cultural phenomena in question. It may be assumed that this sample includes the relevant range of the relevant variables.

5.5 Integrated Fatness of Musical Sounds

While momentary fatness makes it possible to capture and compare the perceptual fatness of music in snapshots, the question remains of the integrated fatness of musical sounds: that is, of a measure capable of capturing the overall fatness of complex musical sounds. Typically, such sounds are entire tracks or longer excerpts from them.
Since the data basis no longer consists of constant, monophonic sounds, this investigation extracted not only the same 16 measures for the total signal and for the two frequency bands, but also a set of time-aggregated descriptors for each of them: arithmetic mean, median, standard deviation, kurtosis, minimum, and maximum.
The considerably greater complexity of the research object, together with the large number of 288 feature values per track, necessitates a more exploratory approach than was used in the modelling of momentary fatness.

5.5.1 Requirements

The requirements for integrated fatness are, as postulated above, as follows:

1. If momentary fatness, or one of its temporal descriptors, proves unsuitable as a long-term measure for making predictions of comparable quality about the perceived fatness of complex sounds at the level of musical form, then an integrated fatness measure must be modelled for this purpose. The suitability of momentary fatness must therefore be tested first.
2. Integrated fatness, too, must be based on a music-immanent calculation. Behavioural data or constructed values are used only as training data.
3. It must yield meaningful, significant, and plausible predictions for actual musical sounds from the field of dance music.

5.5.2 Analysis of Contributing Factors

5.5.2.1 Momentary Fatness

The first question is the extent to which momentary fatness reflects integrated fatness. Since not all values are normally distributed, it is advisable to begin by considering the non-parametric correlations:

Feature	ρ	p
Fat M	0,542	< 0,001
Fat~	0,6	< 0,001
Fat σ	0,468	< 0,001
Fat Kurtosis	0,03	0,768
Fat Min	-0,065	0,52
Fat Max	0,639	< 0,001

Table 23: Selected Correlates of Momentary Fatness

The two measures of central tendency correlate highly significantly and with relevant effect strength. Nevertheless, it is clear that integrated fatness cannot be understood simply as the mean value of momentary fatness. One reason for this is certainly the selection of excerpts, which allows for quiet passages in some tracks, since the only requirement was that the excerpt include the maximum of integrated loudness. It is therefore useful to examine values that are more robust against this influence.

Kurtosis and minimum do not correlate with the perceived fatness of complex sounds. Standard deviation shows a medium-strength correlation. The strongest correlation is found for the maximum of momentary fatness. Since the maximum is more independent of quiet passages, it is plausible to consider it. At the same time, however, in order to achieve greater robustness against individual outliers, the quantiles should be examined. Starting from the maximum, the 85^{th} percentile offers the strongest correlation with perceived integrated fatness before the effect strength decreases again toward the median ($\rho = .72$, $p < .001$).

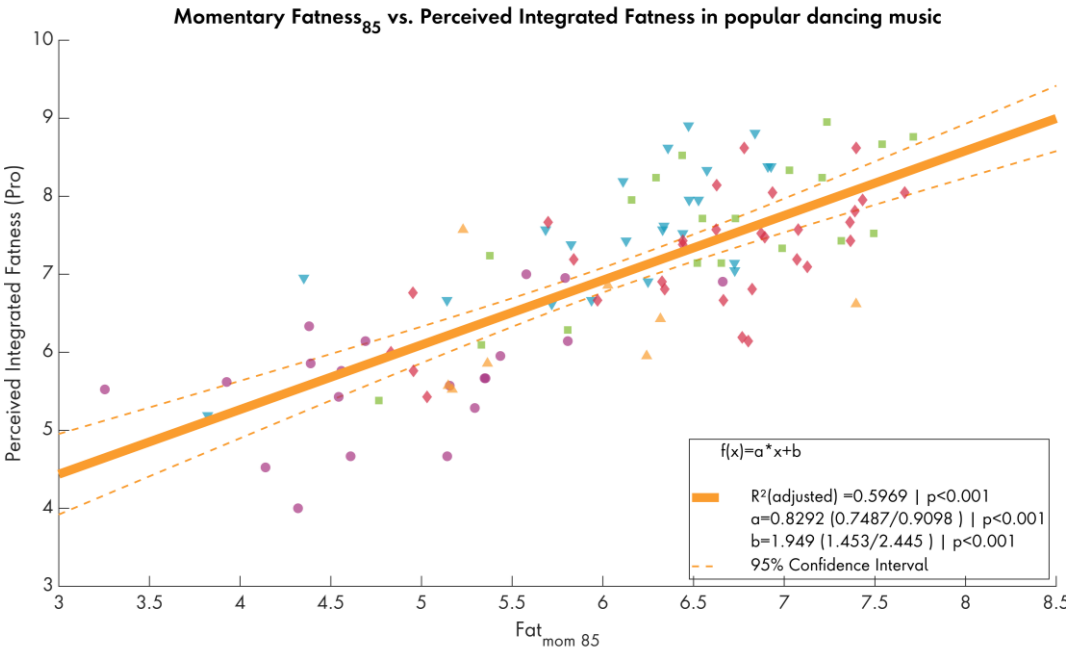


Figure 80: Figure 80: $Fat_{mom,.85}$vs. Perceived Integrated Fatness

Modelling all basic function types available in the SPSS Curve Fittinh Tool[20] does not yield any gain in explained variance over a linear model ($R^2 = .597, p < .001$). Consequently, the 85th percentile of momentary fatness alone does not provide a sufficient explanation of perceived integrated fatness, but it should be considered as a factor in its modelling.

5.5.2.2 Loudness

Given the probable inclusion of Fat_{mom}, the analysis of further factors should consider not only their correlations with fatness judgments, but also their correlations

[20] The SPSS Curve Fittin tool allows for the ad hoc calculation of the following univariate regression models: linear, quadratic, compound, growth, logarithmic, cubic, S-curve, exponential, inverse, power, and logistic.

with the regression residuals. With regard to loudness measurements, the following values are noteworthy:

Correlate	Residuals		Perceived Fatness	
Feature	ρ	P	ρ	p
SPL~	0,033	0,743	0,548	< 0,001
SPL~ <200Hz	0,003	0,978	0,610	< 0,001
SPL σ	0,346	< 0,001	0,255	0,011
SPL<200Hz σ	0,315	0,001	0,420	< 0,001
SPL~>200Hz	-0,148	0,140	-0,601	< 0,001
SPLmax >200Hz	0,004	< 0,970	-,419	< 0,001

Table 24: Table 24: Selected Correlates of Loudness

When considering the medians, the possible distortion caused by passages of low loudness must again be taken into account. Apart from this, the medians correlate very well with perceived integrated fatness; however, a relationship with the residuals can be ruled out. The same applies to the values of the upper critical bands.

The most favourable correlations are found, as expected, for the standard deviations of sound-pressure level. Experience suggests that these provide a relatively robust representation of loudness distribution and are suitable for differentially characterizing tracks; they also permit conclusions to be drawn about sustain and, above all, the degree of compression (cf. (Bader, Zielke, & Franke, 2021, pp. 5,7)). In both substantive terms and with regard to the correlations, the standard deviation of loudness in the two lowest critical bands appears particularly relevant here.

Here, too, SPSS Curve Fitting does not identify a better fit than a linear one. A linear regression calculated in SPSS yields a rather low $R^2$of only approximately .13.

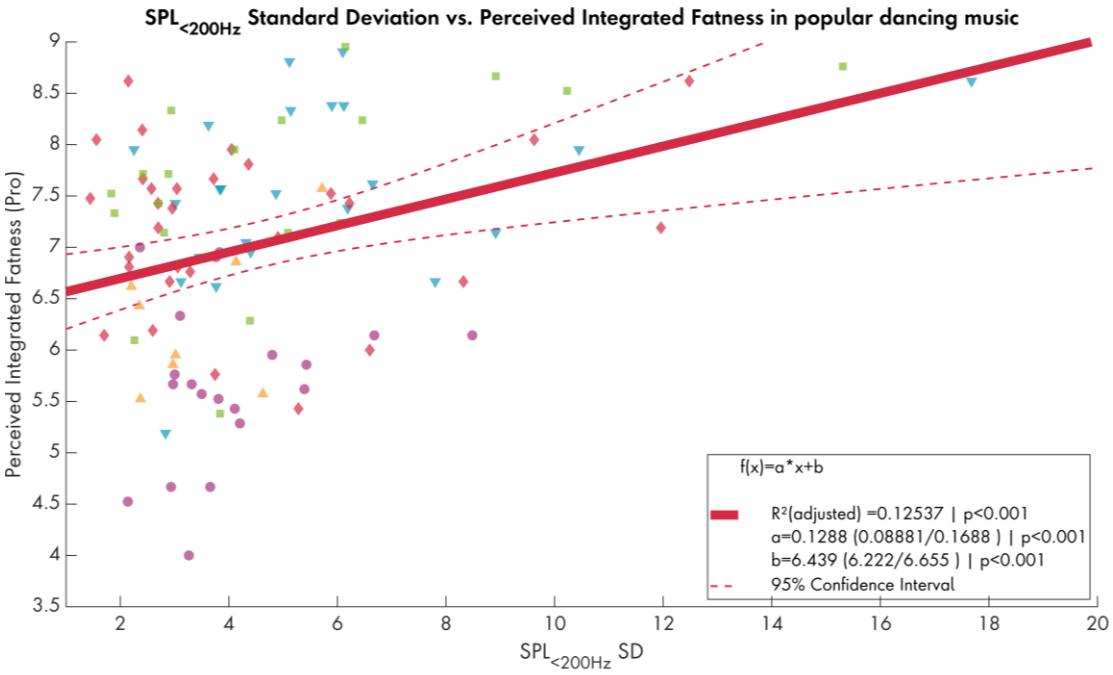


Figure 81: SPL < 200 Hz SD vs. Perceived Integrated Fatness / Regression

Polynomial modelling including $Fat_{mom,.85}$becomes highly significant and increases the R^2value to .66. This represents a modest gain in explained variance of 6%. It therefore remains unclear whether $SPL_{<200Hz}\sigma$makes a relevant contribution to the modelling of integrated fatness.

5.5.2.3 Centroids

When considering the values obtained for the spectral centroid, medians and standard deviations once again stand out. Since the medians are not reliable because of the influence of song structures, and since they do not correlate with the residuals, they should not be considered further - even though, particularly for the lower critical bands, there is a strong relationship with perceived fatness. The standard deviation of the spectral centroid likewise does not correlate with the residuals, and no gain in explained variance is therefore to be expected from it.

Two factors thus appear especially interesting: the minimum of the centroid of the two lowest critical bands and the standard deviation of the spectral centroid in the upper critical bands.

Correlate	Residuals		Perceived Fatness	
Feature	ρ	P	ρ	p
SCentroid~	0,15	0,880	-0,578	<0,001
SCentroid σ	0,14	0,893	0,314	0,001
SCentroid~<200Hz	-0,16	,112	-0,661	<0,001
SCentroid$_{min\ <200Hz}$	-0,289	0,004	-0,683	<0,001
SCentroid$_{0,20\ <200Hz}$	-0,297	<0,001	-0,666	<0,001
SCentroid$_{>200Hz}$ σ	0,334	0,001	0,511	<0,001

Table 25: Selected Correlates of the Spectral Centroids

Since minima, like maxima, are susceptible to outliers but not to song structures, a further quantile-based analysis is necessary. Here, the 20th percentile proved particularly robust. Its correlations differ only minimally from those of the minimum. Non-linear modelling showed no gain in explained variance compared with the following linear model:

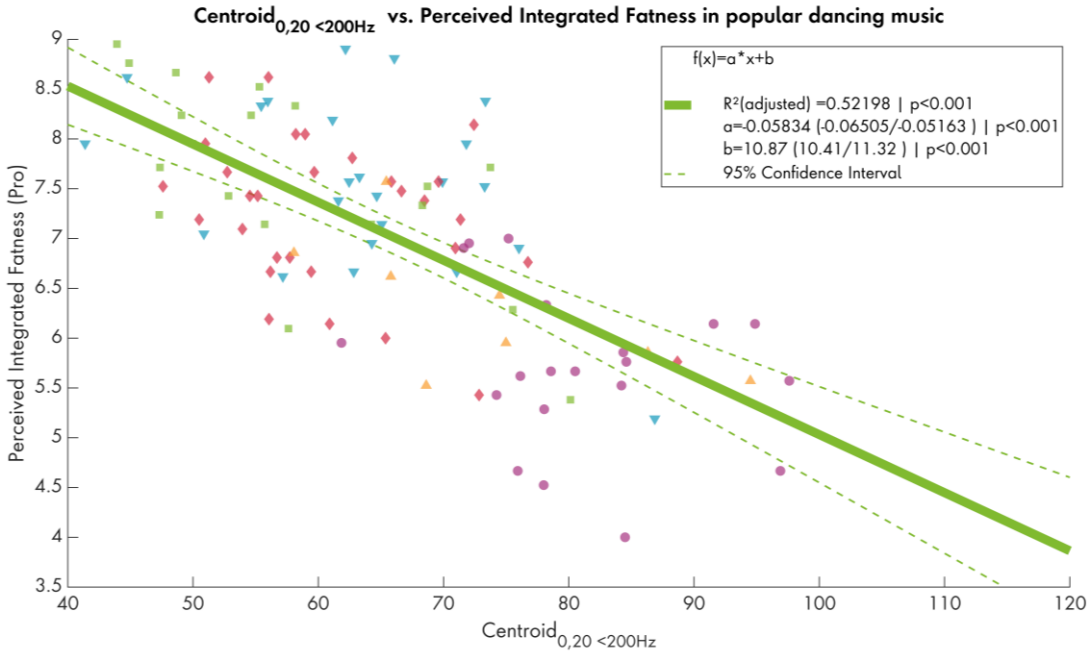


Figure 82: Centroid$_{0.20 < 200\ Hz}$ vs. Perceived Integrated Fatness / Regression

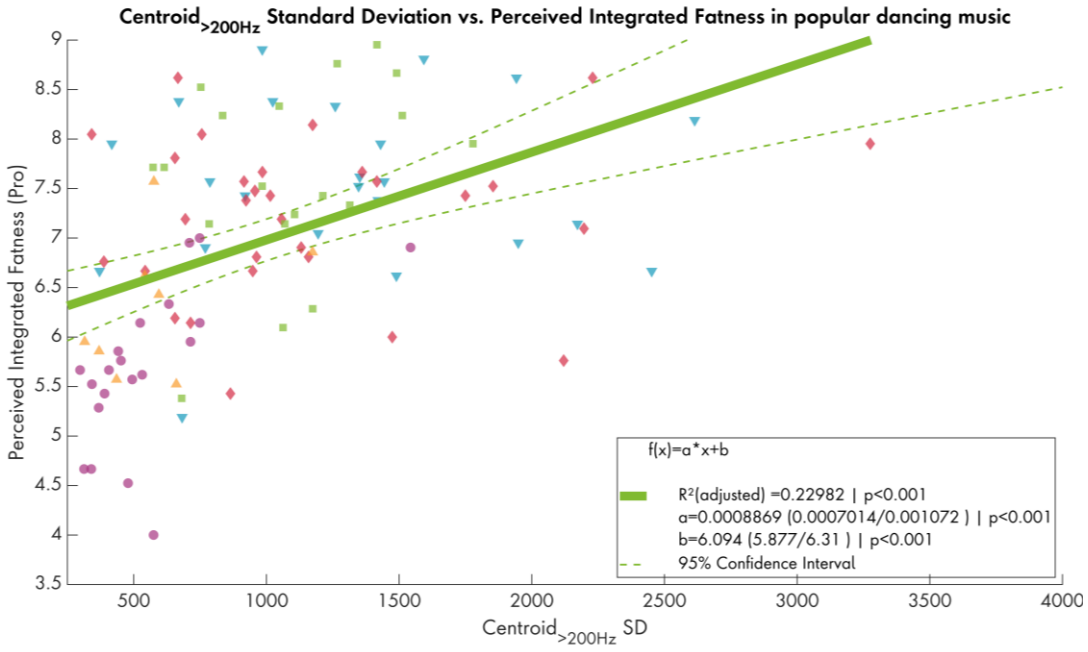


Figure 83: Centroid $_{>200\,Hz\,SD}$ vs. Perceived Integrated Fatness / Regression

The correlation between the standard deviation above 200 Hz and perceived fatness appears counterintuitive at first. Given its correlation with release year ($\rho = .560$, $p < .001$), it is conceivable that this reflects a parallel development: greater tonal dynamics, like fatness, may have become an increasingly desirable quality within the production paradigm of popular dance music. It is also conceivable that such a quality enables greater auditory contrast, creating spaces in which the bass can be perceived as distinct, as well as accompanying sonic components against which the bass can stand out or which contribute to its harmonicity.

The SPSS Curve Estimation tool suggests a logarithmic fit. However, this cannot be calculated significantly for all coefficients. Thus, despite the lower R^2, a linear relationship must again be assumed.

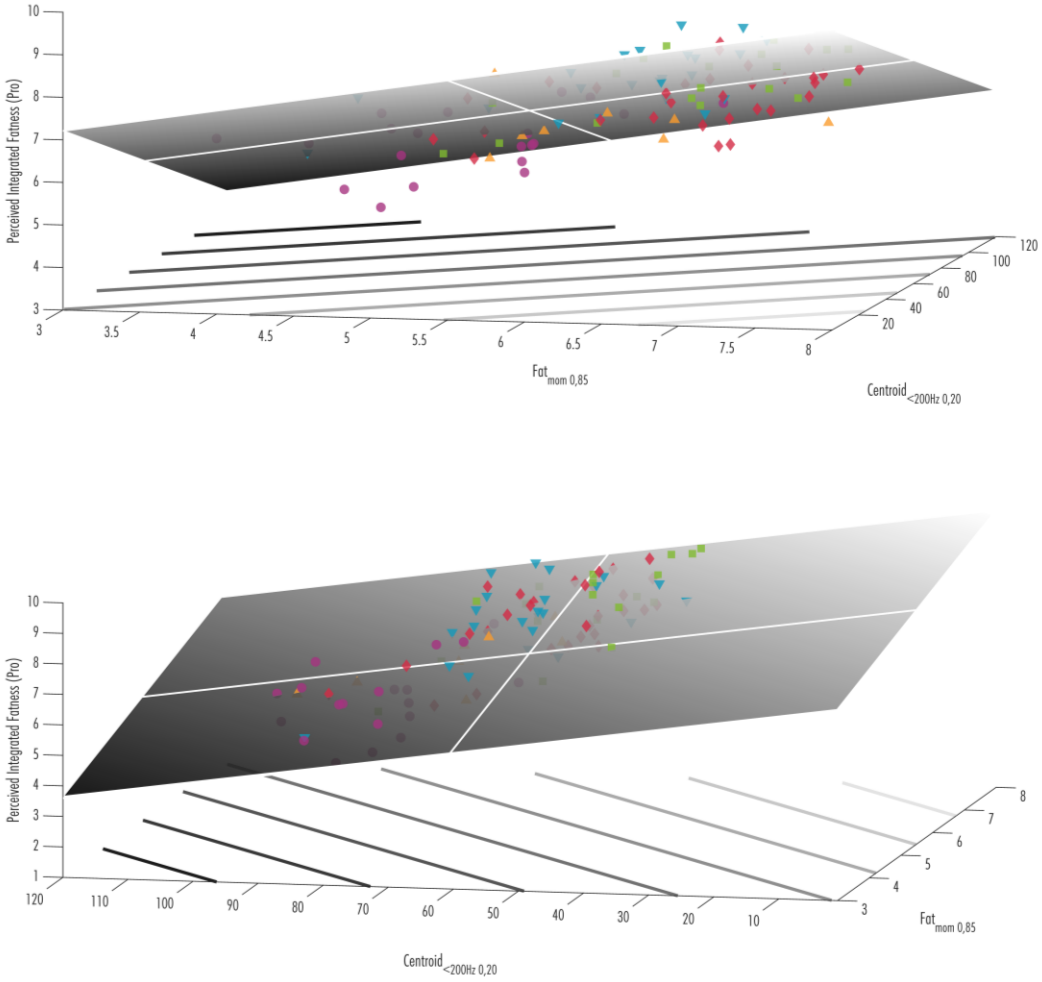


Figure 84: Graph of the Preliminary Modelling of Integrated Fatness from $Fat_{mom,.85}$ and $\text{Centroid}_{0.20<200Hz}$, View from Below / View from Above)

Despite the strong correlation between $Fat_{mom,.85}$ and $\text{Centroid}_{0.20<200Hz}$ ($\rho = -.644$, $p < .001$), an influence of the spectral centroid appears plausible. A preliminary bivariate linear model yields an R^2 of .667 and thus exceeds the univariate models. Both the model and its coefficients can be calculated as highly significant. It explains 8% more variance than Fat_{mom} alone and also exceeds the value of the model developed in Chapter 4.

Alongside the covariance of the coefficients, a systematic overestimation of *Hip Hop* tracks and a systematic underestimation of *EDM* tracks can be observed. Since the model nevertheless offers a good preliminary approximation of integrated fatness, the residuals of this model are included in the further analysis.

5.5.2.4 Tonality and Harmonicity

Correlate	Residuals		Perceived Fatess	
Feature	ρ	P	ρ	p
SNR SD	0,15	0,880	-0,578	<0,001
SNR_{min}	-0,254	0,01	-0,288	0,004
$HR_{<200Hz}$ SD	0,306	,002	0,354	<0,001
$sFlat_{<200Hz}$ SD	0,198	0,049	0,227	0,023
$sSpread_{<200Hz}$ SD	0,209	0,037	0,261	0,009
$sSpread_{<200Hz}$ K	0,197	0,049	0,278	0,005
sEntropy SD	0,240	0,016	0,598	<0,001
sEntropy K	0,337	0,001	0,435	<0,001

Figure 85: Selected Correlates of Tonality and Harmonicity

While the standard deviation of the signal-to-noise ratio correlates strongly with fatness, it shows no correlation whatsoever with the residuals. The minimum of the signal-to-noise ratio, by contrast, shows highly significant correlations of medium strength with both.

The minimum of the SNR is considerably more interesting; in normalized sounds, it serves as an indicator of the signal-to-noise margin. Its correlations with both fatness and the residuals are highly significant and of a similar order of magnitude. A quadratic regression provides the best significant explanation of variance, although this remains unexpectedly weak at $R^2 = .133$. Nevertheless, the relevance of this factor cannot be ruled out.

The same applies to the standard deviation of the harmonic ratio, with slightly higher ρ values. Here, a linear model is appropriate and becomes significant with an $R^2$of .132.

SNR_{Min}			Spectral Entropy Kurtosis		
R^2= 0,133			R^2=0,094		
	Esti-mate	p		Esti-mate	p
$f(x)=a+bx+cx^2$		<0.001	$f(x)=a+bx+cx^2$		<0.001
a	8.248	<0,001	a	12,581	<0,001

b	0,429	0,047	b	-3,592	0,007
c	0,029	0,011	c	0,543	0,011

Harmonic Ratio SD			Spectral Entropy SD		
R^2= 0,132			R^2=0,439		
	Esti-mate	p		Esti-mate	p
f(x)=a+bx		<0.001	f(x)=a+bx		<0.001
a	4,205	<0,001	a	4.392	<0,001
b	16.022	<0,001	b	21.493	<0,001

Table 26: Regressions of Selected Factors of Tonality and Harmonicity

For the values measured below 200 Hz, neither the standard deviation of spectral flatness nor the standard deviation or kurtosis of spectral spread yields a significant regression model.

The standard deviation of spectral entropy correlates strongly with fatness and moderately with the residuals of the preliminary model. A linear curve fit yields a highly significant model with favourable explained variance of $R^2 = .439$. This parameter should be considered for inclusion in the model.

The kurtosis of spectral entropy shows even more favourable correlations with fatness and the residuals. It can be calculated as highly significant, but reaches a maximum $R^2$of only .094 in the quadratic fit. Nevertheless, an influence cannot be ruled out, precisely because of the strong correlation with the residuals.

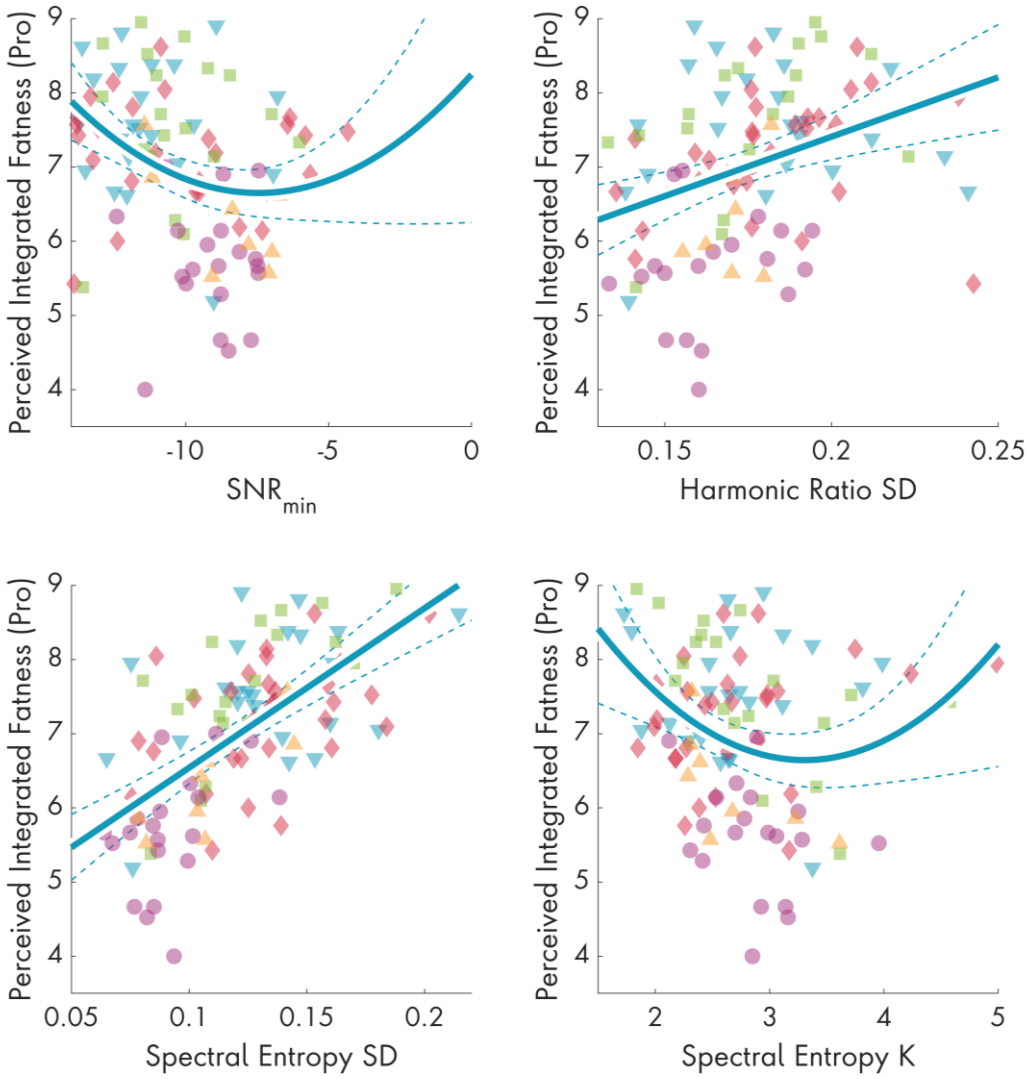


Figure 86: Regression Graphs of Selected Factors of Tonality and Harmonicity

5.5.2.5 Spectral Parameters

Correlate	Residuals		Perceived Fatness	
Feature	ρ	P	ρ	p
sCrest~$_{>200Hz}$	-0,284	0,004	-0,209	0,036
sFlux$_{<200Hz}$ SD	0,065	0,519	0,531	<0,001
sKurtosis SD	0,177	0,519	0,538	<0,001
sKurtosis K	0,216	0,031	0,239	0,017
sROP$_{<200Hz}$ SD	0,244	0,014	0,494	<0,001
sSkew Kurt	0,255	0,024	0,278	0,005

Table 27: Correlates of Selected Spectral Parameters

For the means and standard deviations of the various frequency bands, spectral crest shows many strong correlations with fatness ($.60 < r < .75$; $p < .001$), but no correlation with the residuals ($p \approx .8$–$.9$). The exception here is the median of the upper critical bands. This relationship, however, still cannot be represented by regression. Although the model narrowly reaches significance, the constant is the only coefficient that can be estimated reliably.

The kurtosis of spectral kurtosis correlates significantly and moderately with both the residuals and fatness. The similar magnitude of the two ρ values is favourable. SPSS Curve Estimation indicates the greatest explained variance for an exponential fit in particular. Modelling in MATLAB, however, yields only an $R^2$of .076.

The correlations of the standard deviation of the spectral roll-off point in the lower critical bands also appear promising. A moderate relationship with the residuals and a considerably stronger relationship with fatness suggest an analysis by means of curve fitting. A quadratic fit provides the best fit here, although the R^2, at .094, remains low and coefficient *b*only narrowly reaches significance.

Finally, the kurtosis of spectral skewness must be considered. Here, too, significant moderate relationships are present, and these are of a comparable magnitude. An exponential fit can be calculated as highly significant throughout, but the R^2value, at .123, remains rather low. The visual influence of outliers also raises the question of possible overfitting.

Roughness and sharpness do not produce any correlations. This is surprising, since a negative relationship between fatness and sharpness had been expected.

Spectral Kurtosis Kurtosis			Spectral Skew Kurtosis		
R^2= 0,0767			R^2=0,123		
	Esti-mate	p		Esti-mate	p
$f(x)=a*x^b$		<0.001	$f(x)= a*x^b$		<0.001
a	5,936	<0,001	a	5,902	<0,001
b	0.041	<0,011	b	0,066	0,001

Spectral Crest <200Hz Median			Spectral Roll-Off Point <200Hz SD		
R^2= 0,046			R^2=0,094		
	Esti-mate	p		Esti-mate	p
$f(x)=a+bx+cx^2$		<0.039	$f(x)=a+bx+cx^2$		<0.001
a	9,287	<0,001	a	3,035	0,004
b	-0,013	0,193	b	0,164	0,049
c	$1,746*10^{-5}$	0,308	c	-0.00142	0,011

Table 28: Regressions of Selected Spectral Parameters

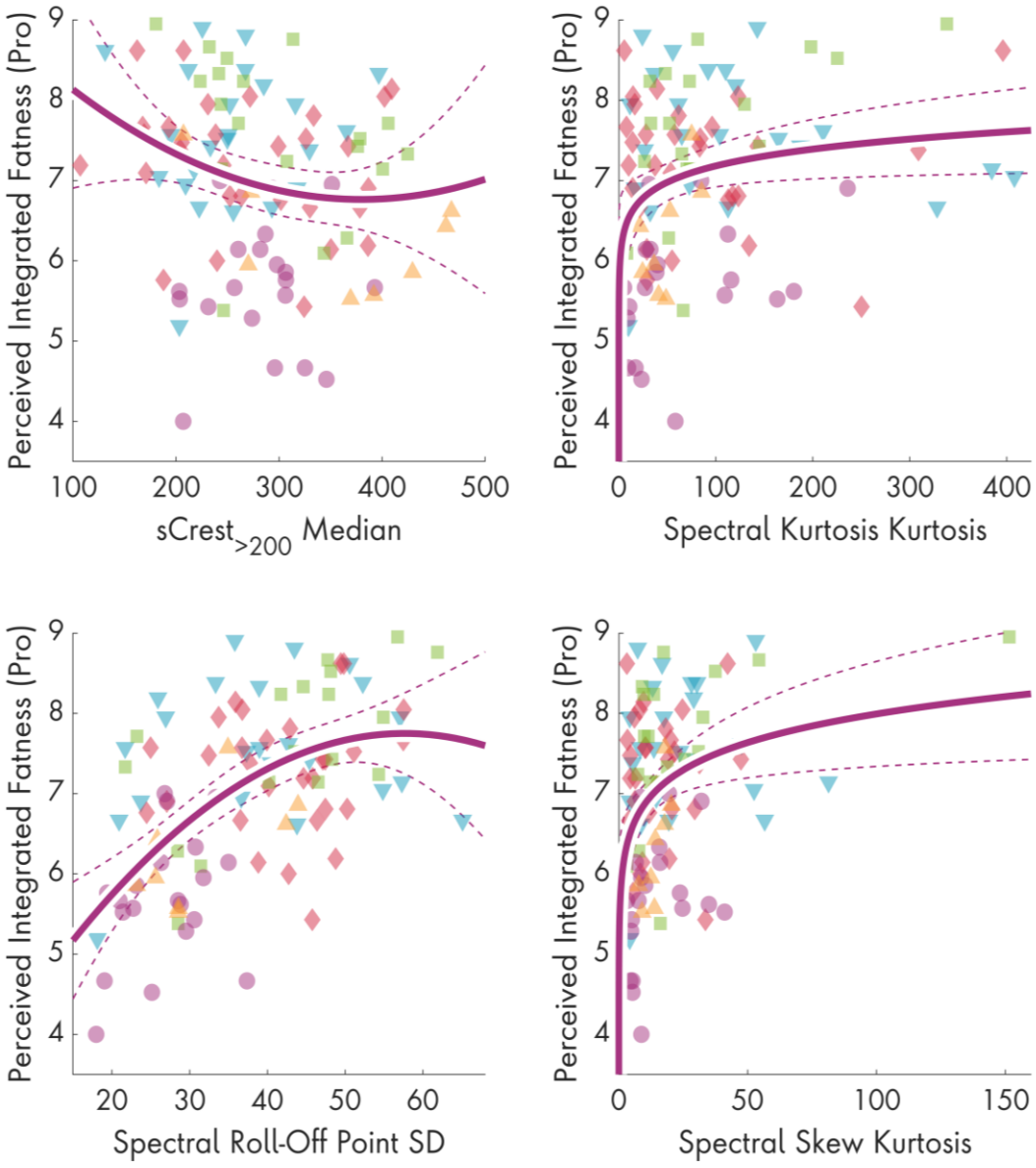


Figure 87: Regression Graphs of Selected Spectral Parameters

5.5.3 Modelling

In accordance with these data analyses, and with the findings from the preliminary fatness model (cf. §§4.3–4.6) and the model of momentary fatness (cf. §5.4), the following parameters should clearly be considered for the modelling of integrated fatness:

1. the 85th percentile of momentary fatness (x_1);
2. the SD of the weighted sound-pressure level below 200 Hz (x_2);
3. the 20th percentile of the spectral centroid below 200 Hz (x_3).

In order to achieve an explained variance of more than two thirds, the following parameters must additionally be tested for a meaningful and significant contribution to the model:

4. the minimum of the signal-to-noise ratio (x_4);
5. the SD of the harmonic ratio below 200 Hz (x_5);
6. the SD of spectral entropy (x_6);
7. the kurtosis of spectral entropy (x_7);
8. the kurtosis of spectral kurtosis, transformed (x_8);
9. the SD of the spectral roll-off point below 200 Hz, transformed (x_9).

These parameters were again entered into a complete second-order polynomial, allowing both interactions and squared terms to be tested. Since none of the parameters suggested a cubic relationship, a third-order construction could be omitted. Parameters 8 and 9 were transformed in accordance with the regression results.
The 55-term polynomial was again created using the Multivariate Polynomial Regression Tool (Cecen, 2021) and calculated with the Nonlinear Curve Fitting function of the MATLAB Curve Fitting Toolbox. The term with the highest *p*-value was then removed successively, and the regression recalculated until only significant terms remained within a significant model.

Integrated Fatness		
R^2= 0,745		
	Estimate	p

$f(x)=k + a*x_2*x_4 + b*x_7 + c*x_6*x_3 + d*x_1*x_3 - e*x_3^2$		<0.001
$a*x_2*x_4$	0,0169	0,0291
$b*x_7$	0.393	<0,001
$c*x_6*x_3$	1.118	0,002
$d*x_1*x_3$	-0.0642	<0,001
$e*x_3^2$	-0.0171	0.036
k	7.172	<0,001

Table 29: Regression of Integrated Fatness

This modelling fulfils all hypotheses. Both the model and its coefficients are significant. The explained variance of $R^2 = .745$reaches an acceptable level and once again clearly exceeds that of the two preliminary models.

Figure 88: Histogram of the Regression Residuals of Integrated Fatness

The residuals of this model show no significant correlations with the measured values obtained and are sufficiently normally distributed (Shapiro–Wilk test: p = .125; Kolmogorov–Smirnov test: p = .075). Heteroscedasticity can also be ruled out. The decisive White test yields a very favourable value of p = .914, while the modified Breusch–Pagan test yields p = .704. These necessary assumptions are therefore also fulfilled, and the significance values of the regression can be regarded as robust.

he integrated fatness of a complex musical sound can thus be calculated as follows::

$$Fat_{Int} = 7{,}172 + 0{,}0169 * SD(spl_{<200\,Hz}) * min(s2n) + 0{,}393 * kurt(SEN) + 1{,}118 * SD(SEN) * Centroid_{0,20\,<200Hz} - 0{,}0642\, Fat_{mom\,0,85} * Centroid_{0,20} - 0{,}0171\, Centroid^2_{0,20\,<200Hz}$$

5.5.4 Discussion

The model of integrated fatness proposed here is both considerably less elegant and less intuitive than the model of momentary fatness. This gives rise to two lines of

consideration. First, the validity of the model and of its terms must be discussed. Subsequently, considerations regarding the measurement method must be formulated.
The model as a whole is highly significant, as are most of its coefficients, with the exception of $a$and e, which are significant but not highly significant. An explained variance of almost 75% appears quite strong for such an abstract research object. It can be plausibly argued that the remaining 25% is attributable to a large extent to factors such as personal taste, daily condition, and mood. It may therefore be assumed that integrated fatness modelled in this way is suitable for calculating reliable estimates of the positive bassness of modern popular dance music.
The model contains six terms, which will be discussed in the following.

1. Constant ($\boldsymbol{k}$)

The constant term is 7.172. This corresponds quite closely to the median of perceived fatness, which is 7.143. For relevant dance music, high fatness is thus, plausibly, the normal case and point of departure.

2. Term 1 ($\boldsymbol{a \cdot x_2 \cdot x_4}$)

The first term describes the interaction between the standard deviation of the C-weighted sound-pressure level below 200 Hz and the minimum of the signal-to-noise ratio.

The standard deviation of the C-weighted sound-pressure level is, among other things, a measure of the degree of compression and thus of the dynamic range of a recording.

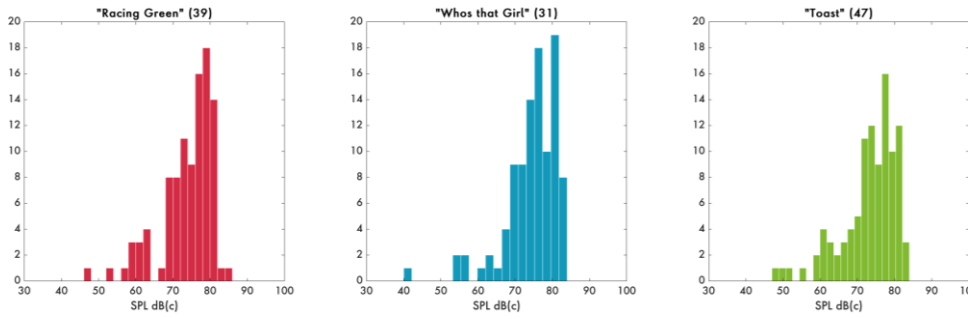


Figure 89: SPL dB© < 200 Hz of selected tracks with low standard deviation

As expected, loudness distributions are right-skewed, since music usually consists to a substantially greater extent of sound than of silence. Tracks with a low standard deviation have a mode close to the maximum and tend to contain few components below 70 dB©. This points to modern, club-oriented mastering.

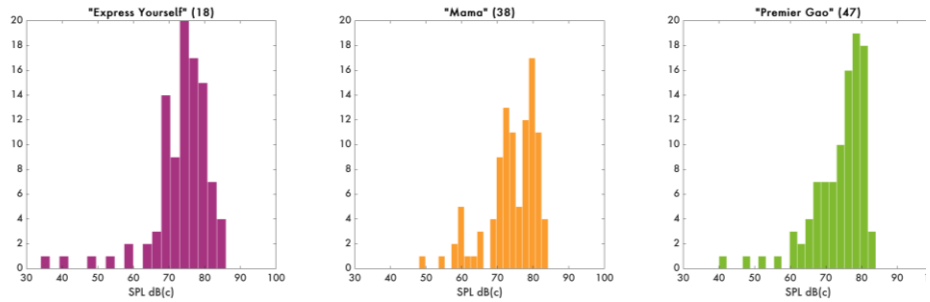


Figure 90: SPL dB© < 200 Hz of selected tracks with high standard deviation

Tracks with a high standard deviation are often historical recordings in which both a larger proportion to the right of the mode and a larger proportion below 70 dB© are present than in tracks with a low SD. Overall, they sound quieter.

The minimum of the SNR can be understood as a negative signal-to-noise margin. Where it reaches its lowest value, the degree of noise present is most likely to be free of musically intended noise components and can therefore be understood as a technically induced disturbance component. This is supported, among other things, by the fact that an ANOVA demonstrates a relationship between recording medium and minimum SNR ($p = .044$). Since the minimum of the SNR is not unambiguously normally distributed (Kolmogorov–Smirnov: $p = .200$; Shapiro–Wilk: $p = .010$), bootstrapping with 10^5 samples was applied here. The highly significant correlation with perceived modernity likewise supports this assumption ($\rho = -.325$, $p < .001$).

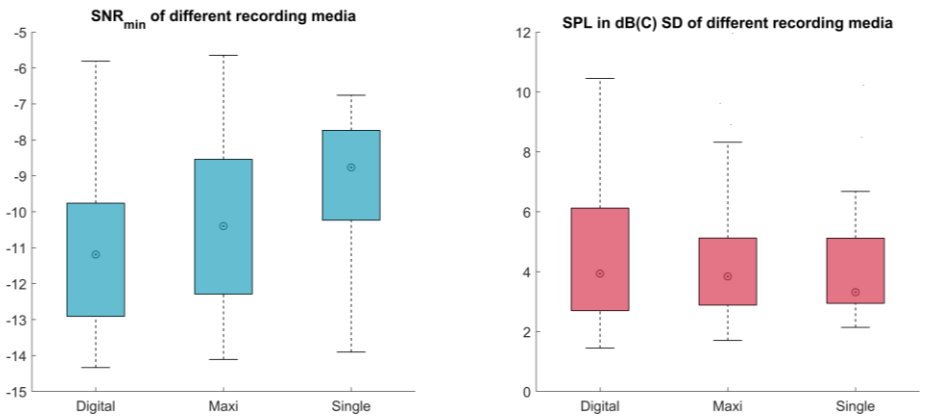


Figure 91: Relationship of SNRmin and SPL SD with the Recording Medium

This term can be interpreted as a measure of sound quality, which makes a negative contribution to the perception of fatness when excessive dynamic reduction occurs that cannot be explained by a technically limited signal-to-noise ratio..

This “penalty term” initially affects very strongly compressed modern productions such as “Turn Down for What” (24) or “Mi Gente” (41), but to a lesser extent also older *Soul* and *Reggae* tracks such as “Respect” (5) and “Rockers Uptown” (6), whose mastering may be regarded as advanced for its time.

This term has the least influence on modern *EDM* tracks whose mastering preserves a relatively large amount of headroom, such as “Racing Green” (39) or “Mutter” (49). It may therefore be assumed that this term primarily compensates for statistical distortions caused by compression.

3. Term 2 ($\boldsymbol{b} \cdot \boldsymbol{x_7}$)

The second term is based on the kurtosis of spectral entropy. It should be noted that, in this case, the linear term becomes significant rather than the quadratic term, which had been preferred in the preliminary modelling.

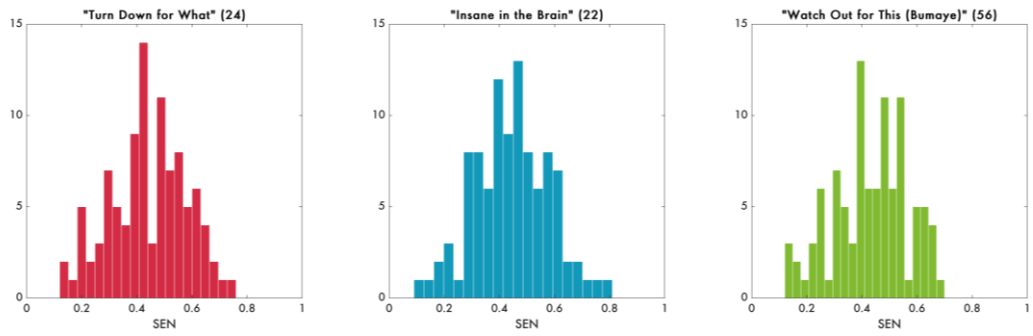


Figure 92: Spectral entropy of selected tracks with low kurtosis

Tracks with low SEN kurtosis usually show a pronounced mode. They therefore tend toward one or more specific states of signal uniformity.

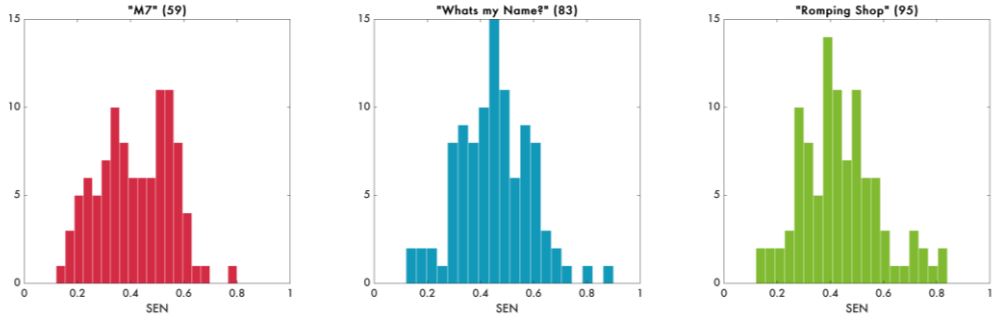


Figure 93: Spectral entropy of selected tracks with high kurtosis

Tracks with high kurtosis, by contrast, generally exhibit broader dispersion, suggesting continuous transitions between uniform and non-uniform components. They also tend to contain high-entropy sections. This can generally be interpreted as a positive influence of a dynamic and differentiated sound image on the perception of fatness.

Many of the tracks with low kurtosis are modern *EDM* productions with conspicuously strong dynamic mastering. This suggests that, alongside restricted dynamic range, a restricted entropy distribution may also represent a concession to the increasing consumption of music through the very small loudspeakers of consumer electronics - a distortion that is corrected by this term.

4. Term 3 ($\boldsymbol{c \cdot x_6 \cdot x_3}$)

The third term describes the interaction between the standard deviation of spectral entropy and the 20th percentile of the centroid.

Tracks with a low value for $sCentroid_{0.20<200Hz}$ are generally modern productions from the field of *Tropical*, but also *Hip Hop* and, to a lesser extent, *EDM*. In general, this includes tracks that measure values below 60 Hz in many measurement windows, and not merely as outliers.

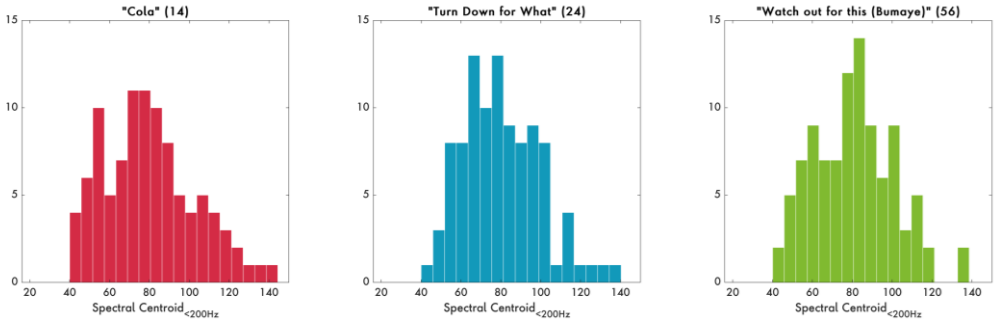


Figure 94: Spectral centroid < 200 Hz of selected tracks with a high 20th percentile

Tracks with a high $sCentroid_{0.20<200Hz}$ are generally *Soul* and *Reggae* productions from the 1960s, for example tracks 89 and 43, and, to a lesser extent, early digital productions with outdated mastering, such as tracks 45 or 90.

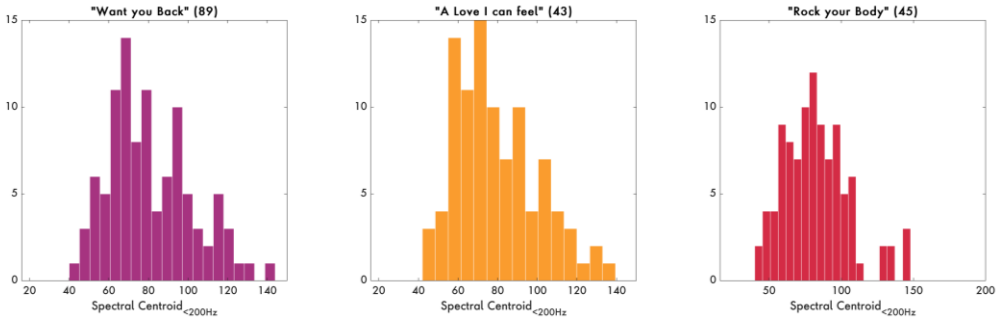


Figure 95: Spectral centroid < 200 Hz of selected tracks with a high 20th percentile

A negative relationship between $sCentroid_{0.20<200Hz}$ and perceived fatness is to be expected and can be demonstrated (cf. Figure 82). he effort, repeatedly discussed in Chapter 2, to make the generation, recording, and reproduction of ever lower tones technically possible is confirmed by the correlation with year of release ($\rho = -.744$, $p < .001$) and perceived modernity ($\rho = -.769$, $p < .001$). This also corresponds to the observations concerning the relationship between perceived fatness and time (cf. Figure 57).

Tracks with a low SD of spectral entropy generally date from the period between 1975 and 1992. These are predominantly *Funk* and *Soul* songs, as well as early digital productions with eccentric mastering.

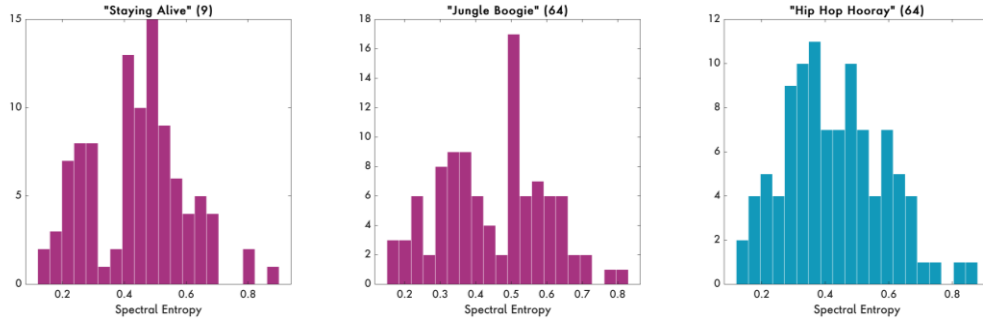


Figure 96: Spectral entropy of selected tracks with low SD

Tracks with high SD are, for the most part, modern electronic "wall of sound" productions (33, 60) or *Electro-Funk* pieces with strongly accentuated individual sounds distributed across a wide frequency range (1).

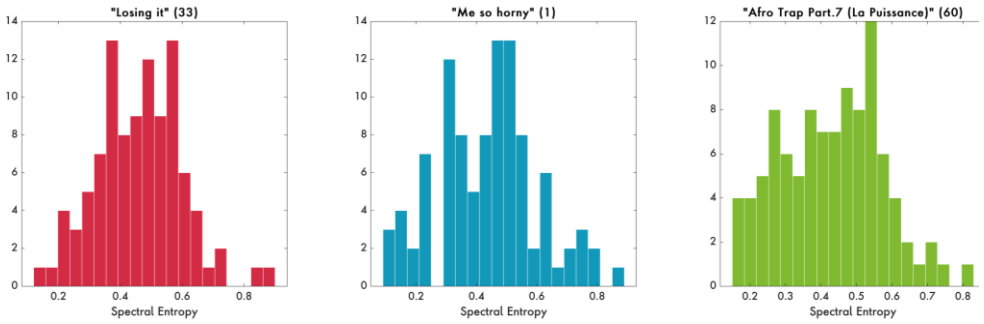


Figure 97: Spectral entropy of selected tracks with high SD

Since the means, as already discussed, are of limited significance because of the heterogeneous track excerpts, it can be argued that the standard deviation of spectral entropy is, among other things, a measure of frequency response, comparable to spectral spread; a strong relationship between the two has already been established in Table 21. Beyond this, however, entropy also provides information about the dynamics of the overall sound image. Since both the centroid and the SD can only take positive values, the positive sign is initially surprising. It would seem to imply that, at this point, a higher pitch register could lead to greater fatness. This term, however, instead means

that in more broadband and dynamically varied productions, the spectral centroid can be higher for the same perceived fatness than in narrowband and static productions. It can be argued that this term therefore indirectly compensates for masking effects.

Accordingly, there are three main types of tracks on which this term has a positive influence:

1) Electronic tracks with broadband synthesizers and deep basses, such as "Losing It" (33), "King of My Castle" (96), or "Turn Down for What" (24);
2) *Hip Hop* and *Electro-Funk* productions with extremely deep basses but also very prominent high-frequency components, such as "My Adidas" (76), "Clear" (21), and "Drop It Like It's Hot" (84);
3) 1960s *Soul* and *Funk* tracks with large ensembles, especially prominent horn sections, such as "Respect" (5) and "Papa's Got a Brand New Bag" (42).

5. Term 4 ($\boldsymbol{d} \cdot \boldsymbol{x_1} \cdot \boldsymbol{x_3}$)

The fourth term describes the interaction between the 85th percentile of momentary fatness and the 20th percentile of the spectral centroid. What is initially striking is that this term decreases as $Fat_{mom,.85}$increases.

Tracks with low fatness are generally either *Soul* and *Funk* recordings or early electronic productions with suboptimal mastering.

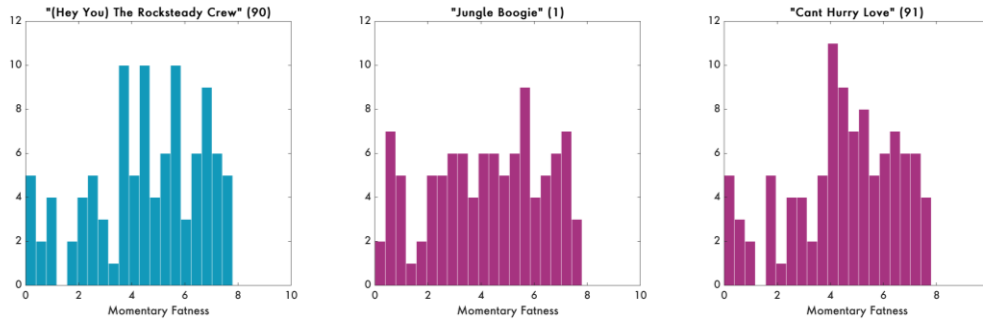


Figure 98: Momentary fatness of selected tracks with a low 85th percentile

High values are reached above all by *Minimal*, *Dubstep*, and *Tropical* tracks from the last ten years.

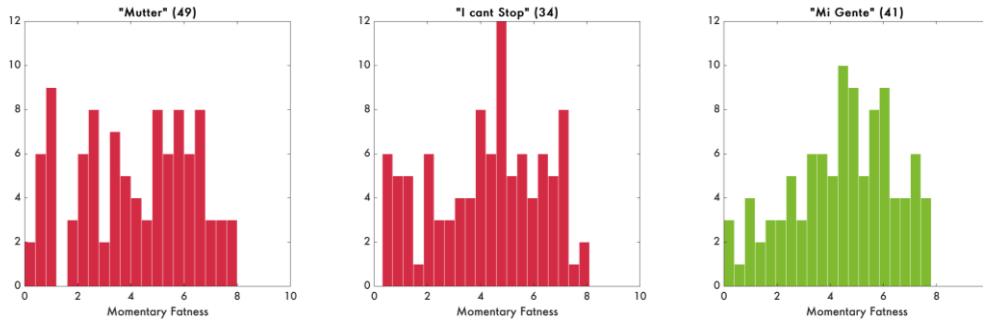


Figure 99: Momentary fatness of selected tracks with a high 85th percentile

This term therefore has a negative effect on sounds in which a high centroid coincides with high fatness. This means that the influence of the centroid becomes particularly relevant when the sound is frequently fat. If this is only rarely the case, for example because of a lack of tonality or harmonicity, the penalty associated with a high 20th percentile of the centroid has a weaker effect.

Since momentary fatness is largely derived from weighted SPL, and since this correlates both with the median of the spectral centroid in test sounds ($\rho = -.595$, $p < .001$) and with its 20th percentile in complex sounds ($\rho = -.522$, $p < .001$), a constellation of low centroid and low momentary fatness is generally not to be expected. The relationship is therefore plausible: sounds with high momentary fatness favour a higher integrated fatness value especially when the bass range is tonally extended as far downward as possible..

Moreover, there is no obvious systematic pattern with regard to the styles or years of release to which this applies. The effect is particularly pronounced, for example, in "Respect" (5) from 1967, "Kontrol" (57) from 2014, and "Insane in the Brain" (22) from 1993. By contrast, this term has little influence both on modern tracks with particularly low $sCentroid_{0.20<200Hz}$, such as "Gasolina" (25) or "Yeah!" (94), and on historical tracks with particularly low $Fat_{mom,.85<200Hz}$, such as "Jungle Boogie" (50) or "Thank You" (81).

6. Term 5 ($-\boldsymbol{e} \cdot \boldsymbol{x_3^2}$)

The final term is the negative square of $sCentroid_{0.20<200Hz}$. The relationship is evident and difficult to dismiss. While Terms 3 and 4 describe the conditional dependence of integrated fatness on the spectral centroid as a function of other factors, this term expresses the general dependence of integrated fatness on the spectral centroid.

As a limitation, it should be noted that selecting the music-sample excerpts according to the maximum of integrated loudness produced a relatively heterogeneous sample in terms of measured values. This heterogeneity is primarily due to aspects of form. Some samples consist only of a constant loop, while others contain quiet passages, sections of several loops, or breaks and bridges. Although this procedure proved well suited as the basis for an expert survey, and is both automatable and reproducible for a large number of tracks, it is certainly conceivable that a more homogeneous selection of samples could lead both to more elegant modelling and to higher validity, significance, and explained variance. Ideally, the main loop of a track would be captured and a fixed number of bars analysed with tempo correction. At present, however, there are neither criteria for identifying a formal section as the main loop, nor techniques for extracting it reliably and accurately from bar onset to bar onset.

Although the residuals of the model meet the requirements for regression analysis and show no significant correlations with the measured values, they do show slight systematic over- and underestimations across different musical styles. It can be observed that the overestimation of *Hip Hop* and *Tropical* recordings, as well as the underestimation of *EDM* tracks, persists in this model (vgl. Figure 84). This may be related to the overlaps in preference between *Hip Hop* and *Tropical* listeners, in contrast to those of electronic music, already noted in §5.3.2. It may be more appropriate, where

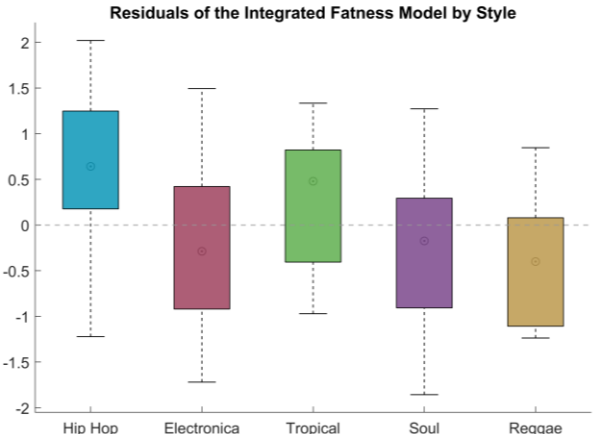


Figure 100: Residuen des Models der Integrierten Fettheit nach Stil

the participants are concerned, to understand *Tropical* as a subset of *Hip Hop*. At least within the reference space of modern dance music as defined in this study, the *Tropical* scene is considerably smaller than the two much larger stylistic fields of *Hip Hop* and *EDM*. Such a sample could, for example, be distributed across the styles as follows: 35% *Hip Hop*, 50% *EDM*, and 15% *Tropical*. At the same time, it cannot be ruled out that the unequal evaluation of the styles is due to an as yet unidentified underlying factor that is correspondingly style-specific.

The present model describes integrated fatness significantly, validly, and plausibly as a function of acoustic depth, dynamics in loudness and timbre, and tonality and harmonicity. It also compensates for strong compression and masking effects. It can be calculated intrinsically from the music itself and is suitable for calculating and comparing the overall fatness of complex musical sounds.

Together with momentary fatness, which can localize fatness within music at a high temporal resolution on the basis of music-intrinsic parameters, this model therefore fulfils the objective of the present work.

6. Application Examples

That fatness constitutes a key element of modern popular dance music has already been argued in Chapter 2 on the basis of both the literature and the music itself. In order to further substantiate this status on the basis of the models and data collected, and at the same time to support the validity of the models themselves, the following chapter presents and discusses one application example each for momentary and integrated fatness.

Integrated fatness is used here as one of the underlying parameters of a self-organizing Kohonen map (SOM), whose purpose is to analyse the similarity of dance-music tracks on the basis of music-intrinsic features.

Momentary fatness, by contrast, is examined with regard to its suitability for analysing rhythm and form in dance music. Particular emphasis is placed on the cyclicality of loop-based music.

The aim is to demonstrate that the proposed fatness models yield plausible results and can make a substantial contribution to knowledge even within complex musicological analytical procedures.

6.1 Self-Organizing Map

As outlined in §3.3.1, self-organizing maps, owing to their "elastic" dimensions, can often represent cluster-like datasets more efficiently than conventional clustering techniques (Blaß & Bader, Computational Music Archiving as Physical Culture Theory, 2019, p. 159)

The COMSAR database (*Computational Music and Sound Archive*) uses the Apollon framework (Blaß, Apollon Framework, 2021) to generate Kohonen maps for the analysis of the extensive collection of ethnographic music recordings held by ESRA, the University of Hamburg's Ethnographic Sound Recordings Archive. For this purpose, MIR (*Music Information Retrieval*) is used to extract data from the respective recording, which are then used for clustering according to timbre. A second analytical dimension consists of rhythmic analysis by means of Hidden Markov Models (HMMs). (Blaß & Bader, 2019, pp. 145-148, 150, 155ff)

Since an analysis of modern popular dance music using HMMs proved problematic (see §6.2), and since fatness is a phenomenon that can very plausibly be assigned to the category of timbre, a modified version of the Apollon framework was used for this example.

Similarity is understood here as the kind of similarity that allows a DJ in a club context to link compatible tracks into a coherent DJ set by means of mixing transitions. In addition to the spectral-timbral measures underlying the map, tempo in BPM is therefore also included.

The training basis consists of the 100 tracks that had already undergone extensive MIR analysis for the modelling of integrated fatness. To test the trained maps, a second sample of another 100 tracks is used, modelled on the categorical specifications of the first sample. Unlike the training sample, this second sample consists entirely of digital media.

6.1.1 Feature Selection

The following section discusses the selection of the features and their contribution to the model. This selection is based on an analysis of the features in terms of their style-specificity, that is, their suitability for differentiating between individual styles.

Integrated Fatness constitutes a central factor of the SOM. The boxplot shows that it is particularly well suited to differentiating between modern and historical dance music. In addition, it promises a very effective distinction between historical African American and Afro-Caribbean music.

The component layer of fatness shown here makes it possible to localize its influence on the map. The relatively homogeneous diagonal gradient demonstrates the suitability of Integrated Fatness for making fundamental distinctions within dance music.

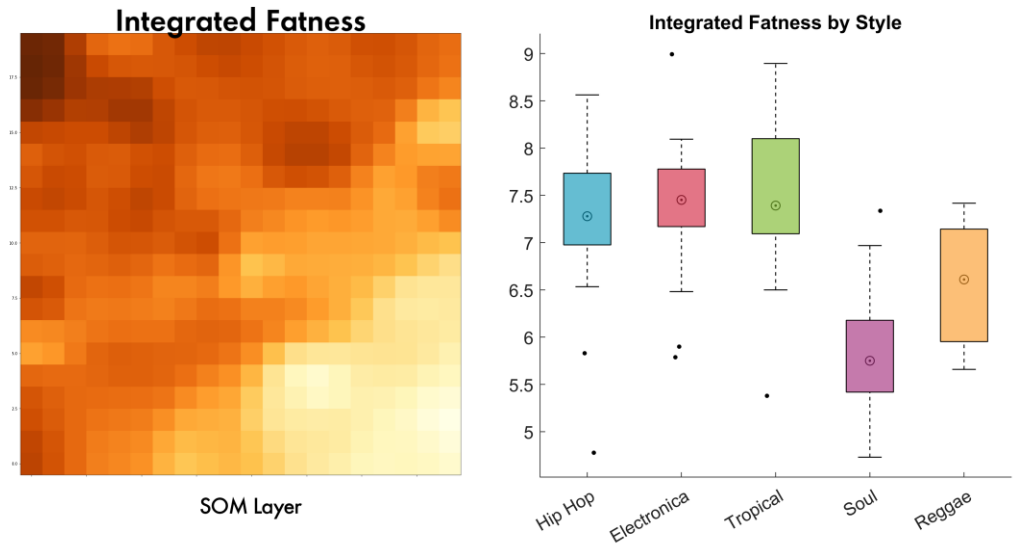


Figure 101: Figure 101: Integrated Fatness as SOM Component / Distribution by Style

Tempo is one of the most important characteristics of a track in the context of dance music. In order for two tracks to be blended professionally, they must be set to exactly the same tempo. DJ technology typically allows tempo adjustment of at least ±8%. If impairments to sound quality are to be avoided, this range is reduced to approximately ±4%. Beyond this, pitch-shift procedures lead to excessive formant shifting, while time-stretch procedures may produce clearly audible artifacts, depending on the source material. Similar BPM values are therefore a prerequisite for skilled beatmatching transitions.

The BPM value was determined using Serato DJ Pro 2.5.6 and manually corrected where necessary.

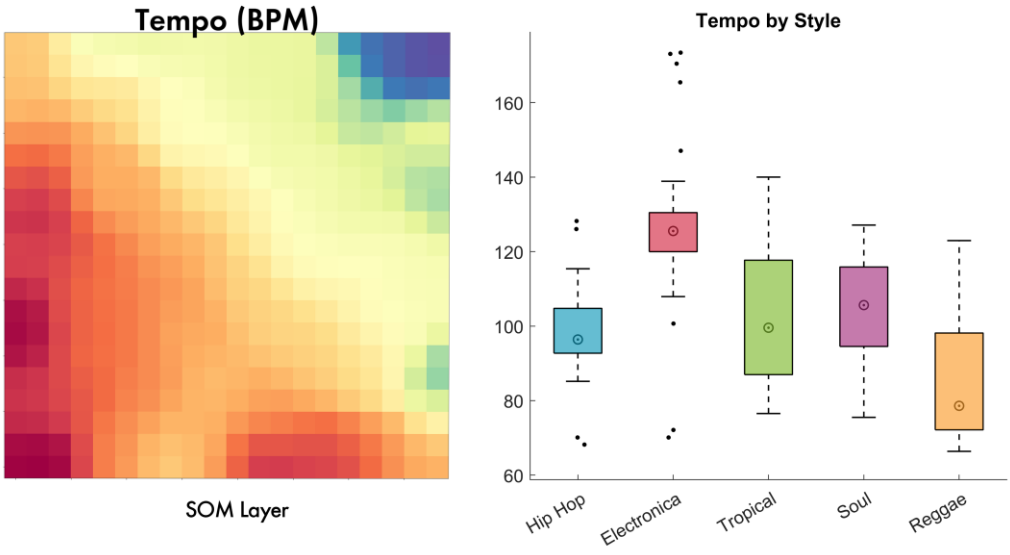


Figure 102: Tempo as SOM Component / Distribution by Style

As expected, tempo also allows for very effective differentiation between the styles. This is particularly evident when comparing *Hip Hop* and *Electronica*, where it highlights the typical and conventional tempo ranges of these two styles. The outliers at the lower end are *Trap* in the case of *Hip Hop* and *Dubstep* in the case of *EDM*. The upper outliers within the *EDM* range belong to the style complex of *Jungle* and *Drum & Bass*.

The tempo layer of the SOM also shows a general diagonal increase, underscoring its high explanatory value. Clear exceptions are, however, visible at the margins. Tempo is entered into the calculation with double weighting in order to reflect its particular importance for mixability.

Since Integrated Fatness already characterizes the low-frequency range quite clearly, it is unsurprising that measures of the higher critical bands now suggest themselves for constructing the map. The maximum of the C-weighted sound-pressure level in the higher critical bands appears to be highly style-specific, but it does not differentiate between the mutually influential styles of *Hip Hop* and *Tropical*. The pronounced outliers at approximately 70 dB© are again attributable to the field of *Minimal*.

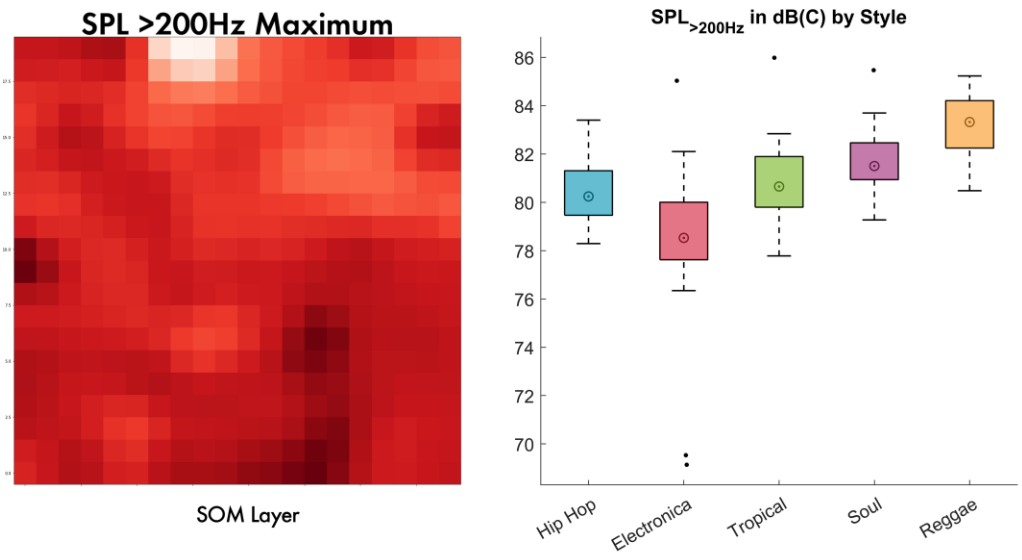


Figure 103: SD of C-weighted Sound-Pressure Level > 200 Hz as SOM Component / Distribution by Style

This time, the component map shows an increase in values only along the Y-axis. Several loci become apparent, however, which further differentiate the preceding layers. For example, the aforementioned *Minimal* outliers are assigned to the white field at the upper edge and are thus differentiated from other tracks with comparable fatness and tempo.

The interpretation of this component remains ambiguous. It may be assumed that it reflects both musical properties and audio-engineering conventions, and that it does so along both historical and stylistic dimensions. The historical dimension is evident in the comparatively high values for *Soul* and *Reggae* relative to more recent styles, while the stylistic dimension is again reflected in the distance between *Hip Hop* and *EDM*. Any further quantification, however, would require additional analyses.

The median spectral flux of a recording is a measure of spectral dynamics and indicates a broadly distributed, varied spectrum. This is a particular characteristic of electronically produced music, which is not bound by the limitations of instrumental acoustics in the creation of spectra. Accordingly, *EDM* values stand out against all other styles, especially *Hip Hop*. It is notable that the value ranges for *Soul* and *Hip Hop* correspond closely, and that a similar phenomenon occurs between *Tropical* and *Reggae*. This

may indicate that spectral flux is suitable for differentiating African American and Afro-Caribbean music.

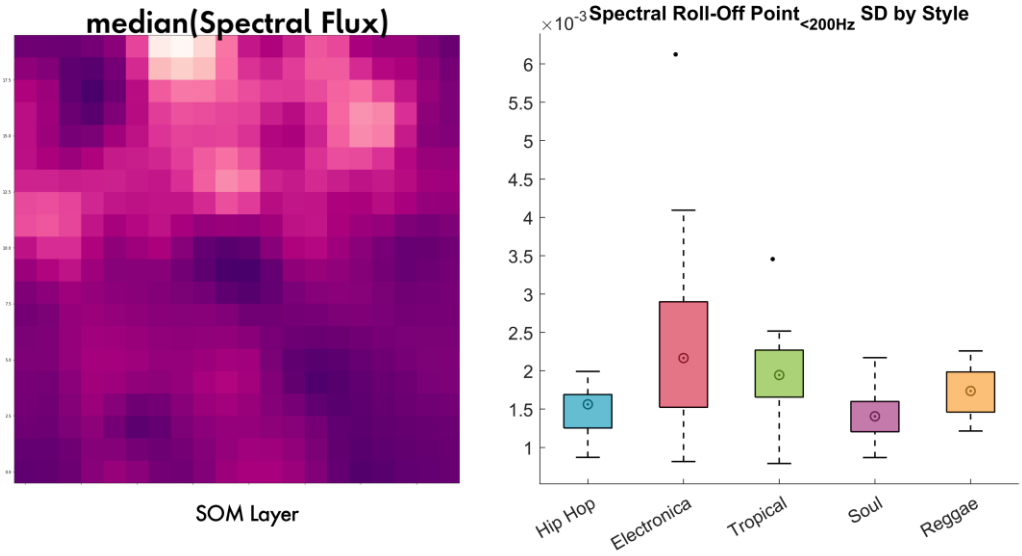


Figure 104: Median Spectral Flux as SOM Component / Distribution by Style

The component map shows islands of high values in the upper half of the map, where modern productions, mostly from the *EDM* domain, are located. Similar to the previous SD of sound-pressure level, a decrease in values along the Y-axis can be observed. The loci, however, hardly correspond, suggesting that this component increases the information content of the SOM.

The standard deviation of the Spectral Roll-Off Point above 200 Hz is a measure of the dynamics of high-frequency emphasis in a recording. Since modern synthesis techniques, as well as continuously improved microphone and equalization technology, allow for greater control over the desired frequency profile of a recording, a clear distinction between recent and historical tracks is evident here as well. Since an SD in the four-digit range requires correspondingly high mean values that must not be present continuously, it seems plausible to interpret this as a measure of the intended brilliance of specific elements, such as hi-hats or similarly high-frequency sounds. It is also possible, however, that this brilliance is a property of the recording-medium type. A Pearson correlation with the dichotomous variable vinyl/digital supports this assumption ($r = .665$, $p < .001$).

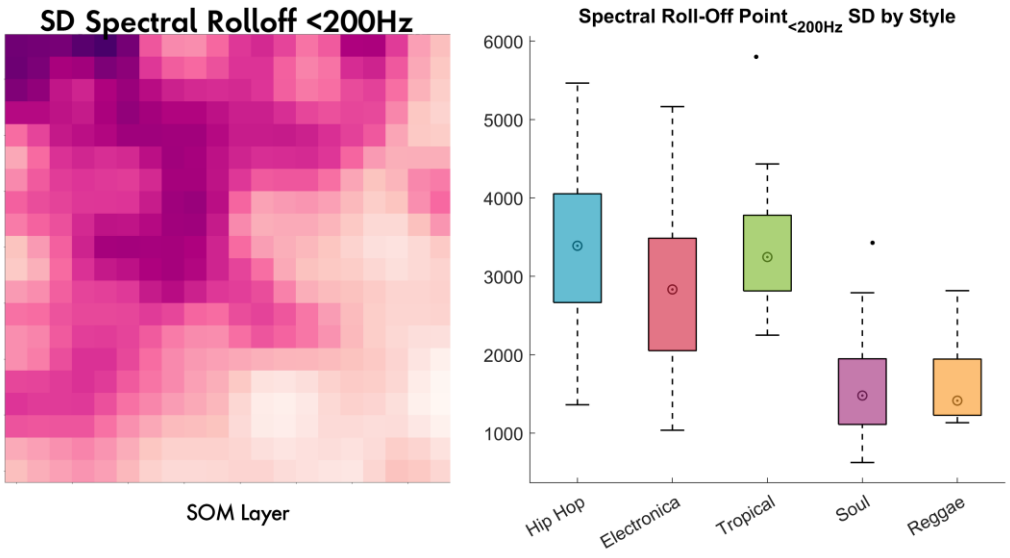


Figure 105: SD of Spectral Roll-Off Point > 200 Hz as SOM Component / Distribution by Style

On the component map, a slight diagonal distribution parallel to Integrated Fatness becomes apparent. The numerous divergent loci, however, indicate a further increase in differentiation.

An even more granular spectral differentiation is provided by the standard deviation of Spectral Skew above 200 Hz. Again, the component layer displays a diagonal gradient. This shows particularly striking structures in the lower right quadrant, presumably relating to *Soul*, *Reggae*, and early *Hip Hop*. While the standard deviation of the high-pass-filtered $sROP(85)$describes the fluctuation of the highest components, the standard deviation of the high-pass-filtered $sSkew$is better understood as the dynamics of register changes, excluding the bass.

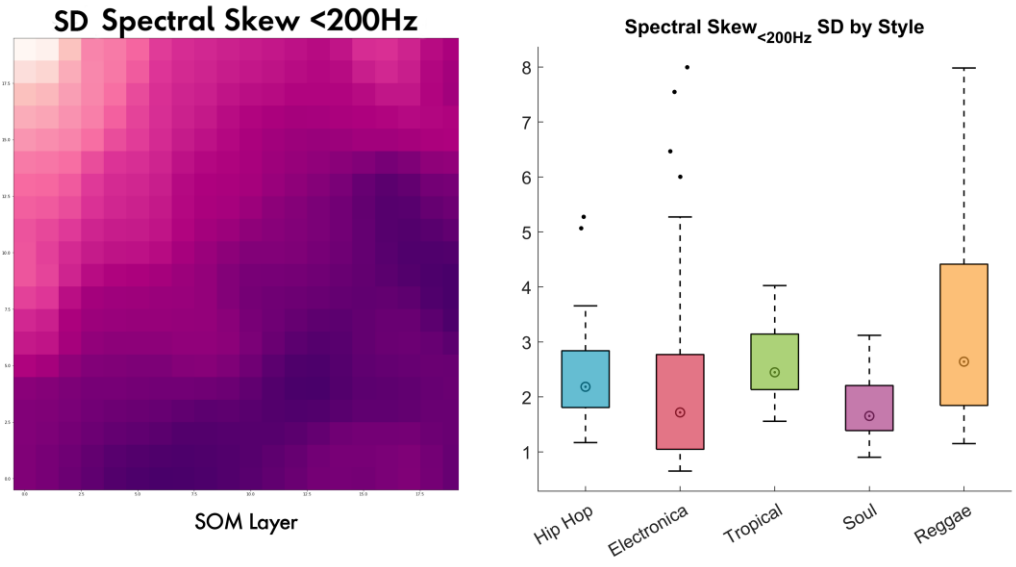


Figure 106: Figure 106: SD of Spectral Skew > 200 Hz as SOM Component / Distribution by Style

Particularly noteworthy here are the high values reached, on the one hand, by *Reggae* - possibly attributable to its typical offbeat harmonies - and, on the other, by *Minimal*. This, in turn, may be rooted in the particular relationship of *Minimal EDM* to King Tubby's production techniques.

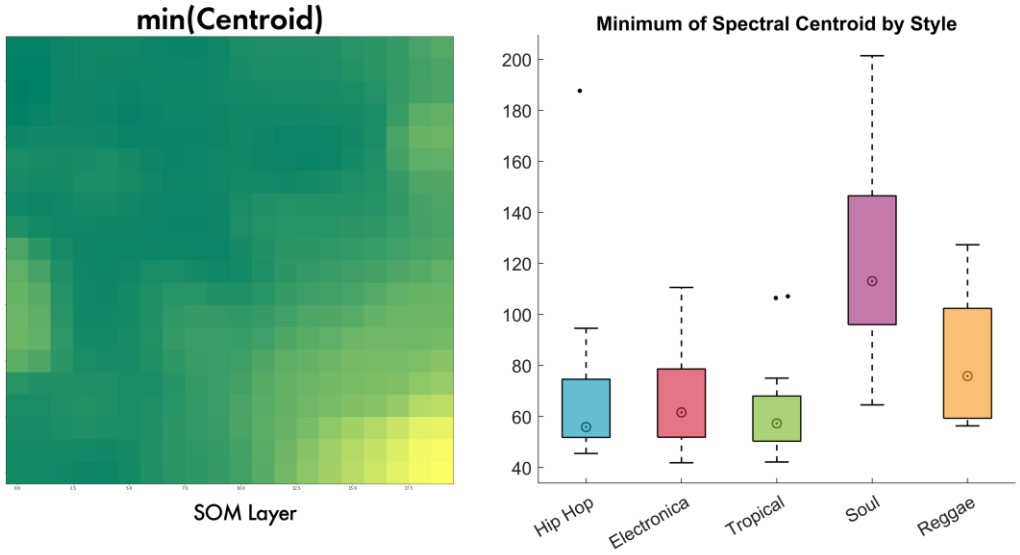


Figure 107: Minimum of Spectral Centroid as SOM Component / Distribution by Style

The minimum of the spectral centroid proved more useful than its 20th percentile in the calculation of this SOM. It cannot be ruled out, however, that the outliers not

removed by this measure represent an additional audio-engineering dimension rather than a musical one. Nonetheless, this feature appears well suited to differentiating historical styles.

The component map shows localized structures wherever tracks released before 1985 are placed. The majority of the SOM is largely uniform with regard to this feature. This is plausible in view of the distributions observed for the more recent styles.

6.1.2 Differential Analysis of the SOM Clusters

A map trained according to these specifications with the music sample from §5.2 shows a clear clustering by style, calculated entirely from music-intrinsic features and without recourse to metadata. The dimensions of this map are flexible. If the map is imagined as a topography, darker fields would be located at higher elevations, and paths through them should be interpreted as greater distances. Since distances in the SOM express similarity, these areas consequently represent lower similarity.

The clusters appearing on the map were drawn interpretively, as shown in Figure 108. They broadly correspond to the "relationships" postulated in Figure 12. *Hip Hop*, *EDM*, *Tropical*, *Soul*, and *Reggae* are each fundamentally grouped together. The tempos of proximate tracks are usually suitable for beatmatching transitions.

The previously postulated convergence of all three recent style groups can also be traced on the map. It results in the "Urban" cluster in the second quadrant.

Some tracks, however, are evidently placed in at least unusual positions. Examples include the clusterless area around tracks (55) and (44), tracks (69) and (85), and track (90). These areas must be discussed with regard to the suitability of the map.

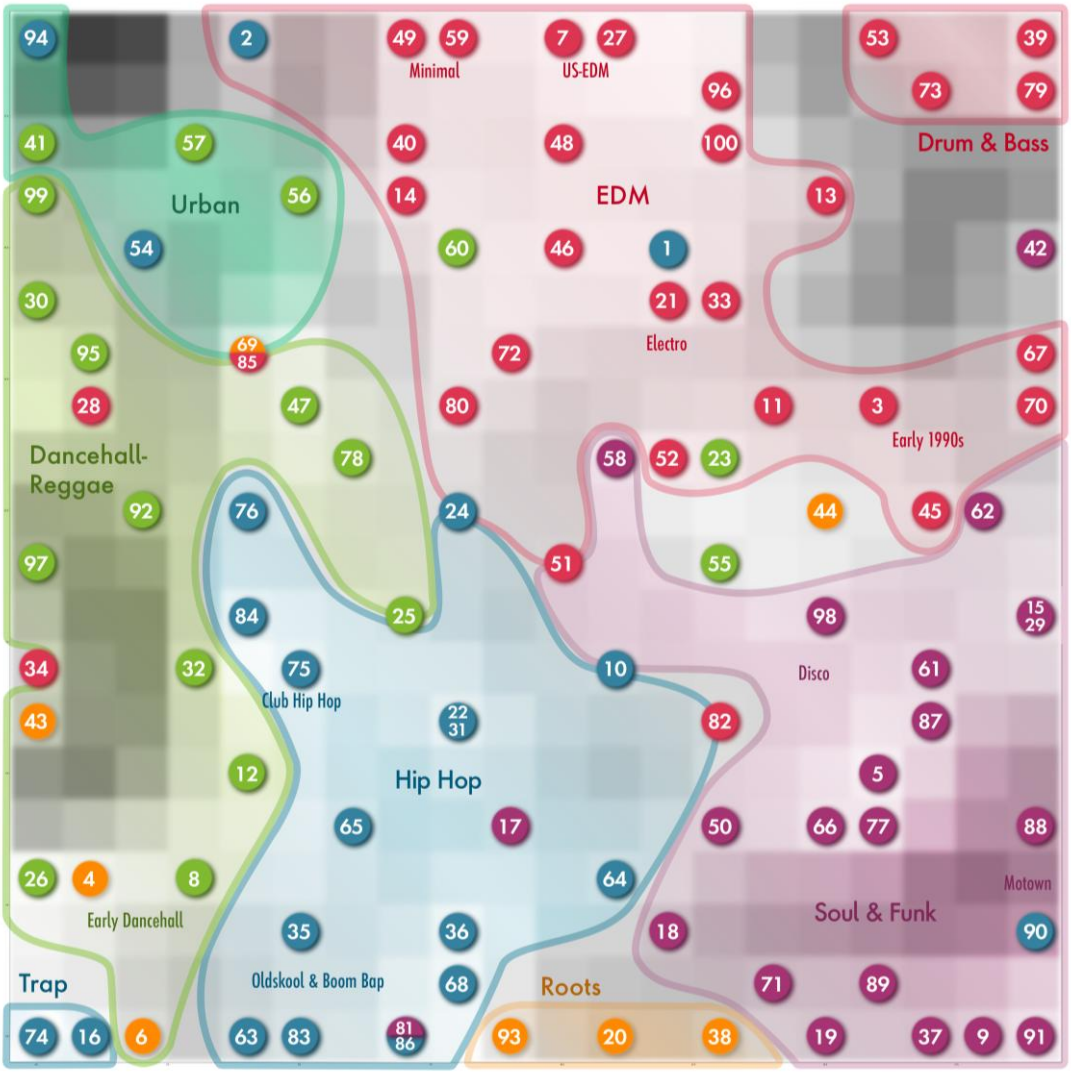


Figure 108: Kohonen Self-Organizing Map of the Training Sample Based on DJ Considerations

Upon examining the clusterless area (Figure 109) , it is noticeable that the tracks "Premier Gaou" (55) and "Carry Go Bring Come" (44) both have tempos that are atypical for their respective domains. They fall within a tempo range more typical of *EDM*. In addition, both are analog tape productions. While a high tempo is typical of *Ska* tracks, "Carry Go Bring Come" is the only uptempo *Ska* song in the sample. The other included *Ska* song, "Don't Stay Away" (69), is considerably slower. In the area of fast *Tropical* tracks, by contrast, "Premier Gaou" (55) is the only analog title. Its placement near *Disco* can therefore be considered plausible, given the lack of more similar tracks in the sample. After all, it corresponds both to the analog production

paradigm and to the tempo of this area. The placement of “Premier Gaou” (55) near the African *Disco* track “Soul Makossa” (58) and the African *House* track “Oliver Twist” (23) is also striking. A DJ mix involving these tracks is more coherent and more conclusive, both contextually and formally, than the predefined training labels would suggest. If necessary, track (23) would therefore have to be understood, in a “culturally blind” sense, as an *EDM* track.

Figure 109: SOM-Ausschnitt / Clusterfreier Bereich

The placement of this area is therefore largely plausible, with the exception of track (44). From a DJ perspective, however, this track is still optimally assigned, given the absence of a more suitable context.

Similar to (44), the *Brostep* track “I Can’t Stop” (34) and the *Electro-Funk* production “Hey You!” (90) form enclaves at the edge of the map. In the case of “I Can’t Stop” (34), it is again noticeable that the sample contains no similar tracks at a comparable tempo. This appears to point to a requirement of the SOM: coherent clusters can only emerge where the data provide sufficient continuity. The highly plausible *Trap* cluster at the lower left edge, by contrast, suggests that even two similar tracks may be sufficient to form a coherent group.

The placement of (34) according to the criteria “relatively slow” and “bass-heavy” is logical; in relation to its neighbours “Under Mi Sleng Teng” (97) and “A Love I Can Feel” (43), however, it is not. This is also indicated by the dark structures surrounding the tracks (Figure 110).

The placement of the dub-oriented "Anti War Dub" (28), by contrast, is considerably more coherent. In terms of both beat and sonic aesthetic, the track corresponds in many respects to the surrounding *Dancehall* titles.

Figure 110: SOM Segment / Dubstep Placement

The enclave formed by "Hey You (The Rock Steady Crew)" (90) among significantly older tracks, by contrast, appears to be of an audio-engineering nature. Compared with other tracks of its time, the recording sounds surprisingly "thin." Whether this is due to the pressing or to the production should be examined. In future uses of this sample, either the pressing or the track itself should be replaced, since in this form it is not representative of modern popular dance music.

The placement of "Don't Stay Away" (69) and "Back 2 Life" (85) at the boundary between the *Tropical* and *Urban* clusters, by contrast, appears counterintuitive only at first glance. "Don't Stay Away" is certainly located here partly because of insufficient continuity in the sample, but it combines a tropical sonic aesthetic with a tempo of around 100 BPM. A relick, that is, a modernized reworking, of the riddim version was successfully released in 2013 as the "Gyal Season Riddim." "Back 2 Life" likewise combines a moderate tempo with influences from *EDM*, African American music, and Afro-Caribbean music and can therefore, despite its *EDM* label, plausibly be understood as a starting point for the aforementioned convergence.

"Papa's Got a Brand New Bag" (42) likewise forms a *Funk* enclave within the *EDM* area. This cannot be attributed solely to its *EDM*-compatible tempo, which also occurs, for example, in the conventionally placed tracks (15) and (29). A closer examination

of the individual SOM layers shows that the SD of Spectral Skew < 200 Hz is particularly conspicuous here. All other measured values are typical of *Soul*. It can be argued that differentiable register changes are particularly useful for identifying different polyrhythmic layers. If this assumption is accepted, James Brown applied a meaningful production technique for the *Funk* style here - one that was ahead of its time and, unlike more superficial musical stylistic devices, was not initially adopted by his contemporaries.

Further apparent misplacements of training labels, such as the inclusion of the *Electro-Funk*-oriented tracks (1) and (2) in the *EDM* area, as well as the placement of *Funk* tracks within *Hip Hop*, prove similarly plausible upon closer musical examination. The placement of "Thank You" (81) between the *DJ Dub* "Wear You to the Ball" (93) and the *Funk DJ Dub* "Rapper's Delight" (86), in particular, is highly coherent and meaningful.

With regard to the training sample, only "I Can't Stop" (34) and "Hey You!" (90) are clearly misplaced after this analysis. The placements of the two *Ska* tracks "Don't Stay Away" (69) and "Carry Go Bring Come" (44) are defensible, but only conditionally meaningful due to the lack of context.

Depending on interpretation, the map trained in this way achieves a very high accuracy of 96–98% with regard to cluster assignment.

6.1.3 Analysis Using a Test Sample

In order to verify the reliability of the trained map, a B-sample of 100 music tracks was compiled. This sample corresponds to the proportional structure of the training sample in terms of year of release, stylistic composition, and sub-stylistic composition. However, these are not original masters, but currently available digital versions. Re-masters are therefore to be expected, although they cannot be assumed in every case. A quick reference of test sample B can be found in the appendix of this dissertation.

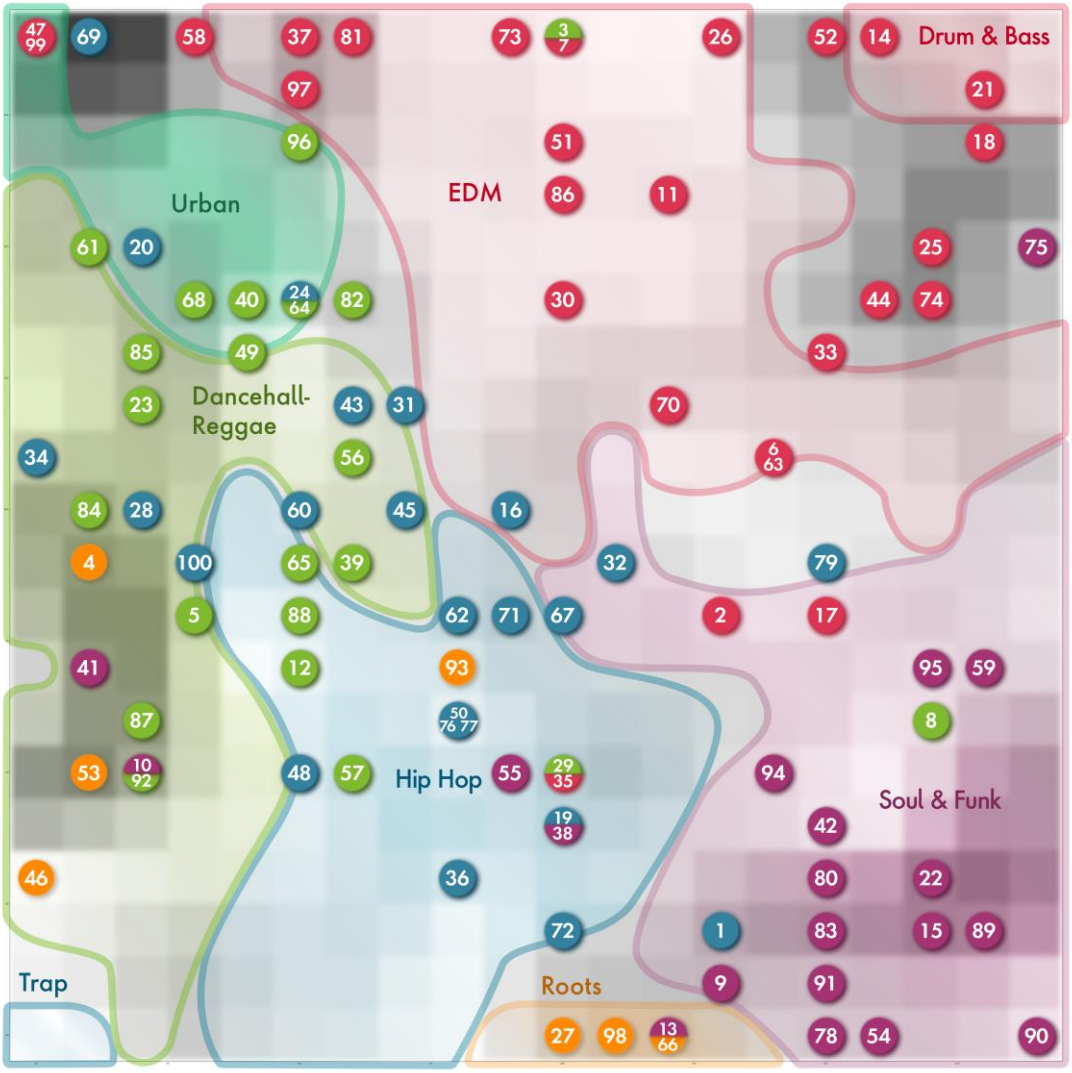


Figure 111: Projection of Test Sample B onto the Trained SOM

The placement of this test sample on the SOM generated from the training sample is shown in Figure 111. There is an evident correspondence between the clusters, although a large transitional area between *Hip Hop* and *Tropical* can be observed. This is plausible, but suggests that the bulge of the *Tropical* cluster between *Hip Hop* and *Urban* might already be assigned to the *Urban* cluster. It can likewise be argued that, without additional rhythmic differentiation, fat-sounding remastered *Hip Hop* exhibits the same properties as, for example, *Dancehall*.

Beyond this, too, the diffusion is, as expected, greater than in the placement of the training sample. This, however, can likewise be argued plausibly.

As an example, the assignment of “Think” (B55), “Shy Guy” (B29), “B-Boy Stance” (B35), and “Funky Sensation” (B38) to the *Hip Hop* cluster will be discussed here (Figure 112). Tracks (B55) and (B38) are both classic and prominent sources of *Hip Hop* samples. For the intro drum loop from “Think” in particular, the sample database WhoSampled.com lists more than 3,000 uses (WhoSampled.com, 2021). It is plausible that remasters of these tracks follow modern sound conventions, which were defined in part by *Hip Hop*, and that they are therefore rightly located here.

Tracks (B29) and (B35), by contrast, can be described as *Hip Hop* beats with light *Reggae* elements and *Dancehall* vocals, despite their cultural origins: the Freestylers are *EDM* producers, while Diana King is a Jamaican *Dancehall* singer. Since this map does not aim to differentiate between vocal techniques, and since these have little influence on mixability, this placement can be accepted as correct.

Figure 112: SOM Segment / Hip Hop in Test Sample B

A DJ mix of all these tracks with the surrounding or similar *Hip Hop* titles is entirely conceivable and has in fact been performed by the author on numerous occasions. Further borderline cases include “Kudaushe” (B3), which can readily be interpreted as Pan-African *EDM*, and “Running Away” (B75), a more recent *Jazz Funk* track by the influential bandleader Roy Ayers, comparable to “Papa’s Got a Brand New Bag” (42). The same assumptions can therefore be made in these cases.

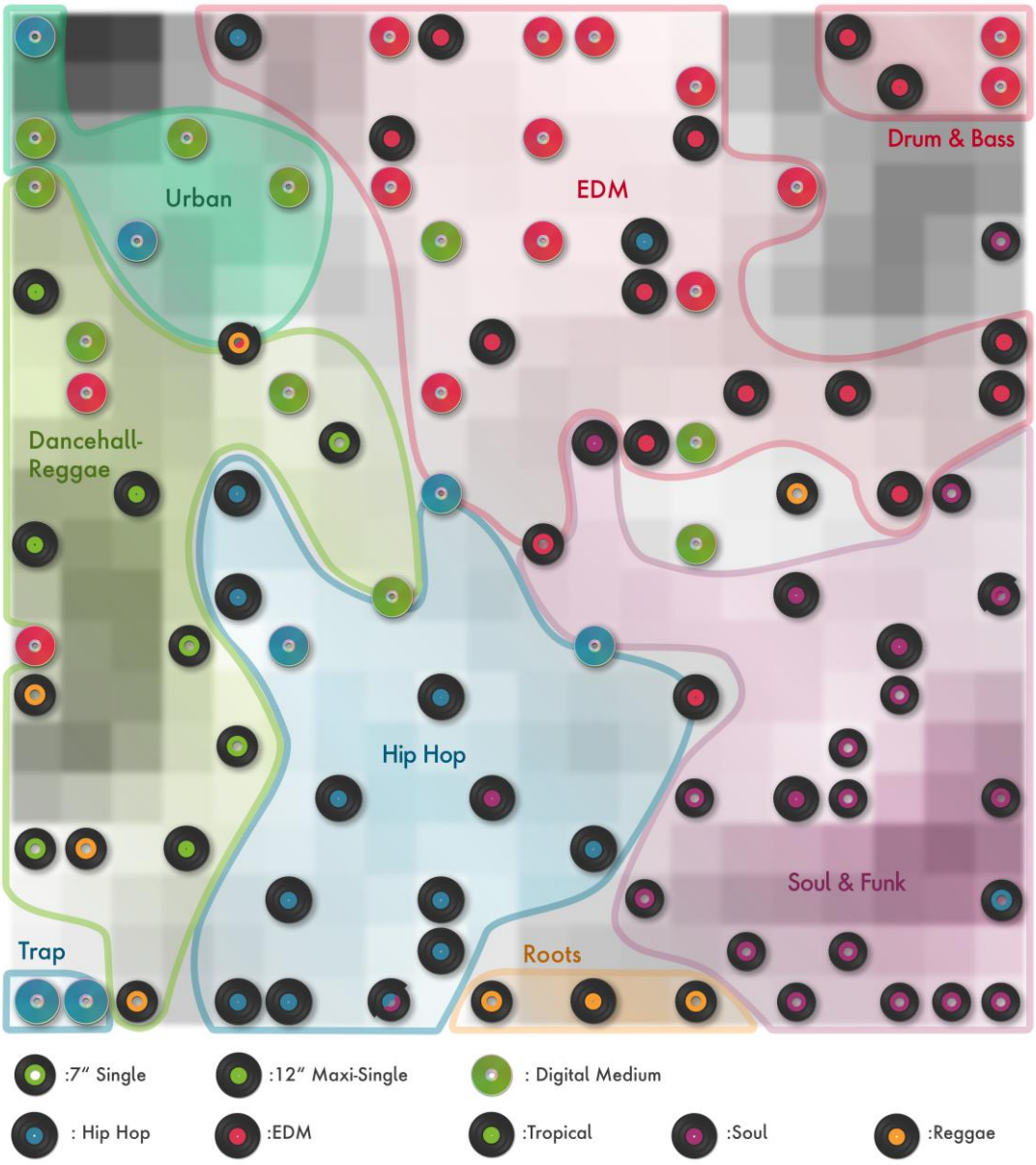


Figure 113: Projection of Recording-Medium Types from the Training Sample onto the SOM

Furthermore, large areas can be observed in which no tracks were placed in this calculation. When the underlying recording media of the training sample are projected onto the map, it becomes clear that the regions in question are occupied almost exclusively by vinyl datasets (Figure 113). The map therefore also captures audio-engineering factors such as medium, as well as the remastering of older titles. In practice, however, such changes relative to the original also alter the permissible mixing context. Minor differences can be compensated for by means of EQ, but strongly divergent

production levels are usually difficult to conceal. In this respect, these empty areas should likewise be regarded as valid.

The titles “Reet Petite” (B41), “Hyph Mngo” (B47), “Cissy Strut” (B92), “The Tide Is High” (B93), and “Original Nuttah” (B99) are evidently assigned suboptimally. In the cases of (B41), (B92), and (B93), it seems likely that substantial remastering means that these recordings no longer meet the requirements of a map trained on original masters. By contrast, (B47) and (B99) exhibit a combination of high fatness and highly distinctive values in the other parameters. The two tracks are not similar to one another: while “Hyph Mngo” (B47) stands out because of its very high SD of Spectral Skew < 200 Hz, the position of “Original Nuttah” (B99) is primarily due to its low maximum sound-pressure level < 200 Hz. This, too, can therefore be interpreted as a lack of necessary continuity in the data.

These assumptions are supported by the placement of the errors on dark, dissimilar SOM cells. Nevertheless, the test sample also achieves an accuracy of 95%. Clustering using the Classification Learner app in MATLAB reaches a maximum of 66% across all modes, including deep learning with neural networks, when the same training and test data are used. Most methods remain well below this value.

6.1.4 Discussion of Plausibility within the Clusters

In order to meet the formulated requirements for the SOM, the procedure must not only assign tracks accurately to cluster regions, but also plausibly represent the similarity of individual tracks to one another in the sense of a DJ set.

If we consider the *Soul* cluster, for example, the close proximity of the Motown titles "I Want You Back" (89), "You Can't Hurry Love" (91), and "Do You Love Me" (88) is immediately apparent (Figure 114). These are surrounded by other fitting *Soul* titles from the late 1960s, such as "At the Party" (38) and "Soul Man" (77). Along the X-axis, the music develops via *R&B* toward *Rocksteady*; along the Y-axis, it develops via *Funk* toward *Disco*. Minor diffusions can be observed, but they mostly concern recordings already noted above for outdated mastering, such as (90) or (9).

Figure 114: SOM Segment / "Motown Cluster"

The *Hip Hop* and *Dancehall* clusters display a comparable quality of similarity representation. In these areas, the map provides meaningful information.

Proximate tracks can generally be linked into coherent DJ sets, as demonstrated by the following hypothetical example set:

Set-Order	Titel	Sample Nr.
1	The Supremes – Can't Hurry Love	91
2	The Jackson 5 - Want you Back	89
3	Charles Wright - Express Yourself	18
4	Naughty by Nature - Hip Hop Hooray	64
5	Pete Rock & CL Smooth - They Reminisce over You	68
6	Grandmaster Flash - The Message	36
7	Gang Starr – Full Clip	35
8	Notorious BIG - Hypnotize	65
9	Buju Banton – Champion	12
10	Rihanna - Work (feat. Drake)	75
11	Daddy Yankee - Gasolina	25
12	Sean Paul – Like Glue	78
13	Koffee - Toast	47
14	El General – Pu tun tun	30
15	Wiley, Stefflon Don & Sean Paul - Boasty (feat. Idris Elba)	99
16	J Balvin - Mi Gente	41
17	Usher - Yeah! (feat. Lil Jon & Ludacris)	94
18	Maleek Berry – Kontrol	57
19	Major Lazer - Watch Out For This (Bumaye) (ft. Flexican, FS Green, Busy Signal)	56

Table 30: Exemplary DJ-Set

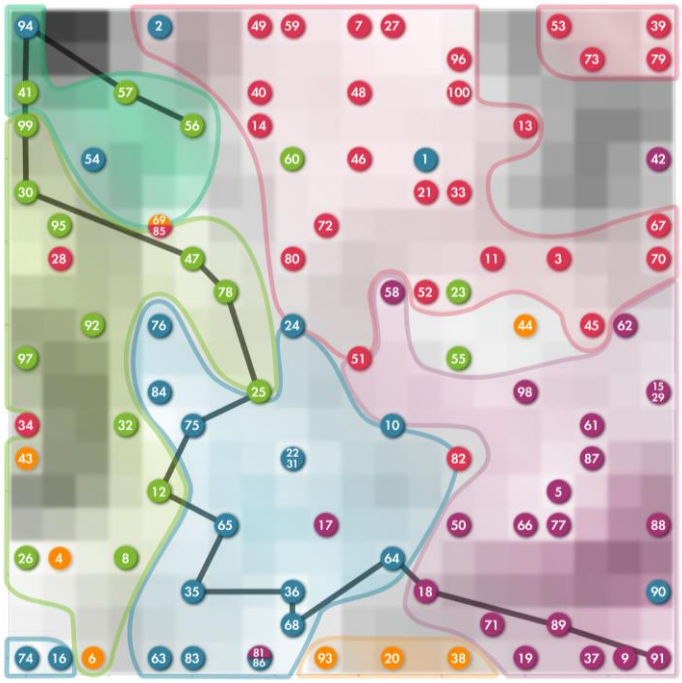


Figure 115: Example DJ Set as Path through the SOM

It should be noted in particular that, at several points in this set, the tempo difference exceeds the 4% threshold relevant for beatmatching. This is attributable to the low resolution of the sample with respect to the individual styles. This Kohonen map represents a field far larger than the usual repertoire of individual DJs or club nights. A transition into the *EDM* area is also difficult for reasons of resolution. As Figure 44 showed, the tempo distribution within dance music is bimodal. At low resolution, there are not enough options to connect the tempo ranges around approximately 100 BPM with those around approximately 130 BPM.Figure 44 showes, the tempo distribution within dance music is bimodal. At low resolution, there are not enough options to connect the tempo ranges around approximately 100 BPM with those around approximately 130 BPM.

When considering the aforementioned *EDM* cluster, a high degree of diffusion with regard to substyles becomes apparent. Although smaller subclusters such as *Minimal*, *Electro*, or American *EDM* emerge, a fundamental distinction - for example between *House*, *Techno*, and *Trance* - does not. The *EDM* area is generally more homogeneous in terms of musical form than the other styles included, which makes these tracks broadly mixable with one another. In this respect, the SOM does indeed fulfil its

purpose; from the perspective of an *EDM* DJ, however, the positioning of the tracks is of questionable informational value. Only the areas of *Drum & Bass* and *Dubstep* stand out, underscoring the significance of distinct British trajectories.

6.1.5 Discussion

It has been shown that the MIR-supported Kohonen SOM is an effective method for clustering dance music and making underlying structures visible. In two sets of 100 tracks each, more than 95% of the assignments could be regarded as plausible.
Within the styles, however, a more stringent assignment of substyles would be desirable. Three possible reasons for this are discussed in the following:

1. Lack of Rhythmic Dimension

With the exception of tempo, the map was calculated purely on the basis of timbre. This appears to depend in part on audio-engineering conditions. These may be rooted, for example, in contemporary production paradigms or in historical and technical limitations. The consequence is that musically different but audio-technically similar tracks may be assigned a degree of similarity that is not fully justified - even though the basic styles are generally assigned well.

Since Chapter 2 showed that modern dance music is defined in particular by rhythmic phenomena, and since precisely these phenomena underlie distinctions between *Hip Hop* and *Dancehall*, as well as between *House* and *Techno*, it appears promising to incorporate rhythmic components into such a map.

Attempts to cluster the training data using the COMSAR rhythm layers proved unproductive, although in individual cases they do appear capable of identifying sample sources. For example, they accurately suggest a similarity between “Trans-Europa Express” (51) and “Planet Rock” (2). Considerations regarding suitable rhythmic measures for modern popular dance music can be found in §6.2.

2. Issues of Resolution

It has been shown that similarity analysis using a SOM requires both high resolution and a high degree of continuity in the distribution of feature values. This is especially true if plausible mixing candidates are to be identified for each individual track.

For training a SOM that could potentially organize all tracks of modern popular dance music according to common, practice-oriented DJ criteria, 100 tracks are evidently insufficient. This can be addressed either by substantially expanding the training sample or by restricting the scope of validity in a practice-oriented manner. The former would be beneficial for musicology and the music industry and, given the digital scalability of the entire procedure, could also be implemented as a Big Data approach. The latter would benefit DJs, manufacturers of DJ software, and automated sound systems, which would obtain more precise information within a stylistic space relevant to practice.

3. Issues of Dimensionality

Figuratively speaking, the SOM at times appears as if an oily and a watery phase had been pressed between the slide and coverslip of a microscope, so that layers that should in fact lie on top of one another are forced to lie side by side and displace one another. This becomes particularly evident when considering the distribution of tracks labelled as *Reggae*. It can also be applied to the substyles within the *EDM* area.

This raises the question of whether, despite the evident benefits of flexible dimensions in non-linear prediction, two dimensions are sufficient to express the similarity of popular-music tracks.

Especially if additional features are to be included, the use of Self-Organizing Cubes or three-dimensional Kohonen maps could ensure a better representation of similarity.

Such three-dimensional SOMs (vgl. (Lim, 2013) oder (D. Wijayasekara, 2011)) are already used successfully, for example, in economics (Kiviluoto, 68-71) and geology (Priezzhev, 2019) and have also been proposed for the musicological organization of sound archives (Azcarraga A., 2011). It may be assumed that this procedure would

have a positive effect on the quality of similarity prediction, but a negative effect on ease of visualization.

6.1.6 Application Perspective

In practice, the procedure presented here for predicting and projecting the similarity of dance music is particularly useful for two areas: the analysis and organization of large sound archives, for example by major labels, streaming providers, or universities; and the similarity assessment of small, closed "sound archives" or libraries used by DJs, DJ software, or automated sound systems.

1. Large Sound Archives

   As of 2021, the catalogue of the market-leading music streaming provider Spotify comprises approximately 70 million tracks (Rabe, 2021). Even smaller providers, such as the online music store Beatport, have catalogues of more than 9 million tracks (Beatport, 2019)It can be assumed that the music industry contains numerous archives of comparable scale. These are usually structured by means of manually created metadata.

   tructuring such archives using MIR-supported SOMs would offer numerous advantages over categorization schemes such as "Users who liked track X also liked track Y" or "More *Classic Rock* hits from 1992." In particular, it should be noted that, unlike conventional procedures, the SOM does not tend toward circular reasoning and can therefore suggest assignments or recommendations involving tracks that are known to only a small number of users. This would be beneficial both for providers and for consumers. Since the procedure presented here is fully automatable and therefore scalable, it is excellently suited to such a Big Data approach, provided sufficient computing power is available.

2. Small Sound Archives

   DJ software such as Serato DJ Pro, Traktor PRO, or Rekordbox is able to detect the tempo and key of tracks, but the display and organization of titles are usually based on metadata in addition to these two parameters.

A suitably trained SOM could, for example, organize set folders or search results by similarity to the currently playing track, rather than alphabetically or by tempo. It would likewise be possible to generate plausible routes toward tracks intended for later use in the set.

In practice, this is conceivable in the following ways:

1) A guest requests a track by the singer Sean Paul. When the DJ uses the search function of the DJ software to display all available Sean Paul tracks, these are automatically sorted by their similarity to the track currently playing. This could, of course, also be applied to genres or set folders.
2) A guest requests Sean Paul's "Like Glue" (78), while Barrington Levy's "Here I Come" is currently playing. The software then suggests a sequence of tracks that approaches "Like Glue" in sufficiently gradual steps, for example (8) – (12) – (25) – (78).
3) It is also conceivable that, by means of this similarity analysis, a jukebox could independently select mutually compatible tracks or determine and play back the optimal sequence for a desired repertoire.

When applied with the appropriate parameters, the structuring of music by means of MIR and SOM promises to be a powerful tool for musicology. It has been shown to be capable of organizing music plausibly and - through, for example, its cultural blindness - of revealing underlying structures that, even when they initially appear counterintuitive, can make a positive contribution to knowledge.

6.2 Considerations on the Cyclicality of Dance Music

The conventional linear notation and analysis of music are quite plausible and meaningful when understood in relation to the largely linear tradition of European art music. With regard to modern popular dance music, however, the writing of this dissertation has revealed numerous indications that cyclic principles occupy a higher status than linear ones. From this, approaches to the rhythmic analysis of loop-based music can be developed that promise greater validity than conventional approaches.

Cyclic perspectives on music are found particularly in analyses of traditional African music, for example in Willie Anku (2000) and Benjamin Ziech (2017). The previously postulated Africanization of African American popular music raises the question of whether rhythmic analysis of popular dance music should take up these perspectives. Tracks from the training sample also show systematic, symmetrical structures when subjected to simple cyclic projections.

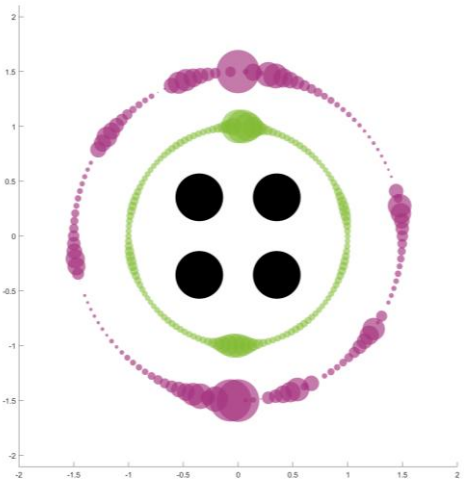
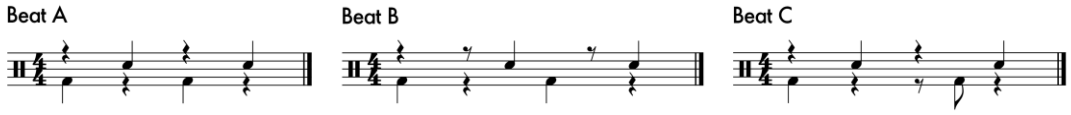


Figure 116: Cyclic Projection of Two Bars from "Blowin' Money Fast"
Snare position in black, fatness in purple, and its autocorrelation in green. Bars begin at $x = 0$.

A recent meta-study of methods in computational musicology has shown that Hidden Markov Models (HMMs), with a prevalence of 37%, are by far the most widely used method in the field as a whole (Mor, 2020). his technique is used particularly in rhythmic analysis, including in the rhythm-based branch of COMSAR (Blaß, 2013) and in numerous other studies (Krebs, 2013) (E. Nakamura, 2017) (I. Antonopoulos, 2007)).

Hidden Markov chains are stochastic models that understand signals as a sequence of discrete observations with determinable transition probabilities (Rabiner, 1989). f we consider beat patterns A–C inNotation 32 , it becomes apparent that these appear identical from the perspective of HMM analysis. The state “bass drum” is followed with 100% probability by the state “snare drum,” which in turn is followed by “bass drum.” Yet all three examples are highly style-specific. Beat A is used in many *Disco* and *House* productions; Beat B is a typical *Reggaetón* clave; and Beat C is the basic pattern of *Boom Bap Hip Hop* in the style of DJ Premier. HMMs therefore appear less suitable for the analysis of modern dance music than for the analysis of European art music or ethnomusicological recordings.



Notation 32: Characteristic Beat Patterns

he introduction of the loop by James Brown in the 1960s, as discussed in §2.6.1, is confirmed, for example, when considering the fatness curves of those tracks for which the evaluation window consists of iterations of a relatively constant loop. Such an analysis is not possible for heterogeneous samples. Figure 117 to Figure 119 show exemplary fatness curves typical of each of the recent style groups. As already shown in §5.4.4, these behave cyclically in the expected way for loops This periodicity can be captured by means of autocorrelation. It is entirely plausible that this autocorrelation provides information about the weighting of different periodic layers within the polyrhythm; in other words, that what is present is not a single loop of length t_{Max}, but rather a polyrhythmic superposition of loops that converge at length t_{Max}. Through the superposition of loops of different lengths, however, faster components obscure slower components by integer multiples, so that no unambiguous conclusion can be drawn about the weighting of the individual components.

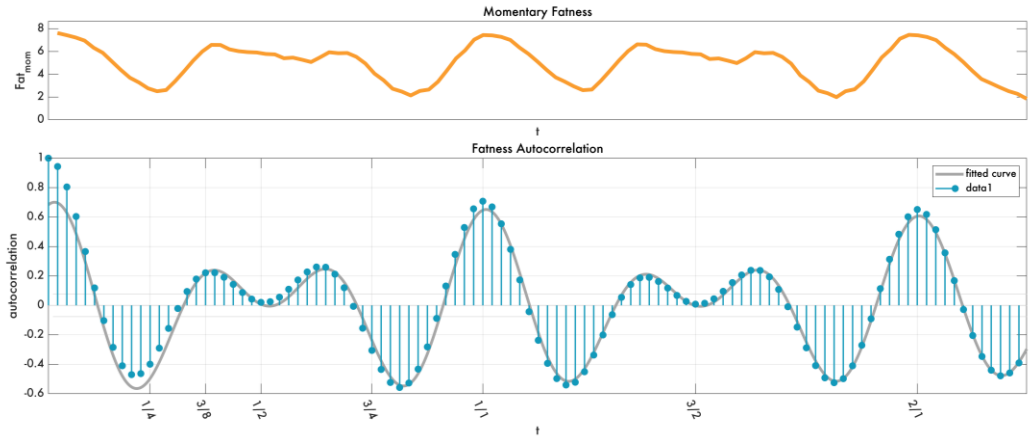


Figure 117: Cypress Hill, "Insane in the Brain" (22) / Fatness Curve, Autocorrelation, and Regression Curve

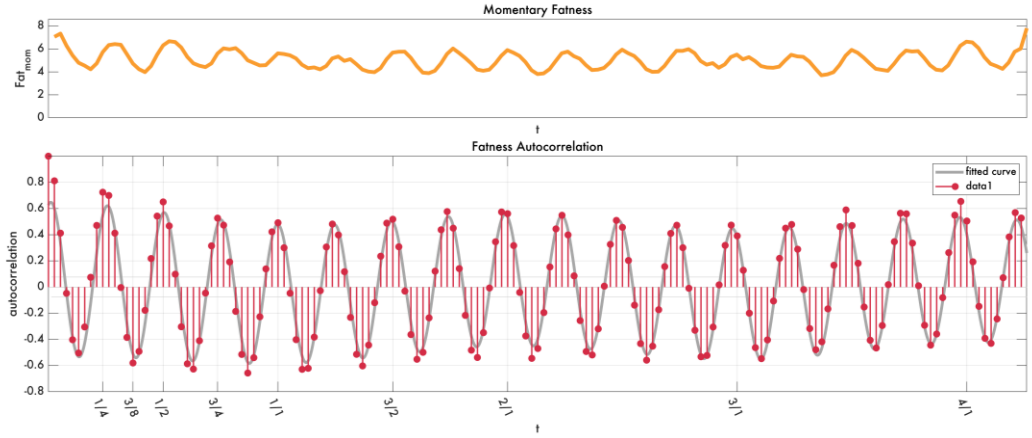


Figure 118: Wamdue Project, "King of My Castle" (98) / Fatness Curve, Autocorrelation, and Regression Curve

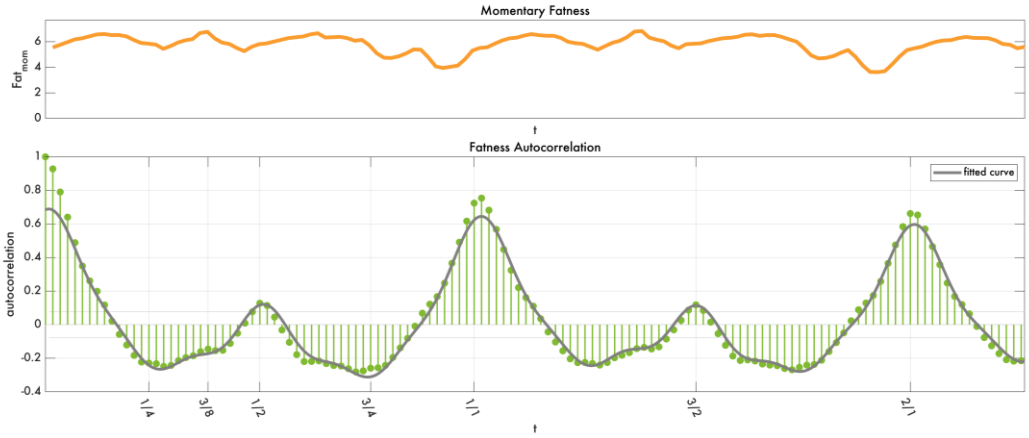


Figure 119: Wayne Smith, "Under Mi Sleng Teng" (97) / Fatness Curve, Autocorrelation, and Regression Curve

The apparent shape of the curves raises the question of whether, across styles, the bar can be understood as $t_{Max}$and thus as the fundamental unit of convergence, even though the quarter-note level appears to be particularly prominent in technoid music. Given their sinusoidal appearance, and in view of the Fourier theorem, it seems plausible that these autocorrelations can also be expressed by chaining sinusoidal terms. Ad hoc regressions using the Sum of Sine model in MATLAB's Curve Fitting app support this assumption for all three styles, with $R^2 > .97$, even though not all terms become significant. The fitted curves obtained in this way were superimposed on the autocorrelations in the figures and cover them convincingly.

The fact that the autocorrelations can be modelled sinusoidally, together with the known tempo, suggests that a suitably designed model formula could determine the weighting of the loop layers as coefficients..

If $t$is the lag for which the partial autocorrelation is to be determined, and $t_♩$ is the lag of a quarter note, and if the following assumption holds:

$$(x \star x) fat(\, x(t)\,) \xrightarrow{reg}$$
$$\left(\sum_{n=1}^{6}\left(a_n * sgn\left(t\frac{\pi}{t_♩} *\ 2^{n-2}\right)\right) * abs^{q_n}\left(cos(t\frac{\pi}{t_♩} *\ 2^{n-2})\right)\right.$$
$$+ \sum_{m=1}^{4}\left(b_m * sgn\left(t\frac{\pi}{t_♩} *\ 2^{n-2} * \frac{3}{2}\right)\right)$$
$$\left.* abs^{p_m}\left(cos(t\frac{\pi}{t_♩} *\ 2^{n-2} * \frac{3}{2}\right)\right)\right) * e^{-t_x * D}$$

then the coefficients $a_1$to $a_6$describe the non-syncopated loop layers, while the coefficients $q_1$to $q_6$describe their sustain or contrast. This calculation covers lag intervals from a sixteenth note to two bars. The coefficients $b_1$to $b_4$and $p_1$to p_4, by contrast, analogously describe the syncopated layers from a dotted eighth note to a dotted half note. The coefficient of the damping term describes the general cyclicality of the sound under investigation. For $D \neq 0$, one could therefore formulate $1/D$as a measure of loopness.

It would be expected, for example, that *Techno*, in contrast to *House*, would exhibit a considerably more prominent quarter-note component, or that clave-based rhythms would show more prominent 3/8and 3/4components.

This would, however, have to be tested empirically using a suitable sample of loops and a sufficiently powerful regression solver.

At present, this model sketch includes only fatness and thus only part of the usual timbral layers or elements. Rhythmic models usually include at least one or two additional layers or timbres: typically a measure of the midrange, or of the range usually occupied by the snare drum, as well as a measure of the high-frequency range, or hi-hats (cf. (Bader R. &., 1994) or (Blaß, 2013)).

These would likewise have to be captured and examined accordingly, possibly also with regard to phase shifts relative to the bass downbeat, as described by Anku (Anku, 2000, p. 5) and Ziech (Ziech, 2017, p. 131ff).

For this purpose, the procedure for selecting stimuli would also have to be reconsidered. Instead of 35-second excerpts centred on the loudness maximum, the most convergent four or eight bars would have to be selected. These could, for example, be identified by means of a variant of autocorrelation in which all possible windows, tempo-dependently adjusted to the corresponding number of bars, are cross-correlated with the complete track, with those windows showing the highest overall correlation then being selected. Further selection parameters would have to be designed in such a way that the excerpts are taken from the “core,” that is, the main section of the track (Solberg, 2014, pp. 71-73). This adjustment of segment selection would likely also improve the quality of the analysis of Integrated Fatness.

7. Outlook

The extensive research project *Bass Drop!* presented in this dissertation offers numerous points of departure for further investigation::

1. Both the modelling of momentary fatness and that of integrated fatness would benefit from a listening experiment of the kind originally planned. This would require the automated generation of suitable, stochastically distributed test sounds varying in loudness, spectral centroid, and harmonic ratio, as well as a larger number of trials conducted in an acoustically appropriate setup.
2. The heterogeneity of the selected excerpts impairs the effectiveness of certain mathematical procedures, particularly the calculation of mean values and autocorrelation. A targeted analysis of representative loops, as proposed in §6.2, promises to significantly improve both the quality of the integrated-fatness calculation - and thus the quality of the Kohonen maps trained with it - and the quality of the rhythmic analyses.
3. Conventional BPM detection procedures are particularly prone, in clave-based music, to interpreting dotted quarter notes as simple quarter notes and therefore to estimating the tempo incorrectly by a factor of 0.75 or 1.5. An algorithm based on the convergence of integer-multiple loops would be protected against this error and promises greater accuracy than conventional procedures
4. In addition to improved modelling of integrated fatness, it can be assumed that the procedure for assessing the similarity of dance-music tracks by means of SOM can be optimized both by focusing and by expanding the training dataset. Focusing here means describing a smaller musical field, for example exclusively *Hip Hop*, *Tropical*, and *Urban*, or exclusively *Techno* and *House*. Expanding the training dataset, by contrast, is also suitable for training a comprehensive map. For this, however, continuity of the data within the styles must be ensured, without niche styles being overrepresented even more strongly in comparison with more conventional music

5. In numerous subfields of machine learning, scholars have made so-called standard datasets available, facilitating entry into the respective field for other researchers (vgl. (UC Irvine Machine Machine Learning Repository, 2021)). In musicology, however, the data situation in this area remains highly unsatisfactory. The few datasets that do exist are insufficiently documented with regard to relevance and validity and consist largely of metadata.

   The MIR dataset compiled at considerable effort for the present dissertation is suitable for publication in this category. This would benefit both researchers in popular-music studies and the field of dance-music research. The adjustments and extensions that may be necessary for this purpose have already been discussed.

6. Moreover, the comparison of the test and training sets in §6.1 raised numerous questions concerning the properties and significance of repressings and remasters, which could be investigated using the methodological apparatus developed here.
7. Both the MIR dataset and the extensive surveys conducted as part of this dissertation offer numerous possibilities for secondary musicological analysis. Conceivable examples include analyses of perceived modernity, as well as of the relationship between liking and taste.
8. The measurement procedure developed for this dissertation - programmed, refined, and automated at considerable effort - still leaves room for performance optimization. In principle, however, it is highly scalable and could also be applied to Big Data through cloud-computing deployment.
9. Similarly, the cultural history of dance music presented here primarily addresses those circumstances that directly or indirectly concern bass. Since no comprehensive scholarly publication on modern popular dance music is currently available, a final expansion of this section would also be worthwhile. At present, the excellent but popular-scientific and relatively non-musical work by Brewster and Broughton (Brewster, 2006) remains the principal source for large parts of the field. It should also be examined whether an expanded

consideration of Afro-Cuban music, Francophone Caribbean music such as *Zouk*, and certain *Jazz* styles would meaningfully complement this cultural history.

10. The assumptions concerning bass suggest that it has a major influence on the rhythmic entrainment triggered by dance music. A particular influence of fatness also appears likely with regard to the rock 'n' roll threshold. The author's admittedly anecdotal, but nevertheless numerous, observations and loudness measurements in various discotheques, gathered in the course of his work as a DJ and sound engineer, suggest a significantly lower threshold of overall loudness when a substantial proportion of that loudness is attributable to bass. Building on a modified fatness model, as described under point 1, an investigation of the influence of fatness on dancing behaviour and the discotheque experience appears warranted.

8. Conclusion

Bass is a key element - if not *the* key element - of modern popular dance music, which occupies a major part of our music-related cultural practice. Each of its substyles assigns bass a prominent position and possesses a rich repertoire of possibilities for shaping it. Moreover, there is an increasing exchange among the respective repertoires of the different styles, which further expands this canon considerably.

The development of bass in modern popular dance music has been examined in detail in this dissertation, with particular attention to sociocultural, technological, and musical developments, as well as to the interactions between them. Bass appears tonally in the forms of the technoid synthesizer bass, the *Soul* and *Funk* bass, and the Afro-Caribbean bass, and percussively in the beat types four-to-the-floor, breakbeat, and clave. Its bassness, however, is independent of these categories.

The pursuit of a fatter, more bass-heavy sound runs throughout the technological history of modern popular dance music. Although concrete performance specifications are often absent from the literature, the trend is nevertheless evident. In the 1950s, the Fender Bassman amplifier still made do with 26 watts. The Herculoids sound system of the early *Hip Hop* era already reached 600 watts. Today's sound-reinforcement systems have power ratings of many thousands of watts.

Instrument technology also plays a role in this development: through the emergence of the electric bass, as well as through analog and digital synthesizers and drum machines, the problems of pre-electric bass production were gradually solved.

These developments created artistic freedoms in the low-frequency range that were taken up anew in each historical period as style-defining possibilities, shaping the role

of bass in modern popular dance music and increasing its significance. Without James Jamerson's electric-bass playing, the synthesizer basses of Stevie Wonder and Bernie Worrell, or the pioneering work with drum machines by Kraftwerk, Afrika Bambaataa, and Juan Atkins, these developments would certainly have taken a different course.

Various aspects of form also exerted a less direct, but nevertheless important, influence. Examples include the pattern structure established in *Funk* or the formats prescribed by recording media such as the single or the maxi-single. The same applies to sociocultural influences, such as the establishment of record-based dance culture as a means of avoiding repression, the function of dance scenes as spaces of freedom for marginalized minorities, and the influence of empathogenic drugs on electronic dance music.

Several factors can be identified that account for the special status of bass. One important aspect is the increased audibility of long-wavelength sounds over long distances, a property that becomes particularly relevant in the legacy of open-air dance culture, including sound systems, block parties, and raves.

There are also indications of a human preference for loud bass in dance contexts. This preference is reflected, for example, in the analyses by Adelman-Larsen and van Dyk, both of which suggest that loud and precise bass reproduction is a fundamental prerequisite for good discotheque sound. The online survey conducted as part of the present dissertation also supports this assumption.

The psychophysical investigations conducted in this dissertation demonstrate that fatness is not merely an idiosyncratic metaphor, but a socially shared perceptual category - both for sounds in general and for music in particular. The results suggest that a positive perception of bass in modern popular dance music depends primarily on three factors: loudness, represented by measures of sound-pressure level; tonality and harmonicity, represented by the harmonic ratio; and acoustic depth, represented by the spectral centroid.

On the basis of a series of empirical experiments and acoustic as well as psychoacoustic measurements, it was possible to develop models that yield plausible, valid, and reliable predictions of this perceptual quality. Momentary Fatness describes the bass-

related components of musical sounds with a temporal resolution of 50 ms. Integrated Fatness, by contrast, captures the fatness of complex musical sounds as integrated over a longer period of time.

For most of human history, sounds that were simultaneously loud, harmonic, and low-frequency occurred only under specific and relatively rare conditions. These include natural phenomena such as thunder, which were often religiously transfigured, but also the synchronized stamping of large groups of dancers or rhythmically coordinated forms of collective manual labour. Sounds of this kind also require either a large sound source or a large number of sound sources acting in unison. It is therefore plausible that associations with size, power, physical force, and communal presence play a role in the perception of bass.

Particularly in view of the cyclic nature of dance music - which, as has been shown, repeatedly converges on the downbeat - and of the convergence of partials within harmonic sound, it may be assumed that fatness is connected to the capacity for interpersonal motor synchronization in larger groups. This connection may be rooted both in prehistoric or archaic dance cultures and in the need for bodily coordination in agriculture, warfare, and craft labour. Given the preference for precise bass reproduction in discotheques, and the collective experience sought in rave culture, this assumption appears plausible.

Furthermore, a similarity map generated by means of Machine Learning has shown that perceptual fatness is a meaningful measure for the analysis of popular music, and that the results generated in this way support the culturally and historically derived model of modern popular dance music.

In summary, bass in modern popular dance music can be understood as the product of an almost 300-year process, one that has accelerated considerably over the past 75 years as a result of technological and social conditions. The central field of tension in this process lies between African and European musical traditions.

Bass cannot be reduced to a single instrument family, timbre, playing technique, or formal principle. It is a heterogeneous field of musical phenomena, constituted above all by harmonic components below 200 Hz, but culturally shaped by technologies,

practices, scenes, and bodies in motion. Despite this abstract and multifaceted nature, there is a broad, socially shared understanding of what constitutes a fat bass, and of why such bass is essential to a compelling dance experience. As the hinge between harmony and rhythm, bass is fundamental not only to both categories themselves, but also to the integration of all other elements of a track. It anchors musical structure, organizes bodily movement, and binds individual perception to collective experience. For this reason, researchers, musicians, and listeners alike assign bass a central role in modern popular dance music: culturally, technologically, musically, and perceptually.

Bibliography

Adams, K. (2015). The musical analysis of Hip Hop. In J. A. Williams, *The Cambridge Companion to Hip Hop* (pp. 118-134). Cambridge: Cambridge University Press.

Adelman-Larsen. (2014). *Rock & Pop Venues - Acoustic & Architectural Design.* Berlin: Springer.

Adriaensen, F. (2011). Loudness measurement according to EBU R-128. *In Proceedings of the Linux Audio Conference.*

Akindes, S. (2002). Playing it loud and straight. In M. Palmberg, & A. Kirkegaard, *Playing with identities in contemporary music in Africa* (pp. 86-103). Nordiska Afrikainstitutet: Nordiska Afrikainstitutet.

Albiez, S. (2017). Dubstep. In D. Horn, J. Shepherd, & P. Prato, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 11* (pp. 213-215). New York: Bloomsbury.

Albiez, S. (2017). Trance. In D. Horn, J. Shepherd, & P. Prato, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 11* (pp. 780-783). New York: Bloomsbury.

Anderson-Rich, L. (2018, 1 2). *8 Dance Music Genres You Didn't Knwo Existet.* Retrieved 8 1, 2021, from MixMag.com: https://mixmag.net/feature/8-dance-music-genres-you-didnt-know-existed

Anku, W. (2000, 1 1). Circles and Time: A Theory of Structural Organization of Rhythm in Africa. *MTO A Journal of the Society for Music Theory, 1*(6).

Aures, W. (1985). Berechnungsverfahren für den sensorischen Wohlklang beliebiger Schallsignale. *Acustica*.

Azcarraga A., M. S. (2011). Design of a Structured 3D SOM as a Music Archive. In H. T. Laaksonen J., *Advances in Self-Organizing Maps* (pp. 188-197). Berlin: Springer.

Bacon, T., & Day, P. (1999). *The Fender Book: A Complete History of Fender Electric Guitars, 2nd Edition.* Milwaukee, Wisconsin: Backbeat Books.

Bader, R. &. (1994). Perception and analyzing methods of Groove in popular music. *Systematische Musikwissenschaft, 1*(2).

Bader, R., & Schneider, A. (2011). Playing "Live" at the Star-Club: Reconstructing the Room Acoustics of a Famous Music Hall. In A. Schneider, & A. von Ruschkowski, *Hamburger Jahrbuch für Musikwissenschaft 28 - Systematic Musicology: Empirical and Theoritical Studies* (pp. 185-210). Frankfurt am Main: Peter Lang Internationaler Verlag der Wissenschaften.

Bader, R., Zielke, A., & Franke, J. (2021). Timbre-based machine learning of clustering Chinese and Western Hip Hop music. *Audio Engineering Society Convention 150.* Audio Engineering Society.

Barton, F. (1934, 3). High-Fidelity Lateral-Cut Disk Records. *Journal of the Society of Motion Picture Engineers*, pp. 179-182.

Beatport. (2019, 1 7). *16 Years of Beatport.* Retrieved from beatportal: https://www.beatportal.com/news/beatport-16-years-in-numbers/

Bellanca, J. L. (2013). Harmonic Ratios: A quantification of step to step symmetry. *Journal of biomechanics, 4*(46), pp. 828-831.

Bello, J. P., Grosche, P., Müller, M., & Ron, W. (2018). Content-Based Methods for Knowledge Discovery in Musik. In R. (. Bader, *Handbook of Systematic Musicology* (pp. 823-840). Springer.

Bilboard Magazine. (1974, 11 16). *Billboard Magazine*. Retrieved 1 31, 2019, from The Hot 100 - The week of November 16, 1974 : https://www.billboard.com/charts/hot-100/1974-11-16

Billboard Magazin. (2021, 8 10). *https://www.billboard.com/music/The-Whispers/chart-history/BSI.* Retrieved 8 10, 2021, from Billboard Magazine: https://www.billboard.com/music/The-Whispers/chart-history/BSI

Billboard Magazine. (1959, 4 6). *Billboard Magazine*. Retrieved 1 21, 2019, from HOT R&B/HIP-HOP SONGS The week of April 6, 1959: https://www.billboard.com/charts/r-b-hip-hop-songs/1959-04-06

Billboard Magazine. (1960, 9 19). *Billboard Magazine*. Retrieved 1 21, 2019, from The Hot 100 - The week of September 19, 1960: https://www.billboard.com/charts/hot-100/1960-09-19

Billboard Magazine. (1962, 1 27). *Billboard Magazine*. Retrieved 1 21, 2019, from Billboard Hot 100 - The week of January 27, 1962: https://www.billboard.com/charts/hot-100/1962-01-27

Billboard Magazine. (1962, 10 20). *Billboard Magazine*. Retrieved 1 15, 2019, from Billboard Hot R&B - The week of October 20, 1962: https://www.billboard.com/charts/r-b-hip-hop-songs/1962-10-20

Billboard Magazine. (1966, 11 26). *Billboard Magazine*. Retrieved 2 14, 2019, from Bildboard The Hot 100, The week of November 26, 1966: https://www.billboard.com/charts/hot-100/1966-11-26

Billboard Magazine. (1970, 3 10). *Chart History: Charles Wright*. Retrieved 6 28, 2021, from billboard.com: https://www.billboard.com/music/charles-wright/chart-history/r-b-hip-hop-songs/song/895516

Billboard Magazine. (1986, 9 27). *Billboard Magazin.* Retrieved 5 6, 2019, from Hot 100 - The week of September 27, 1986 : https://www.billboard.com/charts/hot-100/1986-09-27

Billboard Magazine. (1994, 1 15). Best Selling Records of 1993. *Billboard Magazine* , p. 73.

Billboard Magazine. (2014, 6 27). *Tomorrow's Hits: Kiesza Moves Front And Center With 'Hideaway'.* Retrieved 7 6, 2021, from BillboardMagazine.com: https://www.billboard.com/articles/columns/chart-beat/6140799/tomorrows-hits-kiesza-moves-front-and-center-with-hideaway

Billboard Magazine. (2017, 8 28). *Luis Fonsi,Daddy Yankee & Justin Bieber's 'Despacito' Ties for Longest Run at No. 1 in Hot 100's History*. Retrieved 4 24, 2019, from https://www.billboard.com/articles/columns/chart-beat/7942306/despacito-hot-100-number-one-ties-record-luis-fonsi-daddy-yankee-justin-bieber

Billboard Magazine. (2019, 1 1). *Billboard Magazine*. Retrieved 10 16, 2019, from Hot 100 Songs - Year End: https://www.billboard.com/charts/2018/year-end/hot-100-songs

Billboard Magazine. (2019). *https://www.billboard.com/charts/decade-end/hot-r-and-b-hip-hop-songs.* Retrieved 8 14, 2021, from Billboard Magazone: billboard.com/charts/decade-end/hot-r-and-b-hip-hop-songs

Billboard Magazine. (2021, 7 21). *The 50 Greatest Producers of the 21st Century.* Retrieved 8 14, 2021, from Billboard Magazine: https://www.billboard.com/articles/news/list/9603412/best-music-producers/

Billboard Magazine. (n.d.). *Chart History: Bruno Mars.* Retrieved 6 26, 2021, from Billboard.com: https://www.billboard.com/music/Bruno-Mars/chart-history/HSI/song/996408

Blades, J. (1992). *Percussion Instruments and their History.* Westport, CT: Bold Strumme.

Blair, M. E. (2004). Commercialisation of the Rap Music Youth Culture. In M. Forman, & M. A. Neal, *That's the Joint - The Hip Hop Studies Reader* (pp. 497-504). New York: Routledge.

Blaß, M. (2013). Timbre-based Drum Pattern Classification using Hidden Markov Models. *In The European conference on machine learning and principles and practice of knowledge discovery in databases (ECMLPKDD 2013*, (pp. 11-14). Prag.

Blaß, M. (2021, 4). *Apollon Framework.* Retrieved from GitLab RRZ UHH für Lehre und Forschung: https://gitlab.rrz.uni-hamburg.de/bal7668/apollon

Blaß, M., & Bader, R. (2019). Computational Music Archiving as Physical Culture Theory. In R. Bader, *Content-Based Music Retrieval and Visualization System for Ethnomusicological Music Archives* (pp. 145-173). Springer.

Blatt, W. (1990, 5 12). `Power' Play Ensues Over Hit - Snap, Chill Rob G Have Rival Versions. *Billboard Magazine*, p. 34.

Bohrwick, J. (2003). Record. In J. Shepherd, D. Horn, D. Laing, P. Olliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of The World, Part 1* (pp. 519-520). New York: Bloomsbury.

Bohrwick, J. (2003). Shellac. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Media, Industry, Society* (pp. 519-520). New York: Bloomsbury.

Bohrwick, J. (2003). Vinyl. In J. Shepherd, D. Horn, D. Laing, P. Olliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of The World, Part 1* (p. 524). New York: Bloomsbury.

Boluwaduro, S. O. (2018). Lagos: Music and the Postcolonial Metropolis. *Muziki: Journal of Music Research in Africa, 2*(15), pp. 44-60.

Borneman, J. &. (2000). Politics without a Head: Is the "Love Parade" a New Form of Political Identification? *Cultural Anthropology, 15*(2), pp. 294-317.

Bortz, J., & Schuster, C. (2010). Empirische Forschung und Skalenniveaus. In J. Bortz, *Statistik für Human- und Sozialwissenschaftler* (7 ed., pp. 3-23). Berlin, Heidelberg: Springer.

Borwick, J. (2003). Loudspekaer. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Media, Industry, Society* (pp. 516-517). New York: Bloomsbury.

Bowman, R. (2011). *Soulsville U.S.A. - The Story of Stax Records.* Omnibus Press.

Bowman, R. (2012). Rhythm & Blues. In J. &. Shepherd, *Frank Poloney & Collin Davey, Boogie Woogie 87-91* (pp. 392-395). New York: Continuum.

Bowman, R. (2012). Soul. In J. &. Shepherd, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 439-451). New York: Continuum.

Bradley, L. (2003). *Bass Culture - Der Siegeszug des Reggae.* Höfen: Verlagsgruppe Koch/Hannibal.

Brathfisch, R. (2003). *Das große Reggae-Lexikon.* Berlin: Schwarzkopf & Schwarzkopf Verlag.

Brattico, E. B. (2013). Toward a neural chronometry for the aesthetic experience of music. *Frontiers in psychology*(4), p. 206.

Brattico, E., Bogert, B., & Jacobsen, T. (2013, 5 1). Toward a neural chronometry for the aesthetic experience of music. *froniters in PSYCHOLOGY, 4*, pp. 1-21.

Brewster, B. &. (2006). *Last Night a DJ saved my Life - The History of the Discjockey.* New York: Grove Press.

Brockhaus, I. (2017). *Kultsounds: Die prägendsten Klänge der Popmusik 1960-2014.* Bielefeld: transcript.

Brown, D. L. (2018, 8 16). *How Aretha Franklin's 'Respect' became an anthem for civil rights and feminism.* Retrieved 6 25, 2021, from Washington Post: https://www.washingtonpost.com/news/retropolis/wp/2018/08/14/how-aretha-franklins-respect-became-an-anthem-for-civil-rights-and-feminism/

Brunner, A. (n.d.). Manu Dibango, 1933–2020. *Rock Music Studies, 8*(1), pp. 87-91.

Buchmann, G. (1954). Fortschritte in der Entwicklung von Lautsprechern. *Acustica*(4), pp. 63-66.

Budde, D. (2000). Elektronische Tanz- und Unterhaltungsmusik. In H. &. Rösing, *Beiträge zur Popularmusikforschung 25/26* (pp. 59-71). Karben: German Society for Popular Music Studies.

Bundesverband der Musikindustrie. (2018). *Gold-/Platindatenbank*. Retrieved 4 2019, 24, from Luis Fonsi & Daddy Yankee - Despacito: http://www.musikindustrie.de/nc/datenbank/?action=suche&strTitel=Despacito&strInterpret=Luis+Fonsi+%26+Daddy+Yankee&strTtArt=alle&strAwards=checked

Bundesverband Musikindustrie. (2018). *Gold-/Platindatenbank, Eintrag "Ohne Mein Team".* Retrieved 5 12, 2019, from http://www.musikindustrie.de/nc/datenbank/#topSearch

Burnim, M. V. (2012). Gospel, African-American. In J. &. Shepher, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 233-248). New York: Continuum.

Burnim, M. V. (2012). Spiritual, African-American. In J. &. Shepherd, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 454-463). New York: Continuum.

Camastra, F., & Vinciarelli, A. (2015). *Machine Learning for Audio, Image and Videoanalysis.* London: Springer.

Capetola, C. (2019, 6 12). Starting Something: Synthesizers and Rhythmic Reorientations in Michael Jackson's "Billie Jean". *Souls - A Critical Journal of Black Politics, Culture, and Society*, pp. 77-95.

Cecen, A. (2021). Multivariate Polynomial Regression v1.4.0.0. Retrieved 7 29, 2021, from Ahmet Cecen (2021). Multivariate Polynomial Regression

(https://github.com/ahmetcecen/MultiPolyRegress-MatlabCentral), GitHub. Retrieved July 29, 2021.

Cision. (2021, 3 5). *Iconic Rapper EVE Celebrates 20 Years of SCORPION*. Retrieved 8 1, 2021, from Cision PR newswire: https://www.prnewswire.com/news-releases/iconic-rapper-eve-celebrates-20-years-of-scorpion-301241190.html

Collins, E. J. (2019). Palm Wine Music. In D. Horn, J. Shepherd, G. Kielich, & H. Feldmann, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 12* (pp. 466-470).

Condry, I. (2011). Japanese Hip-Hop and the Globalization of Popular Culture. In G. &. Gmelch, *Urban Life: Readings in the Athropology of the City* (pp. 357-387). Prospect Height, IL: Waveland Press.

Contreras, F. (2020, 12 7). *Cándido Camero, A Father Of Latin Jazz, Dies At 99.* Retrieved 6 28, 2021, from NPR Music: https://www.npr.org/2020/11/07/831252398/candido-camero-a-father-of-latin-jazz-dies-at-99

Cooper, A. (2020, 1 6). *Koffee Wins 2020 Grammy For Best Reggae Album.* Retrieved 8 10, 2021, from https://www.dancehallmag.com/: https://www.dancehallmag.com/2020/01/26/news/koffee-wins-2020-grammy-for-best-reggae-album.html

Cooper, B. L., & Schurk, W. L. (2012, 5 30). Audio Reviews: Diana Ross Presents the Jackson 5. *Popular Music and Society, 35*(2: Special Issue on Michael Jackson), pp. 317-319.

D. Wijayasekara, O. L. (2011). CAVE-SOM: Immersive visual data mining using 3D Self-Organizing Maps. *The 2011 International Joint Conference on Neural Networks*, (pp. 2471-2478).

Dagnini, J. K. (2019). Reggae in Sub-Saharan Africa. In D. Horn, J. Shepherd, G. Kielich, & H. Feldmann, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 12* (pp. 477-479). New York: Bloomsbury.

Davis, S. &. (1982). *Reggae International.* Berlin: Rogner & Bernhard.

Dawkins, R. (1994). *Das egoistische Gen.* Heidelberg: Springer.

Depoorter, B. &. (2013). Copyright false positives. *Notre Dame Law Review, 89*(1), pp. 319-360.

D'Errico, M. (2015, 1 6). *Electronic Dance Music in the Dubstep Era* . Retrieved 5 9, 2019, from Oxford Handbooks Online: https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199935321.001.0001/oxfordhb-9780199935321-e-74

Derry, M. (2004). Public Enemy Confrontation. In M. Forman, & M. A. Neal, *That's The Joint - The Hip-Hop Studies Reader* (pp. 407-420). New York: Routledge.

Diallo, D. (2007). Dr. Dre and Snoop Dogg. In M. (. Hess, *Icons of hip hop: An encyclopedia of the movement, music, and culture* (pp. 317-340). Westport: Greenwood.

Dibble, K. (1995). Hearing loss & music. *Journal of the Audio Engineering Society, 4*(43), pp. 251-266.

Dickreiter, M. (1993). *Musikinstrumente.* Kassel: Bärenreiter.

Dickreiter, M., Dittel, V., Hoeg, W., & Wöhr, M. (2008). *Hand buch der Tonstudiotechnik (7. Ed)* (Vol. 1). (A. medienakademie, Ed.) München: Saur.

Dimitriadis, G. (2004). Hip-Hop: From Live Performance to Mediated Narrative. In M. Forman, & M. A. Neal, *That's The Joint - The Hip Hop Studied Reader* (pp. 421-435). New York: Routledge.

DIN 45681. (2005). *2005-03 Akustik - Bestimmung der Tonhaltigkeit von Geräuschen und Ermittlung eines Tonzuschlages für die Beurteilung von Geräuschimmissionen*.

Disco: A complete history. (2012, 6 7). Retrieved 14 1, 2019, from V is for Vintage: https://visforvintage.net/2012/06/07/disco-a-complete-history/

Ditze, S. (2012, 9 19). The Tom Moulton Mixes. *Groove - Magazin für elektronische Musik und Clubkultur*, pp. 34-38.

Diver, M. (2010). *Roni Size & Reprazent New Forms Review.* Retrieved 7 28, 2021, from BBC Music: https://www.bbc.co.uk/music/reviews/jh6m/

DJ Mag. (2013, 2 28). *Trap Music: Under Lock & Key / The Trap Phenomenon Explained.* Retrieved 7 29, 2021, from DJMag.com: https://djmag.com/content/trap-music-under-lock-key

DJMag. (2013, 2). *DJMag.com.* Retrieved 5 12, 2019, from TRAP MUSIC: UNDER LOCK & KEY; The Trap Phanomenon explained: https://djmag.com/content/trap-music-under-lock-key

Dongnon, E. P. (2018). La transe dans les musiques actuelles aficain. *Chroniques phénoménologiques*(9).

Döringer, M. (2017, 1 23). *Konstantin Sibold über seinen Track "Mutter".* Retrieved 7 6, 2021, from groove.de: https://groove.de/2017/01/23/konstantin-sibold-mutter-track-des-jahres-shdw-obscure-shape-remix-trackpremiere/

Dorochowicz, A., & Kostke, B. (2018). A Study on of Music Features Derived from Audio Recordings Examples - a Quantitative Analysis. *Arhives of Acoustics, 43*(3), pp. 505-516.

Dot, E. S. (2019). Azonto. In D. Horn, J. Shepherd, G. Kiellich, & H. Feldmann, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 12* (pp. 50-53). New York: Bloomsbury.

Downie, J. S. (2003). "Music information retrieval.". *Annual review of information science and technology*, pp. 295-340.

Ducker, J. (2018, 2 21). *Naughty By Nature's '19 Naughty III' Turns 25 | Anniversary Retrospective.* Retrieved 7 27, 2021, from AlbumIsm: https://www.albumism.com/features/tribute-celebrating-25-years-of-naughty-by-nature-19-naughty-iii

E. Nakamura, K. Y. (2017, 4). Rhythm Transcription of Polyphonic Piano Music Based on Merged-Output HMM for Multiple Voices. *IEEE/ACM Transactions on Audio, Speech, and Language Processing, 4*(25), pp. 794-806.

Elflein, D. (1998, 10 1). From Krauts with attitudes to Turks with attidutes: Some Aspects of hip-hop history in Germany. *Popular Music, 3*, pp. 255-267.

Emielu, A. (2011). Some theoretical perspectives on African popular music. *Popular Music*(30(3)), pp. 371-288.

European Boradcasting Union. (2016). *TECH 3342 - Loudness Range: A Measure to Supplement EBU R 128 Loudness Normalization (V.3).* Retrieved 7 1, 2021, from EBU: Technology & Innovation: https://tech.ebu.ch/docs/tech/tech3342.pdf

European Broadcasting Union. (2016, 1). *Loudness Metering: Ebu Mode. Metering to suplement EBU R 128 Loudness Normalization V3.0.* Retrieved 8 23, 2021, from https://tech.ebu.ch/: https://tech.ebu.ch/docs/tech/tech3341.pdf

Eyben, F. (2016). *Real-time Speech and Music Classification by Large Audio Feature Space Extraction.* München: Springer.

Eyre, B. (2019). Afrobeats. In D. Horn, J. Shepherd, G. Kiellich, & H. Feldmann, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 12* (pp. 19-22). New York: Bloomsbury.

Fastl, H., & Zwicker, E. (2007). *Psychoacoustics - Facts and Models* (3. ed.). Berlin: Springer.

Fitzgeralt, J. (2012). Motown. In J. &. Shepherd, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 339-343). New York: Continuum.

Flick, L. (1993, 1 23). Single Reviews. *Billboard Magazine*, p. 80.

Flores, J. (1999, 7 31). Cha Cha with A Backbeat": Songs and Stories of. *Black Renaissance*, pp. 1-22.

Fonesca, A. (2019). Trap. In M. Goldsmith, & F. Anthony, *Hip Hop around the World - An Encyclopedia* (pp. 700-702). Santa Barabara: Greenwood.

Font-Navarette, D. (2015, 12). Bass 101: Miami, Rio and the Global South. *Journal of Popular Music (Special Issue: Sounding Global Southerness), 4*(27), pp. 488-517.

Forman, M. (2004). *That's The Joint - The Hip Hop Studies Reader.* New York: Routledge.

Fox, M. (2013, 5 17). *Macklemore & Ryan Lewis: Billboard Cover Story.* Retrieved 7 5, 2021, from billboard.com: https://www.billboard.com/articles/news/1562815/macklemore-ryan-lewis-billboard-cover-story

Friedland, E. (2005). *The Way they Play: R&B Bass Masters.* Milwaukee: Backbeat Books.

Gaito, J. (1980). Measurement scales and statistics: Resurgence of an old misconception. *Psychological Bulletin, 87*(3), pp. 564-567.

Gawa, F. (2014). Le coupé décalé en Côte d'Ivoire : Sens et enjeux d'un succès musical. *African Sociological Review, 1*(18), pp. 112-126.

Genuit, K., & Sottek, R. (2010). Das menschliche Gehör und Grundlagen der Psychoakustik. In K. Genuit, *Sound-Engineering im Automobilbereich* (pp. 39-88). Berlin: Springer.

George, N. (2004). Hip-Hop's Founding Fathers speak the Truth. In M. Forman, & M. A. Neal, *That's the Joint - The Hip-Hop Studies Reader* (pp. 45-56). New York: Routledge.

George, N. (2004). Sample This. In M. Forman, & M. A. Neal, *That's The Joint - The Hip-Hop Studies Reader* (pp. 437-441). New York: Routledge.

Gietzelt, S. (2017, 9 27). *Das "Kollektiv Turmstraße" macht Techno für Romantiker.* Retrieved 7 6, 2021, from SZ.de: https://www.sueddeutsche.de/kultur/hertzkammer-das-grosse-knuddeln-1.3686371

Gironow, P. (2003). Phonograph. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Media, Industry, Society* (p. 517). New York: Bloomsbury.

Gordy, B. (1994). *To Be Loved: The Music, the Magic, The Memories of Motown: An Autobiography.* New York: Warner Books.

Gueraseva, S. (2011). *Def Jam, Inc.: Russell Simmons, Rick Rubin, and the Extraordinary Story of the World's Most Influencial Hip-Hop Label.* One World/Ballantine.

Günther, R. (2019, 3 9). *Der Firestarter ist Out of Space.* Retrieved 7 29, 2021, from Deutschlandfunk: https://www.deutschlandfunk.de/tod-von-keith-flint-der-firestarter-ist-out-of-space.807.de.html?dram:article_id=443090

Hamhuis, S. (2017). *Progressive House: From Underground to the Big Room.* Utrecht: University of Utrecht / Faculty of Humanities Theses.

Hamilton, J. (1981, 3 6). UK Newbies. *Record Mirror*, 32.

Hammou, K. (2020). Forty Years of French Rap. In A.-P. (. Durand, *Hip-Hop en Français: An Exploration of Hip-Hop Culture in the Francophone World* (pp. 1-16). Lanham: Rowman & Littlefield.

Härter, C. (2008). The Dub Renaissance – Reflections on the Aesthetics of Dub in Contemporary British Music . In L. Eckstein, B. Korte, E. U. Pirker, & C. Reinfandt, *Multiethnic Britain 2000+* (pp. 263-282). New York: Rodopi.

Hartmann, W. (2013). *Principles of Musical Acoustics.* New York: Springer.

Hauswirth, I. (2011). *http://www.head-acoustics.de.* Retrieved from http://www.head-acoustics.de/downloads/eng/application_notes/PsychoacousticAnalysesI_06_11e.pdf

Hauswirth, I. (2011). *Psychoakustische Analysen II.* Retrieved 12 14, 2011, from Head Acoustics: http://www.head-acoustics.de/downloads/de/application_notes/Psychoakustische_Analysen_II_06_11d.pdf

Hazzard-Gordon, K. (1990). *Jookin': The Rise of Social Dance Formations in African-American Culture.* Philadelphia: Temple University Press.

Heikes, W. (2018). *Dónde esta 'Mi Gente?'.* Clark University / ProQuest.

Hellbing, D. &. (2012). Crowd disasters as systemic failures: analysis of the Love Parade disaster. *EPJ Data Services, 1*(1), pp. 1-40.

Henriques, J. (2011). *Sonic Bodies: Reggae Sound Systems, Performance Techniques, and Ways of Knowing.* London: Continuum.

Herd, D. (2009, 12). Changing Images of Violence in Rap Music Lyrics: 1979-1997. (P. M. Journals, Ed.) *Journal of Public Health Policy, 4*(30), pp. 395-406.

Hess, M. (2006, 8 22). Hip-hop Realness and the White Performer. *Critical Studies in Media Communication*, pp. 372-389.

Hess, M. (2007). *Is Hip Hop Dead? The Past, Present and Future of Americas's Most Wanted Musik.* Westport, CT: Prager Publishers.

Hicks, K. (2019, 3 19). *Usher's 'Confessions' Turns 15 | Anniversary Retrospective.* Retrieved 5 4, 2021, from AlbumIsm: https://www.albumism.com/features/usher-confessions-turns-15-anniversary-retrospective

Hjortkaer, J., & Walther-Hansen, M. (2014, January / February). Perceptual Effects of Dynamic Range Compression. *JAE - Journal of the Audio Engineering Society, 62*(1/2), pp. 37-31.

Hodge, D. R., & Gillespie, D. F. (2008, 09 22). Phrase Completion Scales: A Better Measurement Approach than Likert Scales? *Journal of Social Service Research, 33*(4), pp. 1-12.

Hoffmann, H. (2009, 11 13). KRAFTWERK „Das hatte etwas von einem mechanischen Ballett". *Groove - Magazin für elektronische Musik und Clubkultur*(#121).

Hoffmann, H. (2016, 7 12). Tom Moulton - Der Erfinder der Maxi-Single. *Groove - Magazin für elektronische Musik und Clubkultur*(#161), pp. 51-54.

Hoffmann, H. (2017, 12 14). *Charts From the Past: Die besten Tracks 1992 (Dezember 1992).* Retrieved from Groove Magazin: https://groove.de/2017/12/14/charts-from-the-past-die-besten-tracks-1992-dezember-1992/10/

Hoffmann, M. (2004). Breaking: The History. In M. Forman, & M. A. Neal, *That's The Joint - The Hip-Hop Studies Reader* (pp. 31-40). New York: Routledge.

Holbrok, C. (2019, 7 29). *The 20 best Rave anthems of the 90s.* Retrieved 6 26, 2021, from mixmag.net: https://mixmag.net/feature/20-best-us-rave-anthems-90s

Hope, D. P. (2006). *Inna Di Dancehall - Popular Culture and the Politics of Indentity in Jamaica.* Kingston: Universtity of the West Indies Press.

Hove, M., Vuust, P., & Stupacher, J. (2019). Increased levels of bass in popular music recordings 1955–2016 and their relation to loudness. *The Journal of the Acoustical Society of America*(145), pp. 2247-2253.

Howard, D. (2014). Dancehall. In J. &. Shepherd, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9.* 253-258: Bloomsbury.

Huey, S. (2021, 8 1). *Eve - Biography*. Retrieved from Allmusic.com: https://www.allmusic.com/artist/eve-mn0000150962/biography?1628027669780

Huiping, W., & Leung, S.-O. (2017, 6 6). Can Likert Scales be Treated as Interval Scales? - A Simulation Study. *Journal of Social Service Research, 43*(4), pp. 527-532.

Humid, B. (2005, 7 16). Sound Museum- 9 Analogsynthesizer, die die elektronische Musik geprägt haben. *Groove - Magazin für elektronische Musik und Clubkultur*(#95).

Huss, H. (2003). Sound System. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production* (pp. 263-265). New York : Bloomsbury.

Hyoung-Gook, K., Moreau, N., & Sikora, T. (2006). *MPEG-7 Audio and Beyond: Audio Content Indexing and Retrieval.* John Wiley & Sons.

I. Antonopoulos, A. P. (2007). Locating Rhythmic Patterns in Music Recordings using Hidden Markov Models. *2007 IEEE International Conference on Acoustics, Speech and Signal Processing - ICASSP '07*, (pp. I-221-I-224).

Jackson, K. (2012, 1 13). *Sean Paul's Dutty Rock 10 years later - Dutty Rock charted an impressive run.* Retrieved 8 1, 2021, from Jamaica Observer: jamaicaobserver.com/entertainment/Sean-Paul-s-Dutty-Rock-10-years-later_10554582

Jackson, K. (2013, 7 21). *Watch out for Busy Signal.* Retrieved 7 9, 2021, from Jamaica Observer: https://www.jamaicaobserver.com/entertainment/Watch-out-for-Busy-Signal_14716717

James, M. (2020). *n Sonic Intimacy: Reggae Sound Systems, Jungle Pirate Radio and Grime YouTube Music Videos.* New York: Bloomsbury.

Jeffries, D. (2021). *Flux Pavilion Biography.* Retrieved 8 4, 2021, from Allmusic.com: https://www.allmusic.com/artist/flux-pavilion-mn0002437728/biography

Jenkins, D. (2016, 3 23). *Q+A: ANDY C.* Retrieved 8 1, 2021, from MixMag.com: https://mixmag.net/feature/q-a-andy-c/

Johnson, H. T. (2007). Outkast. In M. (. Hess, *Icons of Hip Hop: Am Encyclopedia of the Movement, Music and Culture* (pp. 457-481). Westport: Greenwood.

Jones, S. (2003). Recording. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production* (pp. 224-227). New York: Bloomsbury.

Kaey, D. (1987, 9 23). Interview with Magret Thatcher. *Women's Own*.

Kater, M. H. (1992). *Different Drummers - Jazz in the Culture of Nazi Germany.* Oxford: Oxford University Press.

Kattari, K. (2014). Reggaeton. In J. &. Shepherd, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 672-676). New York: Bloomsbury.

Kaufmann, G. (2019, 2 14). *An Oral History of 2 Live Crew's 'Me So Horny'.* Retrieved 6 25, 2021, from Billboard.com: https://www.billboard.com/articles/columns/hip-hop/8494339/2-live-crew-me-so-horny-oral-history/

Kern A, H. C.-H. (2008, 8 29). Biophysical Parameters Modification Could Overcome Essential Hearing Gaps. *PLOS Computational Biology*.

Kern, A., Heid, C., Steeb, W.-H., Stoop, N., & Stoop, R. (2008). Biophysical Parameters Modification Could Overcome Essential Hearing Gaps. (S. Boccaletti, Ed.) *PLoS Comput Biol*.

Keyes, C. L. (2014). Miami Bass. In J. Shepherd, & D. Horn, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 323-326). New York: Bloomsbury.

Keyes, C. M. (2014). Hip Hop. In J. Shepherd, & D. Horn, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 260-276). New York: Bloomsbury.

Kirby, P. (2017). Acid House. In D. Horn, J. Shepherd, & P. Prato, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 11* (pp. 13-14). New York: Bloomsbury.

Kirby, P. (2017). Drum & Bass. In D. Horn, J. Shepherd, & P. Prato, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 11* (pp. 211-212). New York: Bloomsbury.

Kirby, P. (2017). Grime. In D. Horn, J. Shepherd, & P. Prato, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 11* (p. 343). New York: Bloomsbury.

Kirby, P. (2017). Trip Hop. In D. Horn, J. Shepherd, & P. Prato, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 11* (pp. 783-784). New York: Bloomsbury.

Kiß, J. (2018, 3 1). *"Ohne mein Team" knackt Marke von 100 Millionen Streams.* Retrieved 5 12, 2019, from Musik Woche: http://beta.musikwoche.de/details/427400

Kiviluoto, K. (68-71). Comparing 2D and 3D self-organizing maps in financial data visualization. *Proceedings of the International Conference on Soft Computing and Information/Intelligent Systems (IIZUKA'98)*, (p. 1998).

Kohonen, T. (1997). *Self-Organizing Maps (Springer Series in Information Sciences 30)* (3. ed.). Springer.

Krebs, F. S. (2013). Rhythmic Pattern Modeling for Beat and Downbeat Tracking in Musical Audio. *ISMIR*, pp. 227-232.

Krekow, S., Steiner, J., & Taupitz, M. (1999). *HipHop-Lexikon: Rap, Breakdance, Writing & Co. ; das Kompendium der HipHop-Szene.* Berlin: Lexikon-Imprint-Verlag.

Kreutzer, T. (2020, 4 27). *Digitale Wissenschaft und Nutzung fremder Werke.* Retrieved 6 7, 2021, from forschung-und-lehre.de: https://www.forschung-und-lehre.de/recht/digitale-wissenschaft-und-nutzung-fremder-werke-2726/

Krook, J. (Director). (2016). *I sleep when I am Dead* [Motion Picture].

Kubik, G. (2004). *Zum Verstehen afrikanischer Musik (2. Auflage).* Wien: Lit Verlag.

Kühne, F. (2018, 9 24). *Spex*. Retrieved 1 2019, 28, from Musik im Ring: Red Bull Music Culture Clash in Berlin: https://spex.de/musik-im-ring-red-bull-music-culture-clash-in-berlin/

Laing, D. (2003). Shepherd,John; Horn, David; Laing, Dave; Oliver, Paul; Wicke, Peter. In I. S. Continuum Encyclopedia of Popular Music of the World Part 1 Media, *Continuum Encyclopedia of Popular Music of the World Part 1 Media, Industry, Society* (pp. 513-515). New York: Bloomsbury.

Larkin, C. (2000). *The Virgin encyclopedia of nineties music.* London: Virgin in association with Muze UK.

Lawrence, T. (2014). Disco. In J. Shepherd, & D. Horn, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 180-186). New York: Bloomsbury.

Lee, H. (2000). *Der erste Rasta.* Höfen: Hanibal Verlag.

Leights, E. (2017, 12 8). *CamelPhat & Elderbrook on 'Cola' Success, Unexpected Grammy Nomination.* Retrieved 6 28, 2021, from Billboard.com: https://www.billboard.com/articles/news/dance/8061732/camelphat-elderbrook-cola-success-interview

Leonard, K. E. (2019). Dirty South. In M. Goldsmith, & F. Anthony, *Hip Hop around the World - An Encyclopedia* (pp. 179-181). Santa Barbara: Greenwood.

Lester, T., & Pachamanova, D. (2017, Spring). The Dilemma of False Positives: Making Content ID Algorithms More Conducive to Fostering Innovative Fair Use in Media Creation. *UCLA Entertainment Law Review 24*, pp. 51-74.

Leuffen. (2017, 7 13). Zeitgeschichten: Marshall Jefferson (30 Jahre Acid House). *Groove: Magazin für elektronische Musik und Clubkultur*, pp. 64-69.

Leung, S.-O. (2011, 5 16). A Comparison of Psychometric Properties and Normality in 4-, 5-, 6-, and 11-Point Likert Scales. *Journal of Social Service Research*, pp. 412-421.

Liesenhoff, F. (2019, 12 30). *Jahresrückblick 2019: Diese EDM-Songs haben dieses Jahr dominiert!* Retrieved 7 22, 2021, from DJMag.de: https://www.djmag.de/einzelnews/jahresrueckblick-2019-diese-edm-songs-haben-dieses-jahr-dominiert/

Lim, S. P. (2013). Cube Kohonen Self-Organizing Map (CKSOM) model with new equations in organizing unstructured data. *IEEE transactions on neural networks and learning systems, 9*, pp. 1414-1424.

Lydon, M. (2004). *Ray Charles, Man and Music.* New York: Routledge.

Markman, R. (2013, 1 15). *Macklemore 'neverÄ thought Thrift Shop would hit #1.* Retrieved 18 7, 2021, from mtv.com: http://www.mtv.com/news/1700851/macklemore-thriftshop-number-one-reaction/

Marshall, W. (2008). Dem Bow, Dembow, Dembo: Translation and Transnation in Reggaeton. *Song and Popular Culture 53*, pp. 131-151.

Marshall, W. (2009). Placing Panama in the Reggaeton Narrative. In W. M. Raquel Z. Rivera, *Reggaeton* (pp. 79-80). Durham and Londong: Duke University Press.

Mathworks. (2021). *Audio Toolbox: Spectral Descriptors.* Retrieved 7 13, 2021, from Mathsworks Help Center: https://www.mathworks.com/help/audio/ug/spectral-descriptors.html

Mathworks. (2021). *Harmonic Ratio.* Retrieved 7 5, 2021, from Mathworks Help Center: https://www.mathworks.com/help/audio/ref/harmonicratio.html#mw_7cdb9c59-dec4-459a-94e9-98e1e5721c30

Mazurkiewicz, M. (2012). Buju Banton. In M. Mazurkiewicz, *Contemporary Black biography : profiles from the international Black community ; Volume 93* (pp. 4-7). Detroit: Gale.

McCarthy, S., & Petruso, A. (2014). 50 Cent. In T. (. Ratiner, *Contemporary Musicians Vol. 77* (pp. 69-73). Gale.

McCrown, W., Keiser, R., Mulhearn, S., & Williamson, D. (1997). The Role of Personality and Gender in Preference for exaggerated Bass in Music. *Personality and Individual Differences, 4*(23), pp. 543-547.

McIntyre, H. (2017, 9 12). *Here Are All The Ways Ed Sheeran's 'Shape Of You' Made History.* Retrieved 5 12, 2019, from Forbes:

https://www.forbes.com/sites/hughmcintyre/2017/09/12/here-are-all-the-ways-ed-sheerans-shape-of-you-made-history/#7b13922d6ff5

Melville, C. (2017). Jungle. In D. Horn, J. Shepherd, & P. Prato, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 11* (pp. 427-430). New York: Bloomsbury.

Mickey, B. (2017, 6 23). *The Most Perfect Rap Song Ever Written: If I Ruled The World.* Retrieved 25 7, 2021, from Hip Hop Golden Age: https://hiphopgoldenage.com/perfect-rap-song-ever-written-if-i-ruled/

Millars, A. (2003). Cylinder. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Media, Industry, Society* (pp. 508-509). New York: Bloomsbury.

Mistry, A. (2016, 4 8). *How "One Dance" reveals Drake's Global Ambitions.* Retrieved 5 12, 2019, from The Fader: https://www.thefader.com/2016/04/08/drake-one-dance-regional-sounds

Mitter, S. (2012, Mai 3). *The Hip Hop Generation: Ghana's Hip Life and Ivory Coast's Coupé-Decalé.* Retrieved 3 6, 2019, from Afropop.org: https://afropop.org/articles/the-hip-hop-generation-ghanas-hip-life-and-ivory-coasts-coupe-decale

Mixcloud. (n.d.). *Is Mixcloud licensed to play copyrighted music?* Retrieved 7 28, 2021, from Mixcloud.com: https://help.mixcloud.com/hc/en-us/articles/360004185159-Is-Mixcloud-licensed-to-play-copyrighted-music-

Mor, B. S. (2020). A systematic literature review on computational musicology. *Archives of Computational Methods in Engineering, 3*(27), pp. 923-937.

Morgan, M. &. (2011). Hip-Hop & the Global Imprint of a Black Cultural Form. *Daedalus, 2*(140), pp. 176-199.

Morrison, A. C. (2018). Percussion Musical Instruments. In R. Bader, *Springer Handbook of Systematic Musicology* (pp. 157-170). Heidelberg: Springer.

Möser, M. (2012). *Technische Akustik.* Springer: Berlin.

Moskowitz, D. (2007). *Bob marley: A Biography.* Westport: Greenwood Press.

Moskowitz, D. V. (2006). - *Caribbean Popular Music: An Encyclopedia of Reggae, Mento, Ska, Rock Steady, and Dancehall.* Westport, CT: Greenwood Press.

Munro Smith, H. (2014). Soca. In J. Shepherd, & D. Horn, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 778-781). New York: Bloomsbury.

Murphy, B. (2016, 11 25). *High Contrast: Shooting the Breeze with the D&B Experimenter.* Retrieved 8 1, 2021, from DjMag.com: https://djmag.com/news/high-contrast-feature

Murray, N. (2018, 4 23). *Remembering Avicii, the Producer Who Influenced a Generation of EDM.* Retrieved 6 2021, 26, from Spin.com: https://www.spin.com/2018/04/avicii-obituary/

Musikindustrie, B. (2019, 1 1). *Offizielle Deutsche Charts*. Retrieved 15 10, 2019, from Top 100 Single-Jahrescharts 2018: https://www.offiziellecharts.de/charts/single-jahr

Mustapha, D. (2021, 3 21). *14 most streamed Nigerian songs on You tube.* Retrieved 8 3, 2021, from The Nation Online: https://thenationonlineng.net/14-most-streamed-nigerian-songs-on-you-tube/

Mutsaers, L. (2017). Gabber. In D. Horn, J. Shpherd, & P. Prato, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 11* (pp. 319-320). New York: Bloomsbury.

Niemczyk, R. (1988, 8). Techno! The New Dance Sound of Detroit. *SPEX Musikmagazin*, p. 40.

Nigerian Tribune. (2018, 3 18). *Maleek Berry: I Hope To Create Music That Lasts Longer Than My Generation.* Retrieved 8 3, 2021, from Tribune Online:

https://tribuneonlineng.com/maleek-berry-i-hope-to-create-music-that-lasts-longer-than-my-generation/

Oehler, M. (2015). Lautheit und Anteil tiefer Frequenzen in Aufnahmen populärer Musik seit 1965Michael. *DAGA 2015* (p. 1). Nürnberg: Deutsche Gesellschaft für Akustik e.V.

Oehler, M., Reuter, C., & Czedik-Eisenberg, I. (2015). Lautheit und Anteil tiefer Frequenzen in Aufnahmen populärer Musik seit 1965. *DAGA 2015 - 41. Deutsche Jahrestagung für Akustik,.* Nürnberg.

Oehmen, X. (2011, 8 8). *Im Gespräch: Was stört Sie an Interviews, Herr von Oswald?* Retrieved 7 24, 2021, from Frankfurter Allgemeine Zeitung: https://www.faz.net/aktuell/feuilleton/im-gespraech-was-stoert-sie-an-interviews-herr-von-oswald-11110897.html?printPagedArticle=true#pageIndex_3

Olliver, P. &. (2012). Blues. In J. &. Shepherd, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 64-87). New York: Continuum.

Onanuga, P. (2019, 9). Nigerian Hip-Hop, Youth Subculture and Facets of Development in Selected Contemporary Popular Music. (F. U.-E. Department of English and Literary Studies, Ed.) *Oyé: Journal of Language, Literature and Popular Culture, 1*(1).

Osumare, H. (2002, Winter). Global Breakdancing and the Intercultural Body. *Dance Research Journal, 34*(2), pp. 30-45.

Osumari, H. (2019). Hiplife. In D. Horn, J. Shepherd, G. Kiellich, & H. Feldmann, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 12* (pp. 273-278). New York: Bloomsbury.

Overholtzer, J. (2018). Crunk, Crunking. In T. Riggs, *St. James Encyclopedia of Hip Hop Culture* (p. 102). Gale eBooks.

Owsinksi, B. (2009). *The Audio Mastering Handbook* (2 ed.). Boston: Course Technology.

Owsinski, B. (2006). *The Mixing Engineer's Handbook* (2 ed.). Boston: Thomson Course Technology.

Palombini, C. (2014). Funk Carioca and Musica Soul. In J. &. Shepherd, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 317-325). New York: Bloomsbury.

Peeters, G. (2004). *A Large Set of Audio Features for Sound Description (Similarity and Classification) in the CUIDADO Project.* Paris: IRCAM.

Peretti, B. W. (2009). *Lift Every Voice - The History of African American Music.* Plymouth: Rowman & Littlefield.

Perez, N. (2020, 11 18). *Mixcloud founder: here's what DJs need to know about music copyright.* Retrieved 7 27, 2021, from DJ Techtools: https://djtechtools.com/2020/11/18/mixcloud-founder-heres-what-djs-need-to-know-about-music-copyright/

Peterson, J. (2007). Notorious B.I.G. In M. (. Hess, *Icons of Hip Hop: An Encyclopedia of the An Encyclopedia of the An Encyclopedia of the* (pp. 417-438). Westport: Greenwood.

Pfleiderer, M. (2001). Riddim & Sound. In T. Phleps, *Beiträge zur Popularmusikforschung* (pp. 99-114). Karben: German Society for Popular Music Studies.

Pfleiderer, M. (2006). *Rhythmus: Psychologische, Theoretische Und Stilanalytische Aspekte Populärer Musik.* Bielefeld: transcript.

Pfleiderer, M. (2008). Live-Veranstaltungen von populärer Musik und ihre Rezeption. In G. Gensch, E.-M. Stöckler, & P. Tschmuck, *Musikrezeption, Musikdistribution und Musikproduktion - Der Wandel im Wertschöpfungsnetzwerk der Musikwirtschaft* (pp. 83-108). Gabler.

Poey, D. (2014). Crossing over: Gloria Estefan's Performance of the/on the Hyphen. In D. Poey, *Cuban Women and Salsa* (pp. 77-97). New York: palgrave macmillan.

Poloney, F. &. (2012). Boogie Woogie. In J. &. Shepherd, *Frank Poloney & Collin Davey, Boogie Woogie 87-91* (pp. 87-91). New York: Continuum.

Poschardt, U. (1997). *DJ Culture.* Reinbek: rororo Sachbuch.

Presse- und Informationsamt der Bundesregierung. (2020, 3 27). *Lage von nationaler Tragweite: Epidemien bekämpfen - schnell handeln.* Retrieved 7 6, 2021, from bundesregierung.de: https://www.bundesregierung.de/breg-de/suche/epidemie-bund-kompetenzen-1733634

Priezzhev, I. a. (2019). Seismic waveform classification based on Kohonen 3D neural networks with RGB visualization. *First Break, 37*(2), pp. 37-43.

Rabe, L. (2021, 6 2). *Anzahl der verfügbaren Songs auf Spotify in ausgewählten Monaten von August 2014 bis Juni 2021.* Retrieved 8 20, 2021, from Statista: https://de.statista.com/statistik/daten/studie/378806/umfrage/anzahl-der-verfuegbaren-songs-auf-spotify/

Rabiner, L. R. (1989). A Tutorial on Hidden Markov Models and Selected Applications in Speech Recognition. *Proceedings of the IEEE, 2*(77), pp. 257-286.

Raffeiner, A. (2013, 1 28). Giorgio Moroder „Wenn es rollt, dann rollt es, gell?". *Groove - Magazin für elektronische Musik und Clubkultur*(140), pp. 30-35.

Rani, T. (2016, 3 2). *How Rihanna's 'Work' Made Dancehall Reign in Pop (Again).* Retrieved 7 29, 2021, from Billboard Magazine: https://www.billboard.com/articles/columns/pop/6889497/rihanna-work-dancehall-essay

Raschick, N. (Director). (2007). *Here we Come* [Motion Picture].

Rebala, G., Ravi, A., & Churiwala, S. (2019). *Machine Learning Definition and Basics.* Springer, Cham.

Red Bull Deutschland GmbH. (2018, 8 22). *Red Bull*. Retrieved 1 28, 2019, from Red Bull Culture Clash Berlin: https://www.redbull.com/de-de/culture-clash-berlin-ankuendigung

Reggaeville. (2021). *Bio: Damian Marley.* Retrieved 6 30, 2021, from Reggaeville.com: https://www.reggaeville.com/artist-details/damian-marley/about/

Regis, L. (2014). Calypso. In J. Shepherd, & D. Horn, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 104-116). New York: Bloomsbury.

Resident Advisor. (2021). *Kollektiv Turmstrasse - Biografie.* Retrieved 7 6, 2021, from ra.com: https://ra.co/dj/kollektivturmstrasse/biography

Reuster-Jahn, U. (2019). Bongo Flava. In D. Horn, J. Shepherd, G. Kiellich, & H. Feldmann, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 12* (pp. 84-89).

Reynolds, S. (2000, 6). Die große weite Welt des Trance. *Groove - Magazin für elektronische Musik und Clubkultur*, pp. 68-78.

Ribowsky, M. (2009). *The Supremes - A Saga of Motown Dreams, Success and Betrayal.* Cambridge: Da Capo Press.

Rick, D. (2008, 8 8). *SPIEGEL Online.* Retrieved 5 6, 2019, from Wie Hip Hop nach Deutschland kam: Der Durchbruch nach dem Hype: https://www.spiegel.de/einestages/wie-hiphop-nach-deutschland-kam-a-949537.html

Riddimbase.org. (n.d.). Retrieved 24 1, 2019, from Mama / Love in the House Riddim:

http://www.riddimbase.org/riddimbase/query.php?category=riddim&id=973&page=1

Riddimguide.com. (n.d.). Retrieved 1 2019, 24, from Love in the House Riddim: https://www.riddimguide.com/tunedb/riddim_Love%20In%20The%20House/

Riddimguide.org. (n.d.). *Riddimguide.org: Sleng Teng Riddim*. Retrieved 1. 2019, 3., from https://riddimguide.com/tunedb/riddim_Sleng%20Teng/

Rietveld, H. C. (2015). Breaking the Electronic Sprawl . In P. Guerra, & A. Bennet, *Book of Abstracts KISMIF Conference 2015* (pp. 211-214). Porto: University of Porto, Department of Arts and Humanities.

Rolling Stone. (2003, 12 9). *500 Greatest Songs of All Time: Rolling Stone definitive List of the 500 greatest Songs of all time.* Retrieved 6 25, 2021, from Rolling Stone: https://www.rollingstone.com/music/music-lists/500-greatest-songs-of-all-time-151127/

Rommen, T. (2011). *Funky Nassau - Roots, Routes and Representations in Bahamian Popular Music.* Berkeley: University of California Press.

Rossmann, G. (2012). *Climbin the Charts: What Radio Airplay Tells Us about the Diffusion of Innovation.* Princeton University Press: Princeton.

Rupp, R. R., & Koch, a. L. (1969). Effects of too-loud music on human ears but, Mother, rock'n roll has to be loud! *Clinical pediatrics, 2*(8), pp. 60-62.

Ruschkowski, v. (2013). *Lautheit von Musik - Eine empirische Untersuchung zum Einfluss von Organismusvariablen auf die Lautstärkewahrnehmung von Musik (Disertation).* Hamburg: Universität Hamburg.

Ryman, C. (2014). Burro. In J. Shepherd, & D. Horn, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 93-95). New York : Bloomsbury.

Ryman, C. (2014). Kumina. In J. Shepherd, & D. Horn, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 419-422). New York: Bloomsbury.

Sam Houston State University. (n.d.). *Dances Crazes.* Retrieved 1 14, 2019, from Survey of American Popular Music: https://www.shsu.edu/~lis_fwh/book/brill_building/Dance%20Crazes2.htm

Samponaro, P. (2009, 21 9). “Oye mi canto” (“Listen to My Song”): The History and Politics of Reggaetón. *Popular Music and Society*, pp. 489-506.

Samuels, A. (2012). "I might be Muslim - hell, I might even be Jewish". *Electronic Beats - Conversations on essential issues*(#29 (Spring 2012)), pp. 57-61.

Sawalhi, N. &. (2004, 11). The application of spectral kurtosis to bearing diagnostics. *Proceedings of ACOUSTICS* , pp. 3-5.

Schloss, J. G. (2004). *Making beats: The art of sample-based hip-hop.* Middletown, Conneticut: Wesleyan Univ. Press.

Schmidt, T. (1998, 4 17). Dunplates & Mastering. *Groove - Magazin für elektronische Musik und Clubkultur*(#50), pp. 42-47.

Schneider, A. (2018). Psychophysics / Psychoacoustics. In R. Bader, *Handbooks of Systematic Musicology* (pp. 556-745). Heidelberg: Springer.

Schneider, A., & von Ruschkowski, A. (2011). Techno, Decibels, and Politics: an Empirical Stuy of Modern Dance Music Productions, Sound Pressure Levels, and "Loudness Perception". In A. Schneider, & A. (. von Ruschkowski, *Hamburger Jahrbuch für Musikwissenschaft: Systematic Musicology: Empirical and Theoretical Studies* (pp. 11-62). Frankfurt a.M.: Peter Lang.

Schneider, B. v. (2009). Klangliche Rauhigkeit, ihre Wahrnehmung und Messung. In R. (. Bader, *Musical Acoustics, Neurocognition and Psychology of Music / Musikalische Akustik, Neurokognition und Musikpsychologie. Hamburger Jahrbuch für Musikwissenschaft 25* (pp. 101-144).

Schneider, M. (2017, 9 22). *Ed Sheeran's 'Shape of You' Surpasses Drake's 'One Dance' as Spotify's Most-Streamed Song Ever.* Retrieved 5 12, 2019, from Billboard Magazine: https://www.billboard.com/biz/articles/news/digital-and-mobile/7973700/ed-sheerans-shape-of-you-surpasses-drakes-one-dance-as

Schroers, A. (2001). Zum Drogengebrauch im Techno-Party-Setting. In R. Hitzler, & M. Pfadenhauer, *Erlebniswelten 1: Techno-Soziologie - Erkundungen einer Jugendkultur* (pp. 213-234). Wiesbaden: Springer.

Schuhmacher, T. G. (2004). "This is a sampling Sport" Digital Sampling, Rap Music and The Law in Cultural Production. In M. Forman, & M. A. Neal, *That's The Joint - The Hip Hop Studies Reader* (pp. 443-458; 455-456). New York: Routledge.

Schuhmann, A. (2009). Popular music and political change in Côte d'Ivoire: the divergent dynamics of zouglou and reggae. *Journal of African Media Studies* , pp. 117-133.

Schurz, G. (2011). *Evolution in Natur und Kultur - Eine Einführung in die verallgemeinerte Evolutionstheorie.* Heidelberg: Spektrum.

Schusterman, R. (2004). Challenging Conventions in the Fine Art of Rap. In M. Forman, & M. A. Neal, *That's The Joint - The Hip-Hop Studies Reader* (pp. 459-479). New York: Routledge.

Secondhand Songs. (2021, 6 28). *Cover Versions of Ain't Nobody by Rufus and Chaka Khan*. Retrieved from SecondhandSongs.com: https://secondhandsongs.com/performance/478

Seitaram, D. (2021, 4 9). *Vybz Kartel Remind Critics He's A Billboard Artist Long Before 2009's "Romping Shop".* Retrieved 8 4, 2021, from Urban Islandz: https://urbanislandz.com/2021/04/09/vybz-kartel-remind-critics-hes-a-billboard-artist-long-before-2009s-romping-shop/

Sen, S., Dutta, A., & Dey, N. (2019). *Audio Processing and Speech Recognition - Concepts, Techniques and Research Overviews.* Singapur: Springer.

Serwer, J. (2016, 11 16). *Vybz Kartel Speaks: After Five Years in Prison, He Still Rules Dancehall.* Retrieved 8 4, 2021, from Rolling Stone: rollingstone.com/music/music-features/vybz-kartel-speaks-after-five-years-in-prison-he-still-rules-dancehall-122188/

Shapiro, P. (2007). *Turn the Beat Around - The secret History of Disco* . London: Faber & Faber.

Sheridan, G. (2018). From Luanda to Lisboa: Globalization, Hybridity and Identity in Kuduro. *Preprint*.

Shin, S. H., Ih, J. G., Hashimoto, T., & Hatano, S. (2009). Sound quality evaluation of the booming sensation for passenger cars. *Applied acoustics, 2*(70), pp. 309-320.

Shipley, J. W. (2013, 5). Transnational circulation and digital fatigue in Ghana's Azonto dance craze. *Journal of the American ethnological society*, pp. 363-381.

Sibbles, L. (2017, 10 12). (E-Mail) Re: Questions for my research (leroy@leroysibbles.com). (L. Schmedeke, Interviewer)

Sicko, D. (2010). *Techno Rebels - The renegades of electronic funk (2nd ed.).* Detroit: Wayne State University Press.

Silver, T. (Director). (1983). *Wild Style* [Motion Picture].

Sloan, N. &. (2020). *Switched on Pop.* New York: Oxford University Press.

Sloan, N., & Harding, C. (2020). *Switched on Pop.* New York: Oxford University Press.

Slutsky, A. (1989). *Standing in the Shadows of Motown: The Life an Music of legendary Bassist James Jamerson.* Haverford: Dr. Licks Publishing.

Smith, C. H. (2008). Hip Hop Moguls. In T. Boyd, *African Americans and Popular Culture* (pp. 61-86). Praeger.

Smith, D. (2021, 6 7). *Released 24 Year agp: Wamdue Project – King of my Castle.* Retrieved 8 12, 2021, from EDM House Network: https://edmhousenetwork.com/released-23-years-ago-wamdue-project-king-of-my-castle/

Smith, R. R. (2005). *Fender - Ein Sound schreibt Geschichte.* Hamburg: Nikol Verlagsgesellschaft GmbH.

Solanke, A. (2012, 9). Afro-europe: Winds of Change. *UK Writer*, pp. 25-27.

Solberg, R. (2014). "Waiting for the Bass to Drop": Correlations between emotional expiereinces and production techniques in build-up and drop sections of electronic dance music. *dancecult, Journal of Electronic Dance Music Culture, 1*(6), pp. 61-82.

Sontacchi, A. (1998). *Entwicklung eines Modulkonzeptes für die psychoakustische Geräuschanalyse unter MatLab (Diplomarbeit).* Graz: Technische Universität Graz.

Spotify. (2021, 6 28). *Artist Page: Charles Wright*. Retrieved 6 28, 2021, from Spotify.com: https://open.spotify.com/artist/2t0kaaDtGZtmpczIAMaVTQ

Stanbridge, A. (2012). Jazz. In J. &. Shepherd, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 286-307). New York: Continuum.

Stange-Elbe, J., & Bronner, K. (2008). Musikinstrumentenindustrie im digitalen Paradigmenwechsel. In G. Gensch, E. M. Stöckler, & P. Tschmuck, *Musikrezeption, Musikdistribution und Musikproduktion* (pp. 311-334). Gabler.

Stein, G. (2019, 3 15). *EP Review: Koffee Rapture.* Retrieved 8 10, 2021, from Reggaeville.com: https://www.reggaeville.com/artist-details/koffee/releases/mode/review/release/koffee-rapture-ep/

Stepánek, J. (2006). Musical Sound Timbre: Verbal Description and Dimensions. *Proceding of the 9th Int. Conference on Digital Audio Effects (DAFx-06)* (pp. 121-126). Montreal: DAFx.

Stewart, J. (2014). Retaining a New Format: Jazz-Rap, Cultural Memory, and the New Cultural Politics of Difference. *Critical Studies in Improvisation/Études critiques en improvisation*.

Stolzoff, N. C. (2000). *Wake the Town and tell the People - Dancehall Culture in Jamaica.* London: Duke University Press.

Storb, I. (1986). Afrobeat & Afrojazz. In H. (. Rösing, *Ist Pop die Volksmusik von heute?* (pp. 67-72). Hamburg: Coda Verlag.

Stratton, J. (2008, 10 1). The Beastie Boys: Jews in Whiteface. *Popular Music, 27*(3), pp. 413-432.

Strong, M. C. (2001). *The Great Rock Discography (5th Edition).* Frankfurt a.M.: Zweitausendeins.

Sullivan, G. M., & Artine, A. R. (2013, 12 1). Analyzing and Interpreting Data From Likert-Type Scales. *Journal of Graduate Medical Education*, pp. 541–542.

Tabron, C. (2015). The glass: hip-hop production. In J. A. Williams, *The Cambridge Companion to Hip-Hop* (pp. 135-151). Cambridge: Cambridge University Press.

Tawney, R. (2021, 6 7). *When Nas and Lauryn Hill ruled the World.* Retrieved 25 7, 2021, from LA Weekly: https://www.laweekly.com/when-nas-and-lauryn-hill-ruled-the-world/

Taylor, T.-J. (2019). Coupé Decalé. In D. Horn, J. Shepherd, G. Kielich, & H. Feldmann, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 12* (pp. 120-123). New York: Bloomsbury.

Taylor, T.-J. (2019). Zouglou. In D. Horn, J. Shepherd, G. Kiellich, & H. Feldmann, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 12* (pp. 585-588). New York: Bloomsbury.

The Official UK Charts Company. (2014, 4 20). *Kiesza scores a massive selling hit as her debut single, Hideaway, goes straight in at Number 1.* Retrieved 7 6, 2021, from OfficialCharts.com: https://www.officialcharts.com/chart-news/kiesza-claims-her-debut-uk-number-1-single-with-hideaway__4014/

The Official UK Charts Company. (n.d.). *https://www.officialcharts.com/.* Retrieved 6 25, 2021, from Official Single Charts: Uptown Top Ranking: https://www.officialcharts.com/search/singles/uptown-top-ranking/

Théberge, P. (2003). Acetate. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Media, Industry, Society* (p. 505). New York: Bloomsbury.

Théberge, P. (2003). Computers in Music. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production* (pp. 234-237). New York: Bloomsbury.

Théberge, P. (2003). Digital Recording. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production* (pp. 217-218). New York: Bloomsbury.

Théberge, P. (2003). Drum Machine. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Media of Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production* (pp. 236-237). New York: Bloomsbury.

Théberge, P. (2003). Microphone. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Media, Industry, Society* (pp. 245-247). New: Bloomsbury.

Théberge, P. (2003). MIDI. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production* (pp. 247-248). New York: Bloomsbury.

Théberge, P. (2003). Music Software (Professional & Amateur). In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production* (pp. 250-251). New York: Bloomsbury.

Théberge, P. (2003). Sampler. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production* (pp. 257-258). New York: Bloomsbury.

Théberge, P. (2003). Sound Editing. In J. Shepherd, D. Horn, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Performance and Production.* New York: Bloomsbury.

Théberge, P. (2003). Sound Recording Technologies. In J. Shpherd, H. David, D. Laing, P. Oliver, & P. Wicke, *Continuum Encyclopedia of Popular Music of the World Part 1 Media, Industry, Society* (pp. 259-263). New York: Bloomsbury.

Thomas, M. P. (2017). *MATLAB Machine Learning.* New Jersey: Appress.

Toberrelli, R. (2009). *Michael Jackson: The Magic, The Madness, The whole Story 1958-2009.* New York: Hachette Book Group .

Todd, N. P., & Cody, &. F. (2000). Todd, N. P. M., & Cody, F. W. (2000). Vestibular responses to loud dance music: A physiological basis of the “rock and roll threshold”? *The Journal of the Acoustical Society of America, 1*(107), pp. 496-500.

Trust, G. (2018, 8 2). *Billboard Magazine*. Retrieved 1 21, 2019, from Hot 100 Turns 60! Chubby Checker's 'The Twist' & The Beatles Reign:

https://www.billboard.com/articles/columns/chart-beat/8468122/hot-100-turns-60-chubby-checker-the-twist-the-beatles

Tschmuck, P. (2009). Vom Tonträger zur Musikdienstleistung. In G. Gensch, E. M. Stöckler, & P. (. Tschmuck, *Musikrezeption, Musikdistribution und Musikproduktion* (pp. 141-164). Gabler Verlag.

Twickel, C. (2009). Muévelo (Move It!): From Panama to New York and Back Again, the Story of El General. In R. Z. Rivera, D. Pacinei Hernandez, & W. (. Marshall, *Reggaeton* (pp. 99-110). Durham and London: Duke Universtity Press.

UC Irvine Machine Machine Learning Repository. (2021). *UC Irvine Machine Learning Repository.* Retrieved 8 23, 2021, from UC Irvine: https://archive-beta.ics.uci.edu/

Uhlig, S. (2013, Januar 13). Zeitgeschichten: Frankie Knuckles. *Groove - Magazin für elektronische Musik und Clubkultur*(# 140), pp. 46-52.

UK Official Charts Company. (1974, 10 20). Retrieved 24 01, 2019, from Official Singles Chart Top 50 - 20 October 1974 - 26 October 1974: https://www.officialcharts.com/charts/singles-chart/19741020/7501/

Unger, C. (2001). *Die Entwicklung der Musikindustrie und die Rolle der Medien.* Hildesheim: Diplomica.

Universität Hamburg. (2021, 7 3). *Dienstanweisung 21. / Anlage 5: Experimenteller Forschungsbetrieb und empirische Forschung im Labor.* Retrieved 7 6, 2021, from Uni-Hamburg.de: https://www.uni-hamburg.de/newsroom/intern/dienstanweisungen/20210702-da21.html#15875289

Van Dyck, E. (2012, 12). The Impact of the Bass Drum on Human Dance Movement. *music perception*(4), pp. 349-359.

Van Dyck, E., Moelants, D., Demey, M., Deweppe, A., Coussement, P., & Leman, M. (2013). The Impact of the Bass Drum on Human Dance Movement. *Music Perception: An Interdisciplinary Journal*, pp. 349-359.

Vincent, R. (1996). *Funk.* New York: St. Martin's Griffin.

Vincent, R., & Davis, B. (2012). Funk. In J. Shepherd, & D. Horn, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 216-220). New York: Bloomsbury.

Vineyeard, J. (2005, 5 1). *usher's "Yeah" was most played Song of Year 2004.* Retrieved 5 4, 2021, from MTV: mtv.com/news/1495342/ushers-yeah-was-most-played-song-of-2004/

Völkl, K., & Korb, C. (2017). *Deskriptive Statistik.* Wiesbaden: Springer VS.

Vormann, M. (2011). *Untersuchungen zu psychoakustischen Mess- und Berechnungsverfahren der Tonhaltigkeit (Dissertation).* Oldenburg: Carl von Ossietzky Universität Oldenburg.

Vormann, M., Schick, A., Meis, M., Klatte, M., & Mellert, V. (1998). Tonhaltigkeit aus psychophysikalischer Sichtweise. *DAGA 98.* Oldenburg: Deutsche Gesellschaft für Akustik e.V.

Vormann, M., Verhey, J., Mellert, V., & Schick, A. (2000). Ein adaptives Verfahren zur Bestimmung der subjektiven Tonhaltigkeit. *DAGA 2000.* Oldenburg: Deutsche Gesellschaft für Akustik e.V.

Vrabie, V., Granjon, P., & Serviere, C. (2003). Spectral kurtosis: from definition to application. In *6th IEEE International Workshop on Nonlinear Signal and Image Processing (NSIP 2003).* Grado-Trieste.

Wade, P. (2014). Cumbia. In J. &. Shepherd, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 247-253). New York: Bloomsbury.

Wade, P. (2014). Cumbia. In J. Shepherd, & D. Horn, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 247-253). New York: Bloomsbury.

Watkins, J. (2012, 10 22). *How me made Back to Life by Soul II Soul.* Retrieved 2 2019, 28, from The Guardian: https://www.theguardian.com/culture/2012/oct/22/back-to-life-soul-ii-soul

Watkins, T. D. (2016). Jacksonville, FL. In D. Horn, & D. &. Laing, *Continuum Encyclopedia of Popular Music of the World Volume 4* (pp. 221-224). New York: Continuum.

Welsh-Asante. (1998). *African Dance: An Artistic, Historical, and Philosophical Inquiry.* Trenton, NJ: Afrika World, Inc.

Westhoff, B. (2011). *Dirty South.* Chicago: Chicago Review Press.

Whitburn, J. (2006). *Top R&B/Hip-Hop Singles 1942-2004.* Record Research.

White, J. (2021). Growing Up Under the Influence: A Sonic Genealogy of Grime. In W. '. Henry, *Narratives from Bexond the UK Reggae Bassline - The System is Sound* (pp. 249-268). Cham: Palgrave.

White, M. (2014). R&B, Contemporary. In J. Shepherd, & D. Horn, *Continuum Encyclopedia of Popular Music of the World Volume 8* (pp. 372-377). New York: Bloomsbury.

Who Sampled. (n.d.). Retrieved 2 19, 2019, from Heartbeat by Taana Gardner: https://www.whosampled.com/Taana-Gardner/Heartbeat/sampled/?ob=0&cp=2

Who Sampled. (2021, 6 28). *Who Sampled: Express yourself by Charles Wright & the Watts 103rd Street Rhythm Band*. Retrieved 6 28, 2021, from whosampled.com: https://www.whosampled.com/Charles-Wright-%26-the-Watts-103rd-Street-Rhythm-Band/Express-Yourself/

Who Sampled: Here I Come (Broader Than Broadway). (n.d.). Retrieved 6 26, 2021, from whosampled.com: https://www.whosampled.com/Barrington-Levy/Here-I-Come-(Broader-Than-Broadway)/

WhoSampled.com. (2021). *Who Sampled Think (About it).* Retrieved 8 20, 2021, from Who Sampled: https://www.whosampled.com/Lyn-Collins/Think-(About-It)/

WhoSampled.com. (n.d.). *Samples of I Want You Back by The Jackson 5*. Retrieved 7 14, 2021, from WhoSampled.com: https://www.whosampled.com/The-Jackson-5/I-Want-You-Back/sampled/

WhoSampled.com. (n.d.). *Who Sampled: Funky Drummer by James Brown*. Retrieved 5 6, 2019, from https://www.whosampled.com/James-Brown/Funky-Drummer/

Wignall, M. (2013). Congrats. Hedley Jones. Musgrave Goldmedallist". *Jamaica Observer*, 4.

Wile, R. R. (1982, 4). The Edison Invention of the Phonograph. *Association for recorded sounds collection Journal*(14), pp. 4-28.

Wilke, T. (2017). Disco. In K. M. Hecken T., *Handbuch Popkultur* (pp. 76-72). Stuttgart: J.B. Metzler.

Williams, H. (2007). Grandmaster Flash. In M. (. Hess, *Icons of Hip Hop: Am Encyclopedia of the Movement, Music and Culture* (pp. 27-51). Westport: Greenwood.

Witmer, R. &. (2014). Dub. In J. &. Shepherd, *Bloomsbury Encyclopedia of Popular Music of the World, Volume 9* (pp. 285-293). New York: Bloomsbury.

Wöltz, A. (2006, 5). Das Minimal Jahrzent - Vom Schock zum Standard. *Groove - Magazin für elektronische Musik und Clubkultur*, pp. E6-E7.

Young, J. R. (2009). Brooklyn Beats: Hip Hop's Home to Everyone from Everywhere. In H. Mickey, *Hip Hop in America: A Regional Guide. Volume 1: East Coast and West Coast* (pp. 75-106). Santa Barbara: Greenwood.

Zambrano, R. A. (2018). *Jamaica electrónica: producción de un EP en género moombahton usando soft synths y samples, basado en el análisis de la función que estos cumplen en el álbum Free the Universe de Major Lazer (Bachelor Thesis).* Quito, Peru: Universidad de las Américas.

Zarbo, J. A. (2014). *James Jamerson: From Jazz Bassist to popular music Icon (Master Thesis).* Texas State University.

Ziech, B. (2017). *African Art Music.* Heidelberg: Universität Heidelberg.

Zinnecker, J. (1987). *Jugendkultur 1940-1985.* Opladen: Leske & Budrich.

Zuberi, N. (2015, 11 3). War Dubs. *dancecult - Journal of electronic dance music culture*. Retrieved 8 1, 2021, from https://dj.dancecult.net/index.php/dancecult/article/download/732/696?inline=1

Zwicker, E. (1991). Ein Vorschlag zur Definition und zur Berechnung der unbeeinflußten Lästigkeit. *Zeitschrift für Lärmbekämpfung*, pp. 91-97.

List of Notation Examples

Notation 1: Nina Simone "My Baby just cares for me" Walking Bass (excerpt) / Scource: author's transcription 23

Notation 2: Booker T. & The M.G.s "Green Onions" Bass Riff / Quelle: Eigene Transkription 41

Notation 3: The Contours "Do You Love Me" Bass Riff / Quelle: Eigene Transkription 41

Notation 4: Stevie Wonder "Uptight (Everything's Alright)" Bass / Quelle: Slutsky, 1989, S. 93 43

Notation 5: Stevie Wonder "I'd be a Fool right now" (1969) Bass / Quelle: Slutsky, 1989, S. 94 44

Notation 6: The Supremes "How long has that Evening Train been gone" (1968) Bass / Quelle: Skutsky, 1989, S. 95 45

Notation 7: The Supremes "You keep me hanging on" (1966) Bass / Quelle: Slustky, 1989, S. 131 46

Notation 8: The Wailers "Simmer Down" (Walking Bass Pattern) / Quelle: Eigene Transkription 54

Notation 9: The Heptones - "Mama, let me go" (Bass Pattern) / Quelle: Eigene Transkription 57

Notation 10: John Holt "A Love I can feel" (Love I can feel Riddim) / Quelle: Eigene Transkription 60

Notation 11: James Brown "Papa's got a brand new Bag" / Quelle: Eigene Transkription 71

Notation 12: Sly & The Family Stone "Thank You (Fallentinme Be Mice Elf Agin)" Bass Riff / Quelle: Eigene Transkription 73

Notation 13: Parliament "Flashlight" Synth Bass / Quelle: Eigene Transkription 73

Notation 14: DJ Cam ft. Afu Ra „Voodoo Child (DJ Premier Remix)" / Quelle: Eigene Transkription 106

Notation 15: Cardi B "I like it" Beat Pattern / Quelle: Eigene Transkription 107

Notation 16: Wayne Smith "Under my Sleng Teng" (Sleng Teng Riddim) Bass / Source: Author's own transcription 109

Notation 17: Sean Paul „Like Glue" Beat Pattern / Source: Author's own transcription 110

Notation 18: Shabba Ranks „Dem Bow" (Poco Man Jam Riddim) Beat Pattern / Source: Author's own transcription 111

Notation 19: Fuse ODG „Azonto" Beat Pattern / Source: Author's own transcription 113

Notation 20: Maleek Berry „Kontrol" Beat Pattern / Source: Author's own transcription 114

Notation 21: MHD „Afrotrap Part. 7 (La Puissance)" Beat Pattern / Source: Author's own transcription 116

Notation 22: Marshall Jefferson „Move Your Body" Pattern / Source: Author's own transcription 121

Notation 23: M-Beat ft. General Levy "Incredible" Beat Pattern / Source: Author's own transcription 131

Notation 24: High Contrast "Racing Green" Beat Pattern / Source: Author's own transcription 132

Notation 25: Rihanna ft. Drake „Work" Pattern / Source: author's own transcription 150

Notation 26: Paul van Dyk „For an Angel" Pattern / Source: author's own transcription 152

Notation 27: Bruno Mars „24k Magic" Synth Bass Riff / Source: author's own transcription 153

Notation 28: Calvin Harris ft. Pharrel Williams, Katie Perry & Big Sean "Feels" Bass Riff / Source: author's own transcription 154

Notation 29: Konshens "Couple Up" (Calabash Riddim) / Source: author's own transcription 155

Notation 30: Singuila „Ay Mama" Bass Riff (Refrain) / Source: author's own transcription 155

Notation 31: Cypress Hill, "Insane in the Brain," Bass and Kick Drum, with FatmomCurve 288

Notation 32: Characteristic Beat Patterns 344

List of Figures

Figure 1: Circular projection of the core loop from "A Love I Can Feel" 4
Figure 2: Circular Projection of the Core Loop from "King of My Castle" 6
Figure 3: The first nodal points of a circular membrane and the frequencies as multiples of the fundamental frequency. 18
Figure 4: advertisement for the "Electrified Double Bass" 29
Figure 5: Clarence L. Fender, patent drawing for "Bass Guitar," U.S. Design Patent No. D187,001 31
Figure 6: James Jamerson with Precision Bass „Funk Machine" 42
Figure 7 Lee "Scratch" Perry in the Black Ark Studio (placeholder). 68
Figure 8: Roland TR-808 Rhythm Composer. 75
Figure 9: Fairlight CMI. 88
Figure 10: Artistic depiction of the recording of "The Adventures of Grandmaster Flash on the Wheels of Steel" in comic form 96
Figure 11: Spectrogram of Skrillex's "Bangarang" (bars 31–36) 134
Figure 12: Simplified linear development of modern popular dance music 143
Figure 13: Basic Rhythmic Types of Modern Popular Dance Music 147
Figure 14: Basic Types of Bass in Modern Popular Dance Music 151
Figure 15: Schematic representation of the human auditory system 167
Figure 16: Sottek's Auditory Model. 169
Figure 17: Measurement Results by Aures. 170
Figure 18 Comparison of Aures's $g'(z)$ and von Bismarck's $g(z)$. 171
Figure 19: Weighting Function $g'(z)$According to Aures. 171
Figure 20: Comparison of Sharpness Predictions According to Aures, von Bismarck, and DIN 172
Figure 21: Equal-Loudness Contours and Weighting Curves According to ISO 226 173
Figure 22: Calculation of the Harmonic Ratio 174
Figure 23: Calculation of Fluctuation Strength 175
Figure 24: Calculation Signal to Noise Ratio 175
Figure 25: Calculation of the spectral centroid 176
Figure 26: Calculation of spectral flux 176
Figure 27: Calculation of spectral crest 176
Figure 28: : Calculation of the spectral entropy 177
Figure 29: Calculation of spectral flatness 177
Figure 30: Calculation of spectral kurtosis 178
Figure 31: Calculation of the spectral roll-off point 178
Figure 32: Calculation of spectral skewness 179
Figure 33: Calculation of spectral slope 179

Figure 34: Calculation of spectral spread 180
Figure 35: Preference for Frequency Ranges 189
Figure 36: Bark-scale-compliant filter bank, logarithmic representation 190
Figure 37: Bark-scale-compliant filter bank, linear representation 190
Figure 38: Rank-correlation strength of the parameter fatness by critical band, with regression line 192
Figure 39: Correlation strength of the parameter fatness by critical band, with regression line) 199
Figure 40: Regression Curve: Loudness < 200 Hz 207
Figure 41: Regression Curve: Loudness > 200 Hz 208
Figure 42: Regression Curve: Spectral Centroid < 200 Hz 209
Figure 43: Regression Curve: Signal-to-Noise Ratio < 200 Hz 210
Figure 44: Distribution of Tempos in a Representative Sample of Popular Dance Music 217
Figure 45: Temporal and Stylistic Distribution of the Music Sample 220
Figure 46: Die Vinyl-Tonträger des Musik-Samples 221
Figure 47: Selected recordings, 1990s *Hip Hop* 12-inch singles 229
Figure 48: Selected recordings, *Reggae* 7-inch singles 237
Figure 49: Selected recordings, *EDM* 12-inch singles 241
Figure 50: Selected recordings, *Soul* 7-inch singles 246
Figure 51: : Selected recordings, 1980s *Hip Hop*. 248
Figure 52: Selected recordings, *Reggae* 12-inch singles 256
Figure 53: Stage 3 of Data Collection, Demographic Data (Age, Age by Genre, n by Genre, Experience) 263
Figure 54: Musical Taste of Professionals by Scene 264
Figure 55: Musical Taste of Clubbers by Scene 264
Figure 56: Fatness ratings of professionals by scene and style 265
Figure 57 Release Year vs. Perceived Fatness (Professionals) / Regression 268
Figure 58: SPL < 200 Hz vs. Fatness, Regression 271
Figure 59: SPL < 200 Hz vs. Fatness, Adjusted for SNR / Regression 272
Figure 60: Measurement Ranges of the Sound-Level Measurements 273
Figure 61: SPL > 200 Hz vs. Fatness, Unweighted / Regression 274
Figure 62: SPL > 200 Hz vs. Fatness, Weighted by HR / Regression 274
Figure 63: Spectral Centroid vs. Fatness, Adjusted for SNR 276
Figure 64: Comparison of the Measurement Ranges of the Spectral Centroid 277
Figure 65: Spectral Centroid < 200 Hz vs. Fatness, Weighted by SNR 278
Figure 66: Comparison of the Measurement Ranges of the Measured Tonality Parameters 280
Figure 67: Harmonic Ratio vs. Fatness, Weighted by Spectral Centroid) 281

Figure 68: Spectral Entropy vs. Fatness, Weighted by Spectral Centroid 282
Figure 69: Measurement Ranges of Further Spectral Parameters 283
Figure 70: Spectral Roll-Off Point < 200 Hz vs. Fatness, Weighted by Constructed SNR 284
Figure 71: Graph of the Momentary Fatness Function 286
Figure 72: Histogram of the Regression Residuals of Momentary Fatness 287
Figure 73: Cypress Hill, "Insane in the Brain" (22), Fatness Curve 288
Figure 74: Figure 74: Major Lazer, "Watch Out for This" (56), Fatness Curve 288
Figure 75: CamelPhat & Elderbrook, "Cola" (14), Fatness Curve 289
Figure 76: Maurizio, "M7" (59), Fatness Curve 289
Figure 77: John Holt, "A Love I Can Feel" (43), Fatness Curve 290
Figure 78: James Brown, "Papa's Got a Brand New Bag" (42), Fatness Curve 290
Figure 79: Candido, "Jingo" (15), Fatness Curve 291
Figure 80: $Fatmom, .85$ vs. Perceived Integrated Fatness 295
Figure 81: SPL < 200 Hz SD vs. Perceived Integrated Fatness / Regression 297
Figure 82: $Centroid_{0.20<200\,Hz}$ vs. Perceived Integrated Fatness / Regression 298
Figure 83: Centroid $_{>200\,Hz\,SD}$ vs. Perceived Integrated Fatness / Regression 299
Figure 84: Graph of the Preliminary Modelling of Integrated Fatness 300
Figure 85: Selected Correlates of Tonality and Harmonicity 301
Figure 86: Regression Graphs of Selected Factors of Tonality and Harmonicity 303
Figure 87: Regression Graphs of Selected Spectral Parameters 306
Figure 88: Histogram of the Regression Residuals of Integrated Fatness 308
Figure 89: SPL dB© < 200 Hz of selected tracks with low standard deviation 309
Figure 90: SPL dB© < 200 Hz of selected tracks with high standard deviation 310
Figure 91: Relationship of SNRmin and SPL SD with the Recording Medium 311
Figure 92: Spectral entropy of selected tracks with low kurtosis 312
Figure 93: Spectral entropy of selected tracks with high kurtosis 312
Figure 94: Spectral centroid < 200 Hz of selected tracks with a high 20th percentile 313
Figure 95: Spectral centroid < 200 Hz of selected tracks with a high 20th percentile 313
Figure 96: Spectral entropy of selected tracks with low SD 314
Figure 97: Spectral entropy of selected tracks with high SD 314
Figure 98: Momentary fatness of selected tracks with a low 85th percentile 315
Figure 99: Momentary fatness of selected tracks with a high 85th percentile 316
Figure 100: Residuen des Models der Integrierten Fettheit nach Stil 317
Figure 101: Figure 101: Integrated Fatness as SOM Component / Distribution by Style 321

Figure 102: Tempo as SOM Component / Distribution by Style 322
Figure 103: SD of C-weighted Sound-Pressure Level > 200 Hz as SOM Component / Distribution by Style 323
Figure 104: Median Spectral Flux as SOM Component / Distribution by Style 324
Figure 105: SD of Spectral Roll-Off Point > 200 Hz as SOM Component / Distribution by Style 325
Figure 106: Figure 106: SD of Spectral Skew > 200 Hz as SOM Component / Distribution by Style 326
Figure 107: Minimum of Spectral Centroid as SOM Component / Distribution by Style 326
Figure 108: Kohonen Self-Organizing Map of the Training Sample Based on DJ Considerations 328
Figure 109: SOM-Ausschnitt / Clusterfreier Bereich 329
Figure 110: SOM Segment / Dubstep Placement 330
Figure 111: Projection of Test Sample B onto the Trained SOM 332
Figure 112: SOM Segment / Hip Hop in Test Sample B 333
Figure 113: Projection of Recording-Medium Types from the Training Sample onto the SOM 334
Figure 114: SOM Segment / "Motown Cluster" 336
Figure 115: Example DJ Set as Path through the SOM 338
Figure 116: Cyclic Projection of Two Bars from "Blowin' Money Fast" 343
Figure 117: Cypress Hill, "Insane in the Brain" (22) / Fatness Curve, Autocorrelation, and Regression Curve 345
Figure 118: Wamdue Project, "King of My Castle" (98) / Fatness Curve, Autocorrelation, and Regression Curve 345
Figure 119: Wayne Smith, "Under Mi Sleng Teng" (97) / Fatness Curve, Autocorrelation, and Regression Curve 345

List of Tables

Table 1 Bark Scale ... 168
Table 2: Participants' Stylistic Preferences for Attending Dance Events ... 188
Table 3: Preference for Specific Frequency Ranges in the Club Context ... 189
Table 4: Perceptual Evaluation of the Test Sounds in the Online Survey ... 191
Table 5: Online Survey: Correlates of Fatness with Other Parameters ... 192
Table 6: Spearman Rank-Correlation Coefficients of Timbre Properties and Critical Bands from the Online Survey ... 193
Table 7: Online Survey: Overview of Listening Conditions ... 194
Table 8: Model Summary of the Linear Regression ... 197
Table 9: Pretest: Coefficients of the Linear Regression ... 198
Table 10: Revised Block Construction for Assessing the Signal-to-Noise Ratio ... 201
Table 11: Model Summary: Linear Regression ... 203
Table 12: Analysis of Variance of the Linear Regression ... 204
Table 13: Coefficients of the Linear Regression ... 204
Table 14: Variance Inflation Factors ... 204
Table 15: Prüfung der Normalverteilung ... 205
Table 16: Correlates of Fatness ... 206
Table 17: Parameter Estimates of the Non-Linear Regression ... 212
Table 18: Distribution of the Respondent Subgroups ... 262
Table 19: Analysis of Variance of Professional Expertise ... 266
Table 20: Correlates of Professional Fatness Ratings ... 270
Table 21: Correlates of Tonality Parameters and Perceived Fatness ... 279
Table 22: Correlates among the Tonality Parameters ... 279
Table 23: Selected Correlates of Momentary Fatness ... 294
Table 24: Table 24: Selected Correlates of Loudness ... 296
Table 25: Selected Correlates of the Spectral Centroids ... 298
Table 26: Regressions of Selected Factors of Tonality and Harmonicity ... 302
Table 27: Correlates of Selected Spectral Parameters ... 304
Table 28: Regressions of Selected Spectral Parameters ... 305
Table 29: Regression of Integrated Fatness ... 308
Table 30: Exemplary DJ-Set ... 337

Experimental Instructions: "DJs"

Dear participant,

Thank you very much for helping me with my doctoral study. Your data and responses will, of course, be used exclusively for scholarly purposes and will under no circumstances be made accessible to third parties. Data protection is guaranteed.

With your responses, you are contributing to the first detailed and comprehensive musicological study of modern popular dance music in general, and of the role of bass within it in particular. Club culture and African American music have unfortunately been underrepresented in musicology so far; let us change that together.

About the experiment:

You have received a link to an audio file on the Mixcloud platform and an Excel form from me by email. The audio file consists of 100 short excerpts from the history of club culture since 1960. Please listen through this file and rate the excerpts using the form. Use the sound system on which you would also assess music professionally, at an appropriate listening volume. Please pay close attention to the announced listening-example numbers. You may take breaks at any time; the only important point is that you maintain the given order.

.

1) Liking: "I like this song"

   Here, liking refers to how much you like the respective piece. This is independent of style and refers only to this particular piece. A spontaneous assessment is sufficient.

2) Taste: "I like this style"

   Here, taste refers to how much you like the general musical style, independently of the respective piece. Again, a spontaneous assessment is sufficient.
   This distinction is important in order to make it possible to express, for example, the following situations:
   "I generally like *House* music, but I do not like this track at all."
   "I find *Hip Hop* awful, but I like this song."

3) Modernity: "This piece sounds modern"

   Modernity here refers to the perceived sonic modernity. As a point of orientation: the tracks are from the years 1960 to 2019. The aim is not to estimate the year of release correctly, but to record your individual impression of a modern or non-modern sound image. Here, too, a spontaneous assessment is sufficient.

4) Fatness: “The bass in this track sounds fat”

> The fatness of a sound describes its capacity, in a dance-music context, for example in a club, to produce a positive bass experience. In colloquial terms: how fat a track sounds. Please assess as precisely as possible, based on your expertise as a DJ, music journalist, or similar professional, the extent to which this bass corresponds to your idea of good dance-music bass.

All ratings are given on a scale from 0 to 10, with 0 being low and 10 being high. Please try to make your ratings as if this scale were continuous. Zero describes the absence of what you are rating; ten describes the absolute maximum. The values in between should represent the gradations as evenly as possible..

Please also complete the short demographic section and return the fully completed form by Sunday, 4 October, to #########@gmail.com.

Enjoy, and thank you very much for your help.

Lars Schmedeke (M.A.)
Musikwissenschaftliches Institut
Universität Hamburg

Discography

Alphabetical by Artist

Artist	Titel	Year	Form.	Label
2 Life Crew	Me so horny	1989	12"	Luke Skywalker
50 Cent	P.I.M.P.	2003	12"	Shady Records
Afrika Bambaataa & The Soulsonic Force	Planet Rock	1982	12"	Tommy Boy
Afriquoi	Kudaushe	2015	Digital	Wormfood
Age of Love	Age of Love	1992	12"	Diki
Alexander Robotnick	Problèmes d'Amour	1983	12"	Fuzz Dance
Althea & Donna	Uptown Top Ranking	1977	7"	Joe Gibbs
Artifacts , The	Wrong Side of da Tracks	1994	12"	Big Beat
Astrix	Deep Jungle Walk	2016	Digital	HOM-Mega Productions
Average White Band	Pick Up The Pieces	1974	7"	Atlantic
Avicii	Levels	2011	12"	Universal
Ayers, Roy	Running Away	1977	12"	Polydor
Ballard, Hank & the Midnighters	The Twist	1959	7"	King Records
Balvin, J	Mi Gente	2017	Digital	Scorpio
Banton, Buju	Champion	1994	7"	Penthouse
Basic Channel	Radiance	1994	12"	Basic Channel
Beckford, Theophilius	Easy Snapping	1959	7"	Woldisc
Bee Gees, The	Staying Alive	1977	7"	RSO
Berry, Maleek	Kontrol	2016	Digital	Berry's Room
Beyoncé ft. Jay-Z	Drunk in Love	2013	LP (Beyoncé)	Parkwood / Columbia
Blackstones, The	One more Time	na	7"	Studio One
Blondie	Rapture	1980	7"	Chrysalis
Booker T. & the M.G.'s	Green Onions	1962	7"	Stax
Boothe, Ken	Everythin I own	1974	7"	Trojan
Boymarang	Soul Beat Runna	1997	12"	Regal
Brown, Barry	Dance Tonight	na	7"	Studio One
Brown, James	Sex Machine	1975	7"	Polydor
Brown, James	Funky Drummer	1970	7"	Polydor
Brown, James	Get on the Good Foot	1972	7"	Polydor

Artist	Titel	Year	Form.	Label
Brown, James and the Famous Flames	Papa's got a brand new bag	1964	7"	King Records
BT Express	Do it till your Satisfied (Disco Mix)	1974	7"	Roadshow
Bucket Heads	The Bomb	1994	12"	Universal
Buraka Som Sistema	Kalemba (Wegue Wegue)	2008	Digital	Sony BMG
Burna Boy ft. J Hus	Sekkle Down	2018	Digital	Warner
Camelphat & Elderbrook	Cola	2017	Digital	Defected
Candido	Jingo	1977	12"	Salsoul
Cardi B	I like it	2018	Digital	Atlantic
Caterina & Silvio	Peppermint Twist	1962	7"	Decca
Channel X	Rave the Rhythm	1991	12"	Beat Box
Charley, Ray	Hit the Road Jack	1960	7"	HMV Pop
Chemical Brothers	Block Rockin' Beats	1997	12"	Virgin
Chic	Good Times	1979	7"	Atlantic
Chubby Checker	The Twist	1960	7"	Parkway
Collins, Lynn	Think	1972	7"	People
Contours, The	Do you Love me	1962	7"	Motown
Culture	See dem Come	1977	12"	Joe Gibbs
Culture	Two Sevens Clash	1977	12"	Joe Gibbs
Cybotron	Clear	1983	12"	Fantasy
Cypress Hill	Insane in the Brain	1993	12"	Columbia
Daddy Yankee	Gasolina	2004	12"	Polydor / Universal
D'Banj	Oliver Twist	2012	Digital	Mercury
Dee, Joey & the Starlighters	Peppermint Twist	1962	7"	Roulette
Delerium ft. Sarah McLachlan, Sarah	Silence (Tiësto In Search Of Sunrise Remix)	1999	12"	Nettwerk
Der Dritte Raum	Alienoid	1996	12"	Harthouse
Desiigner	Panda	2015	Digital	self published
Destiny's Child	Survivor	2001	12"	Columbia
Digital Mystikz feat. Spen G	Anti-War Dub	2006	Digital	DMZ
Dillinger	Dub Organiser	1973	7"	Upsetter
Dillion, Phyllis	Don't Stay Away	1967	7"	Treasure Isle
Dizzee Rascal	Bonkers	2009	12"	Dirty Stank Records

Artist	Titel	Year	Form.	Label
DJ Cam ft. Afu Ra	Voodoo Child (DJ Premier Re-mix)	2000	12"	Inflammable
Dj DJ Vibes	Sing it Loud	1993	12"	Asylum
DJ Snake ft. Lil John	Turn Down for What	2014	Digital	Mercury
DJ Snake ft. MØ	Lean On	2015	Digital	Mad Decent
Doctor P	Sweet Shop	2009	12"	Circus Records
Double Exposure	Ten Percent (Special 12" Disco Mix)	1976	12"	Salsoul
Douglas, Carl	Kung Fu Fighting	1974	7"	20th Century Records
Douster	King of Africa	2009	Digital	Mental Groove
Drake ft. Wizkid & Kyla	One Dance	2016	Digital	Young Money
Dunkley, Errol	Love is in the House	1982	7"	Midnight Rock
El General	Pu Tun Tun	1991	12"	Gold Disc
Ellis, Alton	I'm Stylel in Love	1967	7"	Studio One
Eminem	Stan	2000	12"	Aftermath
Eric B. & Rakim	Don't sweat the Technique	1992	12"	RCA Records
Euromasters	Alles Narr de Klote	1992	12"	Rotterdam Records
Eve	Who's That Girl	2001	12"	Interscope
Farley Jackmaster Funk & Jesse Saunders	Love can't turn around	1986	12"	Trax Records
Fatback Band, The	Your my Candy Sweet / King Tim III (Personality Jock)	1979	7"	Spring Records
Fisher	Losing it	2018	Digital	Catch & Release
Flosstradamus	Mosh Pit	2015	Digital	Ultra Records
Flux Pavilion	I can't Stop	2010	Digital	Circus Records
Folkes Brothers, The	Oh Carolina	1960	7"	Buster
Fonzy, Luis & Daddy Yankee	Despacito	2017	Digital	Universal
Franklin, Aretha	Respect	1967	7"	Atlantic

Artist	Titel	Year	Form.	Label
Freestylers feat Tenor Fly	B-Boy Stance	1998	12"	Freskanova
Fuse ODG	Azonto	2014	Digital	Off Da Ground
Gangstarr	Full Clip	1999	12"	Noo Trybe Records
Gardner, Taana	Hearbeat	1981	7"	West End Records
Gaynor, Gloria	Never can say goodbye	1974	7"	MGM
Ginuwine	Pony	1996	12"	550 Music
Goldie	Inner City Life	1994	12"	Metal Heads
Grandmaster Flash	The Adventures of Grandmaster Flash on the Wheels of Steel	1981	12"	Sugarhill
Grandmaster Flash & The Furious 5	The Message	1982	12"	Sugarhill
Guetta, David ft. Rowland, Kelly	When Love takes Over	2009	Digital	Astralwerks
Harriot, Derrick	Lollipop Girl	1960	7"	Duke Reid
Harris, Calvin ft. Williams, Pharrel, Perry, Katie & Big Sean	Feels	2017	Digital	Columbia
Heptones, The	Mama, let me go	1967	7"	Coxsone
High Contrast	Racing Green	2004	12"	Hospital Records
Hinds, Justin & The Dominoes	Carry Go Bring Come	1963	7"	Treasure Isle
Holt, John	I need a Love I can feel	1970	7"	Studio One
Hooker, John Lee	Boom Boom Boom	1961	7"	Vee-Jay
Incredible Bongo Band, The	Apache	1973	LP (Bongo Rock)	MGM
Inner City	Big Fun	1988	12"	10 Records
Iron Butterfly	In-A-Gadda-Da-Vida	1968	LP	ATCO
Jackson 5, The	Want you back	1969	7"	Motown
Jackson, Michael	Billie Jean	1982	7"	Epic
Jackson, Willis	Later Gator	1957	7"	ATCO
James, Etta	Something's got a hold on me	1962	7"	Chess
Jamie Principle	Your Love	1986	12"	Persona Records
Jays, The	Hug & Kiss	na	7"	Studio One

Artist	Titel	Year	Form.	Label
Jefferson, Marshall	Move your Body	1986	12"	Trax Records
Jesse	On and on	1984	12"	Jes Say
Jiving Juniors, The	Lollypop Girl	1960	7"	Duke Reid
Jjames, Bob	Take me to the Mardi Gras	1975	7"	CTI Records
JM Silk ft. Steve „Silk" Hurley	Jack your Body	1987	12"	Underground
Jo Jo Mac	Good Girl gone Bad	na	7"	Studio One
Joy Orbison	Hyph Mngo	2009	Digital	Hotflush
Kamoze, Inie	Here come the Hotstepper (Heartical Mix)	1994	12"	Columbia
Kiesza	Hideaway	2014	Digital	Island
King, Diana	Shy Guy	1994	12"	Work
Koffee	Toast	2017	Digital	Columbia
Kollektiv Turmstraße	Holunderbaum	2008	EP	Musik Gewinnt Freunde
Konshens	Couple Up	2012	Digital	Ranch Entertainment
Kool & The Gang	Jungle Boogie	1975	7"	Polydor
Kraftwerk	Autobahn	1974	LP	Vertigo
Kraftwerk	Ralf & Florian	1973	LP	Philips
Kraftwerk	Numbers	1981	7"	Warner
Kraftwerk	Metall auf Metall	1977	LP (Trans-euro-paext-ress)	Capitol
Kraftwerk	Transeuropaexpress	1977	LP (Trans-euro-paext-ress)	Capitol
Krug, Manfred	Twist in der Nacht	1963	7"	AMIGA
Kurtis Blow	Christmas Rappin'	1979	7"	Mercury
Lady Sovereign	Love me or hate me	2006	12"	Def Jam
Le Chats Sauvages Avec Dick Rogers	Twist A Saint-Tropez	1962	7"	Pathé
Leftfield	Not Forgotten	1991	12"	Outer Rhythm
Levy, Barrington	Here I Come	1984	12"	Time 1

Artist	Titel	Year	Form.	Label
Little Roy	Hard Fighter / Voo-Doo	1971	7"	Bigshot
LMFAO ft. Lauren Bennet & GoonRock	Party Rock Anthem	2011	12"	Party Rock
Macklemore & Lewis, Ryan ft. Wanz	Thriftshop	2013	Digital	Macklemore LLC
Magic System	Premier Gaou	2001	12"	Next Music
Major Lazer feat The Flexican, FS Green & Busy Signal	Watch out for this (Bumaye)		Digital	Mad Decent
Major Lazer ft. Vybz Kartel	Pon de Floor	2009	12"	Mad Decent
Manu Dibango	Soul Makossa	1972	7"	Fiesta
Marley, Bob & the Wailers	Could you be loved	1980	7"	Tuff Gong / Island Records
Marley, Bob & the Wailers	Buffallo Soldier	1983	7"	Tuff Gong / Island Records
Marley, Bob & The Wailers	Talkin' Blues	1991	LP	Tuff Gong
Marley, Damian	Welcome to Jamrock	2005	7"	Ghetto Youths
Mars, Bruno	Uptown Funk	2014	Digital	Columbia
Mars, Bruno	24k Magic	2016	Digital	Atlantic Records
Marvin Gaye	What going on	1971	LP	Motown
Maurizio	M7	1997	12"	Maurizio
Mayfield, Curtis	Move on Up	1971	7"	Buddha Records
M-Beat ft. General Levy	Incredible	1994	12"	Renk
McRae, Gwen	Funky Sensation	1981	12"	Atlantic
Megan Thee Stallion	Body	2020	Digital	300 Entertainment
Meters, The	Cissy Strut	1969	7"	Josie
MHD	Afro Trap Part. 7 (La Puissance)	2015	LP (MHD)	Artside
Miami Sound Machine	Conga	1985	12"	Epic
Mobb Deep	Shook Ones pt.2	1994	12"	Loud
Model 500	No UFOs	1985	12"	Metroplex
Mos Def	Ms. Fat Booty	1999	12"	Rawkus

Artist	Titel	Year	Form.	Label
N.O.R.E., Daddy Yankee & Nina Sky	Oye mi Canto	2004	12"	Roc-A-Fella
N.W.A.	Straight outta Compton	1988	LP (Straight outta Compton)	Ruthless
N.W.A.	Express Yoursef	1988	LP (Straight outta Compton)	Ruthless
Nas feat Hill, Lauryn	If I ruled the World (Imagine That)	1995	12"	Columbia
Naughty by Nature	Hip Hop Hooray	1992	12"	Tommy Boy
Neophyte	Recession	1998	12"	Rotterdam
Nina Simone	My Baby just cares for me	1958	LP	Bethlehem
Notorious B.I.G.	Hypnotize	1997	12"	Bad Boy
Olatunji, Babatunde	Jingo-lo-Ba	1959	LP (Drums of Passion)	Columbia
Pablo, Augustus	King Tubby meets Rockers Uptown	1973	7"	Island
Paragons, The	The Tide is High	1969	7"	Treasure Isle
Parliament	Flashlight	1977	7"	Cassablanca
Paul van Dyk	For an Angel	1998	12"	MFS
Pete Rock & C.L. Smooth	T.R.O.Y. (They Reminisce over You)	1992	12"	Elektra
Prodigy, The	Charly	1990	12"	XL Records
Prodigy, The	Out of Space	1992	12"	XL Records
Project Phuture	Acid Trax	1988	12"	Trax Records
Public Enemy	Don't believe the Hype	1988	7"	Def Jam
Queen of Nile	Young Holt Unlimited	1971	LP (Born Again)	Cotillion
RAF Camora & Bonez MC	Nie ohne mein Team	2016	Digital	Auf!Keinen!Fall!
Reese	Just another Chance	1988	12"	Incognito
Reese & Santonio	The Sound	1987	12"	KMS

Artist	Titel	Year	Form.	Label
Reggie Rockstone	Makaa Makaa	1997	LP	Kassa Records
Reprazent	Brown Paper Bag	1997	12"	Talkin' Loud
Rhythim is Rhythim	Nude Photo	1987	12"	Transmat
Rick Ross ft. Styles P	B.M.F.	2010	12"	Def Jam
Rihanna ft. Drake	Work	2016	Digital	Roc Nation
Rivera, Hector	At the Party		7"	Barry's
Rodriguez, Pete	I like it like that	1967	7"	Alegre
Rufus & Chaka Khan	Ain't nobody	1983	12"	Warner
Run DMC	Walk this Way	1986	7"	Def Jam
Run DMC	My Adidas / Peter Piper	1986	7"	Def Jam
Ruth, Babe	The Mexican	1973	LP (First Base)	Harvest
Sam & Dave	You don't know what that woman has done for me	1968	7"	Atlantic Records
Sam & Dave	Soul Man	1967	7"	Stax
Santana	Jingo	1969	LP (Santana)	Columbia
Scot-Heron,Gil	The Revolution will not be televised	1971	7"	Flying Dutchman
Sean Paul	Get Busy	2002	7"	40 / 40
Sean Paul	Like Glue	2002	7"	K-Licious
Second Phase	Mentasm	1991	12"	R&S Records
Shabba Ranks	Dem Bow	1990	7"	Digital-B
Sheeran, Ed	Shape of You	2017	Digital	Asylum
Shimon, & Andy C.	Body Rock	2001	Digital	RAM
Shpongle	Divine Moments of Truth	2000	12"	Twisted
Sibold, Konstantin	Mutter	2016	Digital	Running Back
Singuila	Ay Mama	2017	Digital	Secteur Ä
Skrillex	Bangarang ft. Sirah	2011	12"	Big Beat
Sly and the Family Stone	Thank You (Fallentinme Be Mice Elf Again)	1969	7"	Epic
Smith, Wayne	Under me Sleng Teng	1985	7"	Jammys
Snap!	The Power	1990	12"	Ariola
Snoop Dogg	Drop it like it's hot	2004	12"	Geffen

Artist	Titel	Year	Form.	Label
Snoop Doggy Dogg	What's my name?	1993	12"	Death Row Records
Soul II Soul	Back to Life	1989	7"	10 Records
Studio 1	Lila	1996	12"	Studio 1
Sugarhill Gang, The	Rapper's Delight	1979	12"	Sugarhill
Summer, Donna	I Love to love you baby	1975	LP	Oasis
Summer, Donna	I feel Love	1976	LP (I remember yesterday)	Cassablanca
Supremes, The	How long has that evening Train been gone	1968	LP (Love Child)	Motown
Supremes, The	You just keep me hanging on	1966	7"	Motown
Supremes, The	Can't Hurry Love	1966	7"	Motown
Temptations, The	Papa was a rolling Stone	1972	7"	Gordy
The Beginning of the End	Funky Nassau	1971	7"	Alston
The Rock Steady Crew, The	(Hey You) The Rock Steady Crew	1983	7"	Charisma
Tony Rebel	If Jah	1997	12"	Flames
Tony Rebel & Swade	Just Friends	2001	7"	Techniques
Tropkillaz vs. Snavs	Que Pasa Amigos	2015	Digital	Elemes
Tropkillaz vs. Snavs ft. Fatman Scoop	Here we go now	2014	12"	self published
UK Apachi with Shy FX	Original Nuttah	1994	12"	SOUR
Uniques, The	My Conversation	1968	7"	Lee's
Upsetters, The	Black Board Jungle / Upsetter 14 Dub	1973	LP	Upsetter
U-Roy & Holt, John (Paragons)	Wear you to the Ball	1964	7"	Treasure Isle
Usher feat. Lil John & Ludacris	Yeah	2003	Digital	Arista
van Buuren, Armin	Communication	1998	12"	Cyber Records
Various Artists	Yamaha Skank	1974	LP	Sucess Dico
Various Artists	Diwali Riddim	2002	LP	Greensleaves / 40/40
Various Artists	Disco Pa-r-r-ty	1974	LP	Spring Records

Artist	Titel	Year	Form.	Label
Various Artists	Techno! The New Dance Sound of Detroit	1988	LP	Virgin
Villalobos, Ricardo	Easy Lee	2015	Digital	Sei Es Drum
Vybz Kartel feat. Spice	Romping Shop	2009	Digital	Tad's
Wailers, The	Simmer Down	1964	7"	Coxsone
Wailers, The	Trenchtwon Rock	1971	7"	Tuff Gong
Wailers, The	Duppy Conqueror	1970	7"	Upsetter
Wamdue Project	King of my Castle	1998	Digital	Strictly Rhythm
Warren G & Nate Dogg	Regulate	1994	12"	Death Row Records
Whispers, The	It's a Love Thing	1980	12"	Solar
Wiley ft. Devlin	Bring them All	2017	Digital	CTA Records
Wiley, Stefflon Don & Sean Paul feat Idris Elba	Boasty	2019	Digital	BMG
Wilson, Jackie	(Your Love keep lifting me) Higher and Higher	1967	7"	Brunswick
Wilson, Jackie	Reet Petite (The Finest Girl You Ever Want to Meet)	1957	7"	Coral
Winstons, The	Amen Brother	1969	7"	Metromedia Records
Wonder, Stevie	I'd be a fool right now	1968	7"	Motown
Wonder, Stevie	Uptight (Everything is allright)	1965	7"	Tamla
Wonder, Wayne	No Letting Go	2002	7"	40 / 40
Wright, Charles & the Watts 103rd Street Rhythm Band	Express Yoursef	1970	7"	Warner
Yellow Claw ft. Rochelle	Shotgun	2013	Digital	Spinnin' Records
Zion Train	Follow like Wolves	1994	12"	Universal Egg
Zomboy & Must Die	Survivors	2014	Digital	Nest HQ

Trainingssample Reference

#	Song	BPM	Style	Label	Year	Format
1	2Life - Crew - Me so Horny	128	Hip Hop	Luke Skywalker	1989	12"
2	Afrika Bambaataa - Planet Rock	126	Hip Hop	Tommy Boy	1982	12"
3	Age of Love - Age of love (Jam & Spoon Remix)	130	EDM	React	1992	12"
4	Althea & Donna - Uptown Top Ranking	79	Reggae	Joe Gibbs	1978	7"
5	Aretha Franklin - Respect	114	Soul	Atlantic Records	1967	7"
6	Augustus Pablo - Rockers Uptown	66	Reggae	Island Records	1973	12"
7	Avicii - Levels (Original Mix)	126	EDM	Universal	2011	Dig.
8	Barrington Levy - Here I Come	85	Tropical	Time 1	1984	12"
9	Bee Gees - Staying Alive	103	Soul	RSO	1977	7"
10	Bruno Mars - 24k Magic	107	Hip Hop	Atlantic Records	2016	Dig.
11	Bucket Heads - The Bomb	126	EDM	Universal	1994	12"
12	Buju Banton - Champion	90	Tropical	Penthouse	1994	7"
13	Buraka Som Sistema - Kalemba (Wegue-Wegue) (feat. Pongolove)	140	Tropical	Sony BMG	2008	Dig.
14	CamelPhat & Elderbrook - Cola	122	EDM	Defected	2017	Dig.
15	Candido - Jingo	120	Soul	Salsoul	1977	12"
16	Cardi - I Like It (feat. Bad Bunny & J Balvin)	68	Hip Hop	Atlantic	2018	Dig.
17	Chaka Khan - Ain"t nobody	104	Soul	Warner	1983	12"
18	Charles Wright - Express Yourself	92	Soul	Warner	1970	7"
19	Chubby Checker - The Twist	76	Soul	Ariola	1961	7"
20	Culture - Jah Jah see dem a come	74	Reggae	Joe Gibbs	1977	12"
21	Cybotron - Clear	125	EDM	Fantasy	1983	12"
22	Cypress Hill - Insane in the Brain	102	Hip Hop	Columbia	1993	12"
23	D"Banj - Oliver Twist	125	Tropical	Mercury	2012	Dig.
24	DJ Snake & Lil Jon - Turn Down for What	100	Hip Hop	Mercury	2014	Dig.
25	Daddy Yankee - Gasolina	96	Tropical	Universal	2004	Dig.
26	Damian Marley - Welcome to Jamrock	77	Tropical	Ghetto Youths	2005	7"
27	David Guetta - When Love Takes Over (feat. Kelly Rowland)	130	EDM	Astralwerks	2009	Dig.
28	Dig. Mystikz - Anti War Dub (feat. Spen G)	72	EDM	DMZ	2006	Dig.
29	Donna Summer - I feel Love	127	EDM	Cassablanca	1977	7"

#	Song	BPM	Style	Label	Year	Typ
31	Eve - Who's that Girl	96	Hip Hop	Interscope	2001	12"
32	Fifty Cent – P.I.M.P.	85	Hip Hop	Interscope	2003	Dig.
33	Fisher - Losing It (Extended Mix)	125	Electronica	Catch & Release	2018	Dig.
34	Flux Pavilion - I Cant Stop	70	Electronica	Circus Records	2010	Dig.
35	Gang Starr - Full Clip	95	Hip Hop	7 Grand Records	1999	12"
36	Grandmaster Flash - The Message	101	Hip Hop	Sugarhill	1982	12"
37	Hector Rivera - At the Party	92	Soul	Barry's	1966	7"
38	Heptones - Mama	78	Reggae	Studio One	1968	7"
39	High Contrast - Racing Green	173	EDM	High Contrasting	2004	Dig.
40	Inner City - Big Fun	120	EDM	10 Records	1988	12"
41	J Balvin - Mi Gente	105	Tropical	Scorpio	2017	Dig.
42	James Brown - Papa's got a brand new bag	127	Soul	King	1965	7"
43	John Holt - A Love I can feel	70	Reggae	Studio One	1970	7"
44	Justin Hinds - Carry Go bring come	123	Reggae	Treasure Isle	1963	7"
45	Kevin Saunderson - Rock your Body	122	EDM	Boy Records	1986	12"
46	Kiesza - Hideaway	123	EDM	Island Records	2014	Dig.
47	Koffee - Toast	100	Tropical	Columbia	2017	Dig.
48	Kollektiv Turmstrasse - Holunderbaum	128	EDM	Musik gewinnt Freunde	2008	Dig.
49	Konstantin Sibold - Mutter	129	EDM	Running Back	2016	Dig.
50	Kool and the Gang - Jungle Boogie	106	Soul	Polydor	1975	7"
51	Kraftwerk - Transeuropa Express	108	EDM	Kling Klang	1977	7"
52	Leftfield - Not forgotten	120	EDM	Outer Rhythm	1991	12"
53	M-Beat - Incredible	165	EDM	Renk	1994	12"
54	Macklemore - Thrift Shop	95	Hip Hop	Macklemore LLC	2013	Dig.
55	Magic System - Premier Gaou	119	Tropical	Next Music	1999	Dig.
56	Major Lazer - Watch Out For This (Bumaye) (feat. The Flexican, FS Green, Busy Signal)	108	Tropical	Mad Decent	2013	Dig.
57	Maleek Berry - Kontrol (Extended)	114	Tropical	Berry's Room	2016	Dig.
58	Manu Dibango - Soul Makossa	115	Soul	Fiesta	1972	12"
59	Maurizio - M7	124	EDM	Maurizio	1997	12"
60	Mhd - Afro Trap Part.7 (La Puissance)	120	Tropical	Artside	2016	Dig.
61	Miami Sound Machine - Conga Dance Mix	123	Tropical	Epic	1985	12"
62	Michael Jackson - Billie Jean	123	Soul	Epic	1982	7"
63	Nas - If I ruled the World	95	Hip Hop	Columbia	1995	12"
64	Naughty by Nature - Hip Hop Hooray	99	Hip Hop	Tommy Boy	1992	12"

#	Song	BPM	Style	Label	Year	Typ
65	Notorious BIG - Hypnotize	94	Hip Hop	Bad Boy Records	1997	12"
66	Parliament - Flashlight	106	Soul	Cassablanca	1976	12"
67	Paul van Dyk - For An Angel (PvD E-Werk Club Mix)	139	EDM	MFS	1998	12"
68	Pete Rock & CL Smooth - They Reminisce over You (T.R.O.Y.)	102	Hip Hop	Elektra	1992	12"
69	Phyllis Dillion - Don't stay away	101	Reggae	Treasure Isle	1967	7"
70	Prodigy - Out of Space	147	EDM	XL Records	1992	12"
71	Ray Charles - Hit the Road Jack	86	Soul	HMV Pop	1960	7"
72	Reese and Santonio - The Sound (Smoothe Mix)	116	EDM	KMS	1987	12"
73	Reprazent - Brown Paper Bag (Full Rap Re-mix)	170	EDM	Talkin' Loud	1997	12"
74	Rick Ross - Blowin Money Fast (BMF) (feat. Styles P)	70	Hip Hop	Def Jam	2010	Dig.
75	Rihanna - Work (feat. Drake)	92	Hip Hop	Roc Nation	2015	Dig.
76	Run DMC - My Adidas	90	Hip Hop	Def Jam	1985	12"
77	Sam & Dave - Soul Man	115	Soul	Atlantic	1967	7"
78	Sean Paul - Like Glue	99	Tropical	K-Licious	2003	7"
79	Shimon & Andy C - Bodyrock	173	EDM	RAM	2001	Dig.
80	Skrillex - Bangarang (feat. Sirah) (Original Mix)	110	EDM	Big Beat	2011	Dig.
81	Sly & The Family Stone - Thank You	106	Soul	Epic	1967	7"
82	Snap - The Power	109	EDM	Ariola	1990	12"
83	Snoop - What's my name	96	Hip Hop	Death Row	1993	12"
84	Snoop Dogg - Drop it like it"s Hot	92	Hip Hop	Geffen	2004	12"
85	Soul II Soul - Back to Life (Jam)	101	EDM	Epic	1989	12"
86	Sugarhill Gang - Rappers delight	110	Hip Hop	Sugarhill	1978	12"
87	The Beginning of the End - Funky Nassau	120	Soul	Alston	1971	7"
88	The Contours - Do you love me	76	Soul	Gordy	1962	7"
89	The Jackson 5 - Want you Back	97	Soul	Motown	1969	7"
90	The Rocksteady Crew - (Hey You) The Rock-steady Crew	115	Hip Hop	Charisma	1983	7"
91	The Supremes - Can't Hurry Love	98	Soul	Motown	1966	7"
92	Tony Rebel - If Jah	79	Tropical	Flames	1997	12"
93	U-Roy & John Holt - Wear you to the ball	96	Reggae	Treasure Isle	1964	7"
94	Usher - Yeah! (feat. Lil Jon & Ludacris)	106	Hip Hop	Arista	2007	Dig.
95	Vybz Kartel - Romping Shop (feat. Spice)	86	Tropical	Tad's	2009	Dig.
96	Wamdue Project - King Of My Castle	127	EDM	Strictly Rhythm	1998	Dig.

#	Song	BPM	Style	Label	Year	Typ
97	Wayne Smith -Sleng Teng	82	Tropical	Witty	1985	12"
98	Whispers - Love Thing	117	Soul	Solar	1980	12"
99	Wiley, Stefflon Don & Sean Paul - Boasty (feat. Idris Elba)	102	Tropical	BMG	2019	Dig.
100	Zion Train - Follow like Wolves	130	EDM	Universal Egg	1994	12"

Style entspricht dem in Grafiken farbcodierten Style

Typ entspricht dem Tonträgertyp

7" :7" Single

12" :12" Maxi-Single

Dig. :Digitaler Tonträger

Test Sample (B) reference

#	Track	BPM	Style	Label	Year
1	2Pac - California Love	92	Hip Hop	Death Row	1995
2	A Guy called Gerald - Voodoo Ray (Original 12" Mix)	119	EDM	Warlock	1988
3	Afriquoi - Kudaushe	127	Tropical	Wormfood	2015
4	Alton Ellis - I'm Just A Guy	80	Reggae	Studio One	1967
5	Anthony Red Rose - Tempo	81	Tropical	Firehouse	1985
6	Armand Van Helden – The Funk Phenomena (Original)	127	EDM	Henry Street	1996
7	Armin van Buuren - Communication	135	EDM	Cyber Records	1999
8	Arrow - Hot Hot Hot	120	Tropical	Chrysalis	1982
9	Arthur Conley - Sweet Soul Music	80	Soul	Atlantic	1967
10	Barrington Levy - Under Mi Sensi	75	Reggae	Time 1	1985
11	Basic Channel - Phylyps Track II	128	EDM	Basic Channel	1994
12	Beenie Man - Romie	91	Tropical	Vibes House	1997
13	Ben E. King - Stand By Me	60	Soul	ATCO	1961
14	Benny Page - Turn Down the Lights	175	EDM	Digital Sound-boy	2006
15	Bill Withers - Lovely Day	98	Soul	CBS	1977
16	Black Sheep - The Choice Is Yours (revisited)	101	Hip Hop	Mercury	1991
17	Bomb The Bass Beat Dis (Extended Dis)	114	EDM	Mister-Ron	1988
18	Boymerang - Soul Beat Runna	168	EDM	Regal	1997
19	Calvin Harris feat. Pharrell Williams, Katy Perry and Big Sean - Feels	101	Hip Hop	Columbia	2017
20	Cardi B - Up	83	Hip Hop	Atlantic	2021
21	Chase & Status feat. IRah - Program	175	EDM	Virgin EMI	2019
22	Chic - Le Freak	119	Soul	Atlantic	1978
23	Chronixx - Here Comes Trouble	84	Tropical	Chronixx Music	2014
24	Crooklyn Clan - Be Faithful (Dirty Version)	101	Hip Hop	AV8	1999
25	Daft Punk - Around The World	121	EDM	Virgin	1996
26	Deadmau5 - Ghosts n Stuff (ft. Rob Swire)	128	EDM	Ultra Records	2009
27	Dennis Brown - Sitting And Watching	80	Reggae	Taxi	1979
28	Desiigner - Panda	73	Hip Hop	Def Jam	2016
29	Diana King - Shy Guy	94	Tropical	Work	1994
30	Diplo & SIDEPIECE - On My Mind	123	EDM	Higher Ground	2019
31	Drake - One Dance (feat. Wizkid & Kyla)	104	Tropical	Young Money	2016
32	Eric B. & Rakim - Don't Sweat the Technique	106	Hip Hop	MCA	1992
33	Faithless - Insomnia	127	EDM	Cheeky	1995
34	*Foxy Brown - Oh Yeah*	85	Hip Hop	Def Jam	2001
35	Freestylers - B-Boy Stance	106	EDM	Freskanova	1998
36	Funky 4 + 1 - That's The Joint	105	Hip Hop	Sugarhill	1980
37	Green Velvet, CamelPhat - Critical (Extended)	127	EDM	Sony	2021
38	Gwen McCrae - Funky Sensation	99	Soul	Atlantic	1981

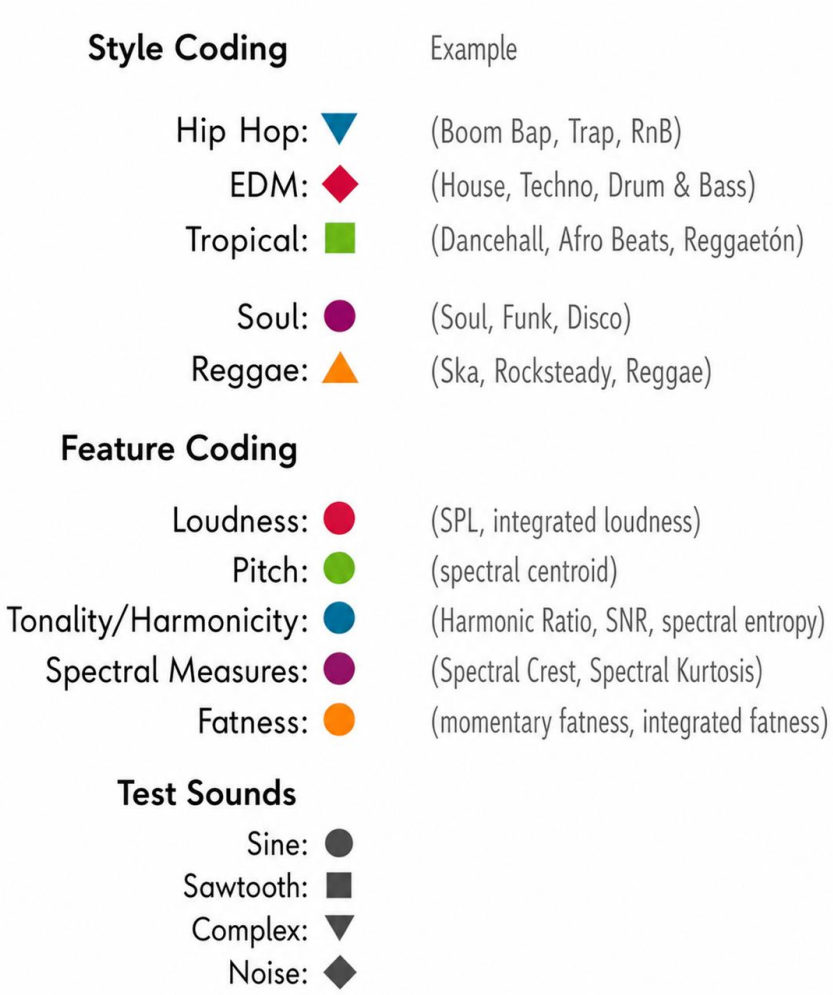
#	Song	BPM	Style	Label	Year
40	J Balvin & Bad Bunny - Como Un Bebe (featuring Mr. EAZI)	103	Tropical	Universal Music Latino	2019
41	Jackie Wilson - Reet Petite (The Finest Girl You Ever Want to Meet)	85	Soul	Coral	1957
42	James Brown - Get Up (I Feel Like Being A) Sex Machine	108	Soul	Polydor	1975
43	Jason Derulo feat. French Montana - Tip Toe	98	Hip Hop	Warner	2017
44	Jeff Mills - The Bells	138	EDM	Axis	1996
45	Jennifer Lopez - Jenny From The Block	100	Hip Hop	Epic	2002
46	Johnny Osbourne - Truths And Rights	80	Reggae	Studio One	1975
47	Joy Orbison - Hyph Mngo	140	EDM	Hotflush	2009
48	Kanye West - Gold Digger (featuring Jamie Foxx)	93	Hip Hop	Roc-A-Fella	2005
49	Kevin Lyttle feat. Spragga Benz - Turn Me On	106	Tropical	Atlantic	2003
50	Kurtis Blow - The Breaks	114	Hip Hop	Mercury	1980
51	LMFAO - Party Rock Anthem Featuring Lauren Bennett And Goonrock	130	EDM	Party Rock	2011
52	LTJ Bukem - Horizons	158	EDM	Looking Good	1995
53	Lee Perry & Mikey Dread - Dread at the Controls	66	Reggae	Black Art	1978
54	Linda Lyndell - What a Man	87	Soul	Volt	1968
55	Lynn Collins - Think	112	Soul	People	1972
56	Major Lazer & DJ Maphorisa feat. Nasty C, Ice Prince, Patoranking & Jidenna - Particula	100	Tropical	Mad Decent	2017
57	Major Lazer feat. MØ & DJ Snake - Lean On	98	Tropical	Mad Decent	2015
58	Martin Garrix - Animals	128	EDM	Spinnin'	2014
59	Marvin Gaye & Tammi Terrell - Ain't No Mountain High Enough	130	Soul	Tamla	1967
60	Megan Thee Stallion - Body	94	Hip Hop	300 Entertainment	2020
61	Million Stylez - Miss Fatty	82	Tropical	Bumpy Ride	2006
62	Missy Elliott - Work It	102	Hip Hop	Elektra	2002
63	Moby - Go	126	EDM	Instinct	1992
64	Montoya - Otun	106	Tropical	ZZK	2019
65	Mr. Vegas - Heads High	92	Tropical	Juvenile	1997
66	Musical Youth - Pass The Dutchie	75	Reggae	MCA	1982
67	N.W.A - Straight Outta Compton	103	Hip Hop	Ruthless	1988
68	Nadine Sutherland & Terror Fabulous - Action	96	Tropical	Mad House	1993
69	Nicky Minaj - Anaconda	65	Hip Hop	Young Money	2014
70	Nightcrawlers - Push The Feeling On (Mk Dub Revisited Edit)	123	EDM	Europe	1995
71	Notorious B.I.G. - Mo Money Mo Problems (feat. Mase & Puff Daddy)	104	Hip Hop	Bad Boy	1997
72	OutKast - Ms. Jackson	95	Hip Hop	La Face	2001
73	Phuture - Acid Trax	119	EDM	Trax	1988
74	Robert Miles - Children (Dream Version)	137	EDM	Deconstruction	1997
75	Roy Ayers - Running Away	115	Soul	Polydor	1977

#	Song	BPM	Style	Label	Year
77	Salt-N-Pepa - Whatta Man (featuring En Vogue)	87	Hip Hop	Next Plateau	1993
78	Sam Cooke - Twisting' The Night Away	80	Soul	RCA Victor	1960
79	Shannon - Let The Music Play (Original Full 12" Mix)	114	Hip Hop	Polydor	1983
80	Stevie Wonder - Superstition	101	Soul	Tamla	1972
81	Studio 1 - Lila 2	126	EDM	Studio 1	1996
82	Stylo G - Move Back	112	Tropical	AATW	2013
83	Taana Gardner - Heartbeat (Club Version)	97	Soul	West End	1981
84	Tanya Stephens - It's a Pity	70	Tropical	Germaican	2002
85	Tarrus Riley feat. Shenseea & Rvssian - Lighter	89	Tropical	Interscope	2020
86	Technasia & Green Velvet - Suga	125	EDM	Toolroom	2015
87	Tenor Saw - Ring the Alarm	85	Tropical	Techniques	1985
88	The Beatnuts - Watch Out Now	100	Hip Hop	Loud	1999
89	The Commodores - Brick House	108	Soul	Motown	1977
90	The Incredible Bongo Band - Apache	118	Soul	Pride	1973
91	The Jackson 5 - ABC	94	Soul	Motown	1969
92	The Meters - Cissy Strut	88	Soul	Josie	1969
93	The Paragons - The Tide Is High	95	Reggae	Treasure Isle	1969
94	The Temptations - My Girl	106	Soul	Tamla	1966
95	The Winstons - Amen Brother	131	Soul	Metromedia	1969
96	Thornato - Back It Up	119	Tropical	Wonderwheel	2018
97	Tiesto, 7 Skies, RebMoe - My Frequency (feat. RebMoe) (Extended Mix)	126	EDM	Musical Freedom	2020
98	Toots & The Maytals - 54-46 Was My Number	80	Reggae	Beverly's	1968
99	UK Apachi with Shy FX - Original Nuttah	170	EDM	SOUR	1994
100	Wiz Khalifa - We Dem Boyz	65	Hip Hop	Atlantic	2014

All titles in test sample B were obtained and analysed in digital form.

Colours and Symbols

In order to ensure ease of comprehension, the graphics created for this dissertation are mostly colour-coded and, in some cases, also shape-coded. Exceptions are indicated in the respective figures. The following provides an overview of the colours and symbols used:



Statement on the Use of AI-Assisted Tools

The research, analysis, argumentation, structure, and original text of this dissertation were developed and written by the author between 2018 and 2021, prior to the widespread availability of large language models. AI-assisted tools were used subsequently in the preparation of this open-access English version.

DeepL and ChatGPT were used to assist with the translation of the author's own German text into English, language revision, and stylistic refinement. All AI-assisted output was reviewed, edited, and approved by the author. The author takes full responsibility for the final wording, scholarly content, references, interpretations, and conclusions.

In addition, two images from the submitted version for which open-publication rights could not be secured were replaced in this open-access version by AI-assisted illustrative images generated by the author. These replacement images are identified in the respective captions. No AI-assisted tool is credited as an author or contributor to the scholarly content of this dissertation.