

ORCHESTRATIONAL COMBINATIONS AND TRANSFORMATIONS IN OPERATIC AND SYMPHONIC MUSIC

by

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ABSTRACT

This dissertation encompasses research into the theory, practice, and perception of orchestration, and includes the creation of an original composition for symphony orchestra.

The research examines basic principles of orchestration, proposing and reviewing several new taxonomic categories designed to provide further insight into the underlying fundamental processes—instrumental combinations and transformations, and the perception of timbral structures—that operate as the building blocks of orchestration.

The research further explores various approaches learned, taught, and employed by composers to structure and shape the orchestration of their compositions, specifically 1) the relationships among the timbral properties of instruments in a musical work, and 2) the respective roles of these relationships in supporting and/or fashioning musical form.

Although in-depth research on the formal functions of pitch and rhythm has for generations occupied music theorists, research is scarce with regard to the form-bearing and structural implications of orchestration choices—both simultaneous (vertical) and successive (horizontal)—across the duration of a work. A taxonomic classification of these qualities establishes the basic principles upon which to build a theory of orchestration. Orchestration combinations and their respective orchestration transformations act as building blocks of musical structure; orchestration-based form can be understood as a large-scale implementation and prolongation of these combinations and transformations.

This dissertation is divided into two volumes: Volume I, research and analysis of works from the repertoire as well my original composition; Volume II, full score of my composition, *Overture*.

RESUME

Cette thèse englobe la recherche sur la théorie, la pratique et la perception de l'orchestration, et comprend la création d'une œuvre originale pour orchestre symphonique. La recherche se penche sur les principes de base de l'orchestration en proposant et en examinant plusieurs nouvelles catégories taxonomiques conçues pour fournir un meilleur aperçu des processus fondamentaux sous-jacents (les combinaisons et transformations instrumentales, et la perception des structures timbrales) qui agissent en tant qu'éléments constitutifs de l'orchestration.

La recherche explore en outre diverses approches apprises, enseignées et utilisées par les compositeurs pour structurer et façonner l'orchestration de leurs compositions, en particulier 1) les relations entre les propriétés timbrales des instruments dans une œuvre musicale, et 2) les rôles respectifs de ces relations dans le soutien ou le façonnage de la forme musicale.

Bien que des recherches approfondies sur la fonction formelle des hauteurs et du rythme occupent les théoriciens de la musique depuis des générations, les recherches sont rares en ce qui concerne les implications formelles et structurelles des choix pour une orchestration – à la fois simultanés (verticaux) et successifs (horizontaux) – sur la durée d'une œuvre. Une classification taxonomique de ces qualités établit les principes de base sur lesquels construire une théorie de l'orchestration. Les combinaisons orchestrales et leurs transformations orchestrales respectives agissent comme des éléments fondamentaux de la structure musicale ; la forme basée sur l'orchestration peut être appréhendée comme une mise en œuvre et une prolongation à grande échelle de ces combinaisons et transformations.

Cette thèse est divisée en deux volumes : Volume I, recherche et analyse des œuvres du répertoire ainsi que de ma composition originale ; Volume II, partition complète de ma composition, *Overture*.

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Chapter 4:

This chapter is based on orchestration and timbre-based research at the McGill Music Perception and Cognition Lab (MPCL), where I am a participant, first as a research assistant on Prof. Stephen McAdams' and Dr. Meghan Goodchild's Orchestration and Perception Project (2014-2017), and now as a student member and research assistant in the Analysis, Creation, and Teaching of Orchestration (ACTOR) Project (2017-present). In a forthcoming journal article, "A Taxonomy of Perceptual Effects of Orchestration Related to Auditory Grouping Principles" by McAdams, Goodchild, and Soden, the taxonomic concepts described below are explored in depth. Other contributors to this perception-based orchestration research include: Stephen Spencer, Moe Touizrar, Victor Cordero, Denys Bouliane, John Rea, Félix Baril, Lindsey Reymore, Chris Goddard, and Christina Volpini. I am the sole author of this chapter.

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INTRODUCTION

RESEARCH BACKGROUND

This dissertation presents the basic principles of orchestration as well as a taxonomic categorization drawn from the perspective of what occurs *simultaneously* and *successively* in an orchestration. By examining and isolating what transpires within a moment of musical time and comparing it with another moment of musical time within the same work, one can clarify its component elements: 1) the vertical relationship of musical material (what appears *simultaneously* in an orchestration) through the combining of the colours of instruments in rhythmic unison, or through orchestral textures—the texturization, so to speak—of instrumental colour in either co-equal or hierarchical roles, e.g., melody-accompaniment functions; and 2) the horizontal relationship of musical material (what emerges in *succession*) that can be understood and defined with regard to how instrumental—and therefore timbral (sound-colour)—properties within simultaneous events interact over time, and how they function together to build musical structures. The principal element in both simultaneous and successive combinations or contrasts concerns the correlations that are formed by the act of scoring instruments together in one moment or in one measure of time along with the overall duration of both a movement and a multi-movement work.

As much as composers employ pitch and rhythmic material in order to create musical structure, they also utilize instrumental¹ tone-colour (i.e., timbre) as a means to deliver these pitch materials. Instrument selection itself—in both the choice of ensemble or choice of instrument scored—creates initial relationships with the tone-colour (*Klangfarben*) properties of the other scored instruments across a work's duration. And such choices, alongside the mnemonic functions and recurrence of these *chroma* (colour/*Farben*) relationships, play important roles in supporting and shaping musical structure and form.

For the student of orchestration, surprisingly, critical information seems unavailable, such as an appropriate amount of clarity and elucidation within the pedagogy dealing with *successive*

¹ Electronics, in my characterization, are also considered a type of instrument.

relationships of orchestrations in musical works, as well as descriptions of how an orchestration develops, how its constituent elements relate over time. These are features that concern the actual writing of orchestral music, and therefore speak to an orchestration's impact upon musical form. In the introduction to his innovative book, *Creative Orchestration*, George Frederick McKay (1963) understandably laments: "Much has been written by theorists about the technicalities of instrumentation, but far too little has been said by the creative artists themselves about 'how' to write for the orchestra" (p. v). In my assessment this observation harbours the ring of truth since a vast majority of writings about orchestration seems to get bogged down in organology and instrumental technique, thus producing a large amount of literature on *simultaneous* events.

A THEORY OF ORCHESTRATION?

Although many composers and musicologists have defined the practice of orchestration through treatises that are still widely used today, no unified theory of orchestration currently exists (Goodchild & McAdams, 2018). Music theory as a discipline presently does not possess a systematic understanding of the role of timbre in music. And given the rarity of scholarly attention and focus paid to them in professional publications, the orchestrations of Mozart to Berlioz to Tchaikovsky to Mahler continue to be viewed, one might conclude, as being superfluous or subsidiary to the so-called primary parameters of pitch, harmony, and rhythm that continue to occupy researchers. It seems to me though that no music scholar, or music lover for that matter, would ever label the orchestrations of the masters as somehow being supplementary material. Yet from the analytical perspective of orchestration theory, and thereby of timbre theory, such orchestrations do appear to have been treated in this summary or inattentive way.

Such oversight may have been instigated curiously by none other than the orchestration experts themselves since authors from Berlioz to Rimsky-Korsakov to Piston insist upon the fact that orchestration is an unteachable art, and that "[t]o orchestrate is to create, and this is something which cannot be taught" (Rimsky-Korsakov, 1912, p. 2). This notion highlights the

fact that the classic pedagogical model for orchestration stems from an approach imbued with exemplar-based practices only.² As Piston (1969) writes in his book, *Orchestration*:

The composer or orchestrator who scores chords with consistent success from the standpoint of balance of tone, smooth blend of instrumental color, and appropriate dynamic effect, does so because of a reliable memory of the sound made by each instrument at any given pitch and dynamic level. He does not do so because of formulas and devices learned from books. (p. 444)

As noted, the methodologies of orchestration located in many treatises thus far tend to be exemplar-based—essentially recipes of combinations and proposed listening tasks (Goodchild & McAdams, 2018)—drawing their tokens from previous compositions, which illustrate the rationale and efficacy of particular instrumental choices or combinations of instruments.³ There exists no systematization of their conceptual constructs, nor an agreed-upon taxonomic qualification of orchestration terminologies that can be serviceable in a clear pedagogical and practical manner. For example, orchestration treatises have focused on the detailed knowledge of the art of combining instruments, yet they conflate methodologies and insight, say, when for many reasons they turn to the term “doubling” without addressing its polysemous character: the term currently functions as a descriptor for 1) the joining of pitches, 2) the joining of registers 3) the combinations of instrumental timbres, and 4) the rhythmic unison of a line. One must infer from various contexts to which kind of doubling an author refers.

This thesis therefore attempts to define and examine the basic concepts of orchestration. It proposes and explores several new taxonomic classifications of the art of orchestration, the classification of timbres, and the perception of timbral constructs. This clarifies the qualifications of orchestrational combinations and provides insight into the temporal qualities of orchestration,

² A Google search, in April 2020, revealed over 100 publicly available syllabi from North American and European Universities that subscribe to this approach or principle.

³ Although this exemplar-based approach has proved successful in the past—as seen and heard in the orchestral repertoire—it runs in contrast to the clear methodology and curriculum with which other facets of music are taught in the modern university setting.

that is, the transformations of these combinations and their roles in the creation of musical structures.

THE ORCHESTRA: INSTRUMENTATION AND ORCHESTRATION, A BRIEF HISTORY

L'emploi de ces divers éléments sonores et leur application soit à *colorer* la mélodie, l'harmonie et le rythme, soit à produire des impressions *sui generis* (motivées ou non par une intention expressive), indépendantes de tout concours des trois autres puissances musicales, constitue l'*art de l'instrumentation*. (Berlioz, 1844, p. 2)⁴
[my emphasis]

The improvement in the quality of wind instruments in the early nineteenth century (Carse, 1925, pp. 200–219; Dolan, 2013, Introduction) brought about a direct impact on musical art since composers began using groups of instruments, strings and winds for example, in contrasting sections where instrumentation fostered the design of dialogue-like figurations (Leibowitz & Maguire, 1960, p. 11). The colour contrast and exchange between string and wind sections offered a “greater scope of variety of colouring than the combination of the two bodies, more especially so at a time when composers hardly yet understood how to combine strings and wind except by uniting them in a common polyphony” (Carse, 2012, p. 98). Contrasting colours such as these stimulated the production of “(1) effects of unity and grandeur, and (2) effects of variety and nuance” (Spitzer & Zaslaw, 2004, p. 437), and helped influence and shape the evolving orchestral tradition.

Instrumentation and its application to the art of orchestration “brings about a clear and systematic grouping of the various instruments, with particular attention that the different tonal-colors are most effectively contrasted and blended, in order that a composition will be transmitted to the ear in an equally clear, concise, and pleasing manner” (Kling, 1905, p. 11). The re-colouring by the orchestra of a chord or of a tone, a present-day standard practice, was

⁴ English translation: “*The art of instrumentation* consists of the employment of these sound elements: either to give a particular color to melody, harmony and rhythm; or independently of these three great musical forces to produce special effects (which may, or may not, serve some purpose of expression).” (Berlioz, 1948, p. 2)

not always standard practice. Donington (1982) explains that formerly the instrumental colour, and thus orchestration, remained constant throughout longer sections or movements of music:

The commonest rule [in the seventeenth and eighteenth centuries] (it was not, of course, invariable) was to play long passages, or even whole movements, in one instrumental colouring or blend of colourings: then to change to some other colouring for a contrasted effect. But that is the exact opposite of the typical symphonic method evolved during the past two centuries, especially the late nineteenth. There are, in this method, occasions for continuing a fairly lengthy passage with the instrumental colouring unchanged; but they are exceptional. In the ordinary way, the blend of instruments is changing continually. Even a single chord may require a special shading or distribution of emphasis: and much will depend on which instruments you cause to play [...]. Or half a phrase may be given to one group; the other half which balances it may be passed to a different group. In such ways a subdued nuance is imparted to each thread in the whole shimmering network. (p. 190)

In the hands of certain composers, the orchestra transitioned from being a platform for simply enriching the music to being an expressive vehicle. Raynor (1978) describes how for Berlioz the modern perspective on the art of instrumentation necessitated a use of colour and expressive qualities “in a way which showed them to belong to each other, to set the instruments of the orchestra free to express their own personalities and to add the power of their personalities to the essential purposes of the music” (p. 127). With a bit of exaggeration Hopkins (1993) emphasizes that, when composing a specific passage, Brahms “never for a moment considered whether it might sound as well or better on a clarinet, a bassoon, a viola, a cello, the first violins or a cor anglais” (p. 3). This impassioned statement underlines the concept by which, from a creative or compositional perspective, a particular instrumental quality becomes the embodiment of an idea for which the sole manner of expression obtains through one specific tone-colour. Instrumental colour, perforce, embodies structural characteristics within a larger-scale formal layout *via* a return, for example, to a specific instrumental colour.

In *Principles of Orchestration* (begun in 1873 and published posthumously), Rimsky-Korsakov details instrumental combinations and balance, and he outlines ways in which changes in orchestration have a direct effect on musical form. In his fourth chapter, *Composition of the Orchestra; Different ways of orchestrating the same music* (p. 97), he examines various principles involved in achieving this goal depending upon the music at hand and what precedes and succeeds it (p. 98). His examples include various instrumental sections to score, and what

kind of timbre to select as well as the impact of range, from *tutti* to solo strings. Categories of diverse techniques include: transference of passages and phrases; chords of different tone quality used alternately; repetition of phrases; imitation; echo; diverging and converging progressions; tone quality as harmonic force; and economy in orchestral colour—all notably useful groupings of orchestrational procedures involving instruments with complementary or contrasting timbral properties. However, he discusses the significance of all of these categories and techniques in just 21 pages (pp. 97-118), and sadly he does not elaborate upon a theory of orchestration and form. Moreover, in the ensuing years, no follow-up publications on orchestration theory materialized that might have either proved or disproved his proclamations.

Schnittke (1977, 2002) conjectures that a “timbral scale” must exist since many creators cherished systems of timbral relationships that generated contrasts and modulations of colour. Unlike a scale of pitches, however, a discrete scale of timbres cannot likely exist due to the infinite amounts of individual coloration available. Schnittke did not pursue his intuition by way of a systematic study; instead he gave an overview of the issues in the field and proposed an outline for a basic taxonomy.

Since orchestration treatises already propose paradigms with regard to timbral structure within instrumental families, I asked myself the following research question: Why not make an attempt to also structure the processes within their connectivity and differences? The more one can define taxonomic categories of orchestration, I assume, the more one can understand the processes.

CHAPTER SUMMARIES

This dissertation is divided into three sections: score-based, perception-based, and form-based principles of orchestration.

SECTION 1

Section 1 presents score-based principles of orchestration, dealing with instrumentation and register.

Chapter 1

Chapter 1 explores orchestrational combinations traditionally referred to as “doubling”: melodic lines in rhythmic unison, and chords voiced for the orchestra. Several new taxonomic categories are presented in order to elucidate the component elements that serve to build these combinations in their orchestral context.

Chapter 2

Chapter 2 integrates the concepts of these combinations and applies the analyses to build a new taxonomic categorization showing how these orchestrational combinations change over time. This concept of transformation of orchestrational material expands upon the theory of thematic transformation, which is both a compositional technique and an approach to analysis that explores the relationships amongst rhythmic, harmonic, and pitch metamorphoses within a piece, and the perception of these connections in the context of musical form (Searle, 1966; Rea, 1978). In the building blocks of a theory of formal hierarchy, orchestrational transformations lend themselves well to an understanding of how orchestration changes are constructed through changes of instrumentation and register.

SECTION 2

Section 2 examines perception-based principles in orchestration through examples which, although visible in the score, require a listening-based analysis to complement the score-based analysis.

Chapter 3

Chapter 3 proposes new terms that expand upon the multifarious qualities of timbres, proposing taxonomic categories to represent collections of related timbres and the relationships that these tone-colours have with one another.

Chapter 4

Chapter 4 reviews a newly created taxonomic classification of orchestration, based on auditory grouping principles. This Taxonomy of Orchestral Grouping Effects (McAdams, Goodchild, and Soden, in preparation) links the listening-based analysis of the perception of timbre and its chunking over time to a score-based analysis.

SECTION 3

Section 3 examines form-based principles in orchestration.

Chapter 5

Chapter 5 unifies the basic principles and taxonomic classifications presented in earlier chapters through examples of how composers—throughout the orchestral repertoire—use these principles to build their musical structures. Orchestration, when viewed in this manner, gives insight into the compositional approaches common in the repertoire. Chapter 5 also examines compositional applications through exploration of the use of the categorizations and principles presented above in a new work for orchestra entitled “Overture.”

SECTION 1: SCORE-BASED PRINCIPLES IN ORCHESTRATION

1 BASIC PRINCIPLES OF ORCHESTRATIONAL COMBINATIONS: DOUBLING, COUPLING, AND THE VERTICAL STRUCTURING OF TIMBRAL AND REGISTRAL MATERIALS

1.1 INTRODUCTION

This chapter presents the basic principles of orchestrational combinations and proposes a taxonomic classification of these principles. It elaborates on pre-existing terminologies in order to clarify the scoring mechanisms behind a commonly used quality in orchestration: the joining of two or more instruments in rhythmic unison. This classification is not meant to replace the use of the word “doubling,” but to add to the terminology with explicit categorization of what happens orchestrationally when this term is being applied.

By exploring the score-based principles of the joining of instruments and register-based qualities (i.e., pitch), this chapter elucidates foundational concepts in the practice and, therefore, the art, of orchestrational combinations.

1.2 COMPONENT ELEMENTS OF ORCHESTRAL MUSIC

1.2.1 DOUBLING

Doubling, in the context of orchestration, refers to the act of simultaneously scoring the same part—whether it be the same pitch class or the same musical line—on two or more instruments; for example, McKay (1963) defines the fundamentals of the practice as “[w]hen two instruments are played in unison” (p. 118). As a key component of orchestration and in the art of combining instruments, doubling represents one of the most commonly used practices. The doubling of the melodic line by either the same or contrasting instruments functions as a joining of similar, complementary, or contrasting timbres. It serves many purposes in a musical structure: it gives weight to a melodic or harmonic passage or reinforces it; it creates mixtures or new hybrids, or even new timbres (Prout, 1902, p. 74; Rimsky-Korsakov, 1912, p. 56; Read, 1979, p. 78; Jacob, 1982, p. 34; Adler, 2002, p. 600; Read, 2004, p. 26; Brant, 2009, p. 21).

As a taxonomic term in the practice of orchestration, doubling most commonly refers to doubling the same pitch or pitch class.⁵ In regards to the orchestrational combination of pitched instruments, the most frequent use of doubling is at the unison (same pitch), at the octave or multi-octave (same pitch class), and at the third or sixth (different pitch class), in parallel motion. However, and this is where taxonomic clarity is needed, doubling can also imply a doubling of the line at the fifth or fourth, and their corresponding compound intervals, or, more common in twentieth and twenty-first century music, at the second or seventh (as well their corresponding compound intervals), in various types of simultaneous—parallel, similar, oblique, or contrary—motion. These pitch relationships—which are in fact relationships in the orchestral and instrumental registers and are created by the rhythmic doubling of a musical line—work in tandem with the addition of tone-colour, via instrumentation, to create the diverse orchestrational combinations that we hear in the repertoire.

However, in orchestration practice, the traditional terminology used to describe this art of orchestrational combinations is somewhat limited. The complexity of the orchestrational concepts involved in creating doublings is misrepresented—even misleading—due to the etymological and semantic baggage of the word *double*, which derives from the Latin *duplus*, from *duo*, meaning “two.” In musical terms, what is usually “doubled” is actually the rhythmic profile (except when playing at the unison, where the pitch is doubled; when at the octave, the pitch class is doubled). This is more often the case in chordal structures, where, for example, the root and fifth are doubled (or tripled) in various orchestral registers. “Doubling” is therefore insufficient as a classifying or analytical term in regard to any pitch other than pitch class, unless explicitly referring to rhythmic unison. As well, a musical line is often “doubled” more than once—it is more commonly tripled or quadrupled; as such, this taxonomy does not provide insight into all the parameters involved in building such orchestrational combinations. Thus, the only occasion where the meaning of the word *doubling* would be correct occurs when the rhythm and pitch or pitch class are replicated.

⁵ Fabien Lévy (2020, private correspondence) elucidates the difference between doubling pitched instruments vs. the doubling of pitched and non-pitched instruments vs. the doubling non-pitched instruments together.

Therefore, a taxonomic categorization of the mechanics behind doubling and the orchestrational combinations involved is needed— a terminology that is able to cohesively describe the component qualities.

1.2.2 ORCHESTRAL REGISTER

Definition: The registral range upon which the orchestra and its instruments are scored.

I use “orchestral register” to mean the musical register upon which we generally score instruments. Orchestral register very closely resembles the piano’s range, A0 to C8 (27.5Hz to 4186k), although there are a few orchestral instruments that exceed this range.⁶ Therefore, the orchestral register can be thought of as the “scored register” —as “absolute register” covers the range of our hearing, approximately 20Hz to 20k—where we hear the scored pitches as well as their higher partials. Orchestral register and absolute register can be thought of as being in concert and in tension with each other. And indeed in sound engineering, the mixing and balancing of the absolute register of a recording or live performance via mechanical or digital means affects orchestral register—e.g., the equalization process can increase or decrease the volume and presence of a particular orchestral register.

1.2.2.1 Instrumental registers vs. Orchestral Register

Orchestration is a complex network of interactions, both a technical and artistic practice of combining and contrasting instrumental qualities and registers in a musical setting over a duration of time. In traditional orchestration (using only mechanical instruments), there is a constant tension between instrumental register (relative) and orchestral register (absolute). The instruments of the orchestra, with their respective ranges that cover certain parts of the orchestral register, also come with individual registral limitations. The timbre of an instrument changes throughout its register: the woodwinds, for example, are well-known for a wide variety of contrasting tone-colours throughout their ranges (Sevsay, 2013, chapter 2). Therefore, there is tension between these registral limitations and constructs; e.g., the pitch D5 can be in a high

⁶ For example, one of the lowest physically produced sounds —a C “negative 1”—at 8.18 hertz is produced by a 64 foot organ pipe, the likes of which are found in St. Louis and Atlantic City, USA, and in Sydney, Australia. The standard 32 foot pipe produces a 16.35 Hertz vibration, or a C0.

instrumental register and sound strained on one instrument, whereas it can be in the low instrumental register on another instrument and sound full and resonant. Rimsky-Korsakov (1912) speaks about the effect of combining the strings (seen in Example 1.1) in one of the few orchestral registers where the different string sections intersect, and where the timbres of each instrument in their respective instrumental registers brings about a unique characteristic to the unison: “Combining violins, violas and ’cellos in unison is not possible except in the alto-tenor register; this process unites the full resonance of the instruments into an ensemble of complex quality, very tense and powerful in forte passages, extremely full and rich in piano.” (p. 40)

Example 1.1 is a musical score snippet from Rimsky-Korsakov's *Scheherazade*, movement ii, rehearsal P. It features four staves: Vln I, Vln II, Vla, and Vc. The key signature is D major (two sharps) and the time signature is 3/8. The tempo is marked 'P' (Piano) with a quarter note equal to 152. The dynamics are marked 'ff' (fortissimo) for all instruments. The notation includes various string techniques like 'Sul G' and 'V' (violins) and 'V' (violas/cellos).

Example 1.1: Rimsky-Korsakov, *Scheherazade*, mov. ii, rehearsal P.

Forsyth (1914, No. 19: The Cornet) comments on the combination of cornet and trombone from Elgar’s concert overture *Cockaigne* (In London Town) (1900–1901), shown here in Example 1.2, and how the cornet in its low register sounds “weak and flabby,” suggesting it’s better not to use it except in combination with horns or trombone.

Allegro
Brillante e marcato

Brillante e marcato

Example 1.2: Elgar, *Cockaigne*, Allegro. Adapted from Forsyth p. 107 (Score in C)

1.2.2.2 Taxonomy of Orchestral Registers

In the *Cambridge companion to orchestration*, Sevsay (2013, chapters 6 and 7) alludes to the ranges of orchestral register, but does not explicitly define all of them: “[o]rchestral register is used to refer to different levels of the orchestral range (e.g., alto-tenor register or soprano register). For further clarification: *c'*, for example, is in the lowest register of the flute, middle register of the horn, highest register of the contrabass tuba and alto register of the orchestra” (p. 262). The terms “soprano,” “tenor,” etc. have been used throughout history to describe the register-based relative ranges of everything from singers to flutes to saxophones, and I have therefore chosen to expand upon Sevsay’s terminology and explicitly define and delineate the ranges in the orchestral register as follows:

- C7 to highest sound: sopranissimo orchestral register
- C6–C7: sopranino orchestral register
- C5–C6: soprano orchestral register
- C4–C5: alto orchestral register
- C3–C4: tenor orchestral register
- C2–C3: baritone orchestral register
- C1–C2: bass orchestral register
- C0–C1: contrabass orchestral register
- Lowest sound to C0: sub-bass orchestral register

1.2.2.3 *Registral voices and instrumental parts*

Definition: Registral Voice — A musical line or voice that is doubled, triple, quadrupled, etc., in the other orchestral registers. One musical voice can have multiple registral voicings, in unique pitches and registers, as registral voices do not have to be the same pitch class as the original musical voice.

Definition: Instrumental part — an individual player in the orchestra, or in the case of the each of the members of the string family, an individual section in the orchestra playing one musical part.

Further commentary: Fundamental Example 1.3⁷ displays four examples of combinations of *registral voices* and *instrumental parts*: A. one registral voice and one instrumental part; B. one registral voice and two instrumental parts; C. two registral voices and two instrumental parts; D. two registral voices and four instrumental parts.

The musical score for Fundamental Example 1.3 is presented in a 4/4 time signature. It consists of four measures, labeled A, B, C, and D, each containing a musical staff for a different instrument: Fl. 1, Ob. 1, Cl. 1, and Bsn 1. The dynamics for all parts are marked as *mf* (mezzo-forte). In measure A, only the Fl. 1 staff has a half note G4. In measure B, both the Fl. 1 and Ob. 1 staves have a half note G4. In measure C, all four staves (Fl. 1, Ob. 1, Cl. 1, and Bsn 1) have a half note G4. In measure D, all four staves (Fl. 1, Ob. 1, Cl. 1, and Bsn 1) have a half note G4. The staves are arranged vertically, with Fl. 1 at the top and Bsn 1 at the bottom.

Example 1.3: Fundamental Example — Orchestral Registral Voices and Instrumental Parts

Another basic principle of orchestration practice lies in the combination of orchestral registers, with the addition of instrumental parts and registral voices, each of them respectively having very unique attributes and utilized in a particular way, as we will see in this chapter.

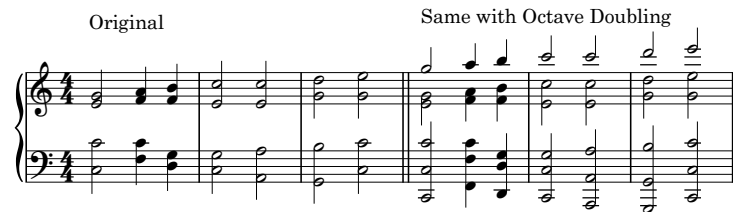
⁷ I use “Fundamental Examples” (FE) to exemplify—in their simplest and reduced form—the necessary component elements of an orchestration. These FE’s are used throughout this dissertation to introduce and/or examine taxonomic categories.

Example 1.4, from Joseph Wagner’s *Orchestration* (1959, p. 23), demonstrates how a line retains the same number of registral *and* musical voices, but expands in parts (Rea, 2009) with the addition of doubled pitch material to a chord progression. On the left is the original, and on the right, the top two notes in the upper staff are doubled (in this, the meaning of the word doubling matches the case); each of these two musical and registral voices has had a part added to it. Take note that the registral quality has not changed from the original, but with the unison addition either a weight and/or colour change has been made to occur.



Example 1.4: Joseph Wagner, *Orchestration*, unison doubling example.

Wagner’s second example, Example 1.5, shows octave doubling. In this case it is the pitch classes being doubled. Here, the orchestral register has been expanded, with each outer voice doubled at the octave, creating two new registral voices.



Example 1.5: Joseph Wagner, *Orchestration*, octave-doubling example.

While Example 1.4 contains four musical voices and four registral voices, Example 1.5 contains four musical voices and six registral voices.

1.2.3 COUPLING OF REGISTERS AND INSTRUMENTS

Definition: The joining of orchestral registers and instrumental parts in a musical setting.

Further commentary: The joining of registral/pitch elements and instrumental/timbral elements in any musical setting, but more specifically in an orchestral setting, represents a complex web of

interactions that demonstrates two distinct musical functions at play: what can be termed as “couplings” (in the mechanical sense of the word—joining, integration, connection) of 1) pitch material or registral qualities, as a well as 2) a coupling of timbral or instrumental qualities (at a specific pitch, as timbre changes with pitch: see Chapter 3).

This joining operates much like the coupling of organ pipes or harpsichord keyboard coupling where one mechanically combines pitch and timbral elements for performative, expressive, or structural reasons. As Blatter (1997) describes:

The upper keyboard [in a harpsichord] is often equipped with a device called a damper for changing the timbre of the strings to that of a lute or guitar. This mechanism mutes or damps the strings, allowing the pizzicato attack characteristic to be more clearly perceived. By the use of a coupler, it is possible to interconnect the two manuals so that by playing keys on the lower keyboard the same keys on the upper keyboard are simultaneously activated. (p. 252)

Therefore, I propose two new terms that in addition to doubling will elucidate what is inherent and what is a basic principle of orchestrational combinations: Registral coupling and Instrumental coupling.

For example, the traditional terminology to describe the following melodic Example (Example 1.6) extracted from m. 44 of Tchaikovsky’s “Pas de Deux” from his ballet, *The Nutcracker*, would call it a multi-octave doubling of the line by woodwinds and strings. Piston (1969, p. 355) would classify it as a “Texture-Type I, Orchestral Unison,” as he doesn’t differentiate between unison and octave textures explicitly. However, much more is at play than a unison and pitch class reinforcement: the line appears in four different octaves, and in each one of those octaves, there are multiple instruments in unison, involving the coupling of registers as well as the coupling of instruments. Using these taxonomic categorizations helps elucidate how Tchaikovsky has written one musical line with fourteen instrumental parts, using nine different instruments, and in four registral voices, to achieve his musical goal.

Andante maestoso (♩ = 69)

Fl. 1.2
Picc. 1
Ob. 1.2
C. A.
Cl. in A 1.2
Bsn 1.2
Vln I
Vln II
Vla
Vc.

ff marcato

Example 1.6: Tchaikovsky, *The Nutcracker*, “Pas de Deux,” mm. 44–45. (Score in C)

1.2.4 SUMMARY OF COMPONENT ELEMENTS OF ORCHESTRAL MUSIC

If one analyzes the most basic of features in orchestral music, melodic lines and chords, one can see the *orchestrational combinations* that are created by using pitch and instrumental coupling. To suitably describe and define these taxonomic categories, the next sections (1.3, 1.4) deal with defining the orchestrational elements in melodic (horizontal) structures; the following section 1.5 concerns itself with orchestrational elements involved in creating chordal (vertical) structures.

1.3 ORCHESTRATIONAL COMBINATIONS: REGISTRAL COUPLINGS

Definition: The principle of combining two or more instruments, whether of the same pitch or pitch class, or a joining of different pitch classes. The unique registers of the instruments are *coupled* or joined together in specific locations or tessituras of the orchestral register.

Further commentary: In the combining of pitch elements, there are three possible basic principles, each one representing a coupling of registral properties: 1. The coupling together of the same pitch; 2. The coupling together of the same pitch class; 3. The coupling of different pitch classes. All of these principles, when presented over time rather than as a chord, represent a type of motion which is *parallel*, where the vertical interval separating the registral voices remains constant. The time-based principle in the coupling of different-pitch-class pitch material and where the intervals between registral voices change to reflect the harmonic context is termed *harmonic coupling*. The taxonomic categories can be summed up as:

- Pitch-based:
 - Unison registral coupling: joining the same pitch, therefore same orchestral register.
- Time-based principle, or motion type: Parallel
- Pitch-class-based:
 - Octave registral coupling: joining the same pitch class, one octave apart.
 - Multi-Octave registral coupling: joining the same pitch class, two or more octaves apart.
- Time-based principle, or motion type: Parallel
- Different-pitch-class-based:
 - Intervallic registral coupling: joining pitches from different pitch classes, or close or compound intervals.
- Time-based principle, or motion type: Parallel or Harmonic

The following table (Table 1.1) presents the “Fundamental Examples”⁸ (FE) of these Registral Couplings, and demonstrates two contrasting views: the upper half is the Register-based view and the lower half is the Score-based view. In the Register-based view, the rows are pitch names, representing two octaves, A3 to A5. In the Score-based view, the rows are representative of the instruments of the orchestra, each row representing one instrument (or in the case of the strings, one section). The columns for both views represent the different types of registral couplings. As the Fundamental Examples are meant to exemplify the most reduced and

⁸ I exemplify each basic principle and its taxonomic classification into a reduced “Fundamental Example.” These FE’s show the principle in an interpretation of its simplest score-based form.

simplified form of each coupling, I have chosen to use the pitch class A for all examples of unison and octave-based couplings. For intervallic couplings, different pitch classes are used. The instrumentation is kept to the woodwinds. Usually only two to four instruments are needed to create these various registral couplings, as it is the orchestral register that changes but not the instrumentation. Each of the Fundamental Examples represented in this table is shown in score format at the beginning of each subchapter.

Table 1.1: Registral Coupling — Register and Score-based views

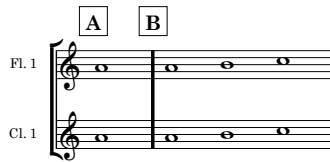
Orchestral Combinations									
Registral property :	Registral coupling								
	pitch	pitch-class	pitch-class	pitch-class	pitch-class	pitch-class	diff. pitch-class	diff. pitch-class	
Time-based principles (if applicable) :	Parallel	Parallel	Parallel	Parallel	Parallel	Parallel	Parallel	Harmonic	
Coupling sub-Type	Unison	Octave	Multi-octave 1	Multi-octave 2	Compound Unison and Octave	Multi-Unison and Octave	Intervallic	Intervallic	
Register-based view									
A5									
G5									
F5									
E5									
D5									
C5									
B4									
A4									
G4									
F4									
E4									
D4									
C4									
B3									
A3									
Score-based view									
Score-based view	Registral coupling								
	pitch	pitch-class	pitch-class	pitch-class	pitch-class	pitch-class	diff. pitch-class	diff. pitch-class	
Flute 1									
Oboe 1									
Clarinet 1									
Bassoon 1									
Horn 1									
Trumpet 1									
Trombone 1									
Tuba									
Timpani									
Cymbal									
Violin I									
Violin II									
Viola									
Violoncello									
Contrabass									

1.3.1 PITCH-BASED

Definition: A pitch-based registral coupling (PRC) represents the principle of combining two or more instruments using the same pitch; it is a unison registral coupling. The time-based simultaneous motion of this coupling is always in parallel motion.

1.3.1.1 Unison registral coupling

Definition: The principle of combining two or more instruments at the same pitch.



Example 1.7: Fundamental example — Unison registral coupling.

Further commentary: Registral coupling at the unison appears in the orchestral repertoire as the most common form of registral coupling, usually in the form of a doubling of the melodic line. Combining two or more instruments in unison joins the instrumental register of the instruments, thereby weighting a certain pitch in the orchestral register. This Fundamental Example (Example 1.7) demonstrates the unison registral coupling of the flute and clarinet. Rehearsal A represents the chordal iteration, and Rehearsal B represents the time-based iteration of the musical line in parallel motion.

Exemplifications: See [Example 1.23](#), [Example 1.26](#), [Example 1.27](#), [Example 1.28](#), [Example 1.29](#), [Example 1.30](#), [Example 1.37](#), [Example 1.38](#), [Example 1.39](#)

1.3.2 PITCH-CLASS-BASED REGISTRAL COUPLING

Definition: A pitch-class-based registral coupling (PCRC) represents the principle of combining two or more instruments using the same pitch class, as either an octave or multi-octave registral coupling. The time-based simultaneous motion of this coupling is always in parallel motion.

1.3.2.1 Octave registral coupling

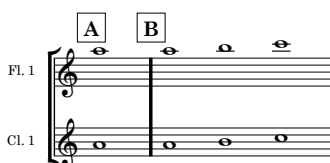
Definition: The principle of combining two or more instruments using the same pitch class, one octave apart.

Further commentary: In an octave registral coupling, one note on one instrument is coupled with another of the same pitch class on another instrument, exactly one octave apart. As with unison registral coupling, octave registral coupling is a common doubling technique.

From a historical perspective, octave coupling is a natural way to sing or play a melody as a group. Think of a chorus of singers following a melody; because of the nature of the

registral differences of the voices, the melody is naturally sung in parallel octaves. This concept ties over to musical instruments as well, as multiple instruments of varying registers playing a melody in a relatively common orchestral register, an octave apart.

This Fundamental Example (Example 1.8) demonstrates the octave registral coupling of the flute and clarinet. Rehearsal A represents the chordal iteration, and Rehearsal B represents the time-based iteration of the musical line in parallel motion.

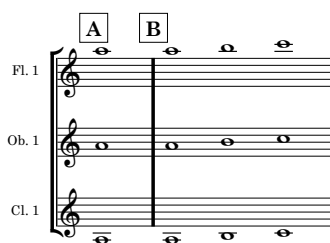


Example 1.8: Fundamental Example — Octave Registral Coupling

Exemplifications: See [Example 1.31](#), [Example 1.32](#), [Example 1.33](#), [Example 1.34](#), [Example 1.35](#), [Example 1.40](#)

1.3.2.2 Multi-octave registral coupling

Definition: The principle of combining three or more instruments on the same pitch class, in three or more separate octaves.



Example 1.9: Fundamental Example — Multi-octave coupling

Further commentary: A defining feature of multi-octave registral coupling concerns voices in octave relationships that are separated by more than one octave. Therefore, this coupling can be scored as a: 1. Two or more octave couplings with an empty octave in between (or similar); 2. Three octave coupling; 3. Four Octave coupling; 4. Five octave coupling. As they usually occur across a large area of the orchestral register, the multi-octave registral couplings are often used for dramatic, expressive, or structural purposes. These kinds of registral couplings—with many

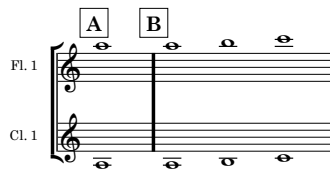
registral voices—will often be used to contrast with registral couplings with a smaller number of registral voices.

This Fundamental Example (Example 1.9) demonstrates a multi-octave registral coupling of the flute, oboe, and clarinet. Rehearsal A represents the chordal iteration, and Rehearsal B represents the time-based iteration of the musical line in parallel motion.

Exemplifications: See [Example 1.44](#), [Example 1.48](#)

1.3.2.3 Multi-octave coupling, thinned out

Definition: The principle of combining two or more instruments at the same pitch class two or more octaves apart.



Example 1.10: Fundamental Example — Multi-octave coupling, thinned out.

Further commentary: This Fundamental Example (Example 1.10) demonstrates a multi-octave, registral coupling of the flute and clarinet that has been thinned out. Rehearsal A represents the chordal iteration, and Rehearsal B represents the time-based iteration of the musical line in parallel motion.

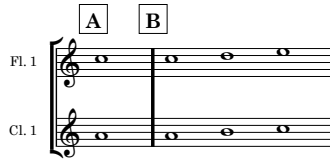
Exemplifications: See [Example 1.36](#)

1.3.3 DIFFERENT-PITCH-CLASS-BASED:

Definition: A different-pitch-class-based registral coupling (DPCRC) represents the principle of combining two or more instruments using the combination of two or more pitch classes simultaneously. The time-based simultaneous motion of this coupling is either in parallel motion (intervallic registral coupling), or a combination of various simultaneous motions—similar, oblique, contrary, and/or parallel motions (harmonic registral coupling). The instrumental colours are combined with the harmonic colours of the various intervals involved.

1.3.3.1 Intervallic registral coupling (*parallel*)

Definition: The principle of combining two or more instruments scored as a horizontal (musical line) or vertical (chordal) structure using two or more pitch classes.



Example 1.11: Fundamental Example — Intervallic registral coupling (different-pitch-class)

Further commentary: This Fundamental Example (Example 1.11) demonstrates the intervallic registral coupling of the flute and clarinet, at the interval of a third. Rehearsal A represents the intervallic or chordal iteration, and Rehearsal B represents the time-based iteration of the musical line in parallel motion (although alternating between major and minor thirds, the interval of a third remains constant and therefore the lines can still be considered *parallel*).

This category can be used to illuminate the construction of a musical line through the creation of registral voices; “[t]he common practice of doubling a melody consistently in thirds or sixths does not add a new melodic voice so much as a harmonic thickening or underlining of the single voice” (Piston, 1969, p. 362). The musical line is replicated at a specific interval—but not using the same pitch class—where the intervallic relationship stays constant. Bouliane (2015) and Cordero (2016) expound upon the differences created in the orchestral colour and texture when pitch-class-based registral couplings (PCRC) are used versus when different-pitch-class-based registral couplings (DPCRC), especially at the third and the sixth. Cordero (personal communication, 2017) elucidates the point that combining DPCRC’s with complementary or contrasting timbres creates a stronger coloration than using PCRC’s, as a combined harmonic and coloristic quality is created in the former. Lévy’s (2020) method of Functional Orchestration teaches that the musical context and the goal of the orchestration will also have a large influence on the perception of the orchestrational combinations at hand (see chapter 6, Future Research, Taxonomies of Orchestration)

In orchestral chords, the creation of registral voices means the doubling (or tripling or quadrupling, etc.) of certain pitch classes in various registers, which can balance or destabilize a

chord from a registral (weighting) perspective depending upon which chord tone is doubled and which instrument is playing in which orchestral register at which instrumental register.

Exemplifications: See [Example 1.24](#), [Example 1.41](#)

1.3.3.2 Harmonic Registral Coupling (non-parallel)

Definition: The principle of DPCRC and PCRC's scored with the other qualities of simultaneous motion (oblique, similar, contrary). Rhythmic unison is a key feature, but musical and registral voices are sometimes independent. This registral coupling is solely time-based; chordal iterations can be classified under intervallic registral coupling.



Example 1.12: Fundamental Example — Harmonic Registral Coupling

Further commentary: In harmonic registral coupling, the line is doubled in rhythmic unison to create an enrichment or densification of the harmony/spectrum, and it features similar, oblique, or contrary motion, as well as parallel motion in combination with other types of motion. The lines, sometimes separated by a wide register, can often be perceived as two or more individual lines, but the rhythmic profile is exactly the same for all lines. Harmonic registral coupling is almost always a compound registral coupling, i.e., multi-unison or multi-intervallic. This Fundamental Example (Example 1.12) demonstrates the harmonic coupling of a musical line, not in parallel motion.

Exemplifications: See [Example 1.25](#), [Example 1.43](#), [Example 1.46](#), [Example 1.47](#)

1.3.4 COMPOUND REGISTRAL COUPLING

Definition: The principle of scoring two or more registral couplings simultaneously.

1.3.4.1 Unison and octave or multi-octave registral coupling

Definition: The principle of simultaneously scoring an octave, or multi-octave, coupling containing a unison coupling in one of the registral voices.

The image shows a musical score for three woodwind instruments: Fl. 1, Ob. 1, and Cl. 1. The score is divided into two sections, A and B. In section A, all three instruments play the same note (G4) in unison. In section B, all three instruments play the same note (G5) in octave coupling.

Example 1.13: Fundamental Example — Compound unison and octave registral coupling

Further commentary: The basic principles exemplified thus far are the fabric upon which more complex orchestrational combinations are built. In compound registral coupling, certain orchestral registers and/or instrumental couplings are emphasized with the addition of a unison of two or more instruments in one of the registral voices.

This Fundamental Example (Example 1.13) demonstrates a registral coupling that contains two types: unison and octave. Rehearsal A represents the chordal iteration, and Rehearsal B represents the time-based iteration of the musical line in parallel motion.

Exemplifications: See [Example 1.40](#), [Example 1.48](#)

1.3.4.2 Compound multi-unison and octave, or multi-octave, registral coupling

Definition: The principle of simultaneously scored octave or multi-octave registral couplings, containing unison couplings in each one of the registral voices.

The image shows a musical score for four instruments: Fl. 1, Ob. 1, Cl. 1, and Tpt. 1. The score is divided into two sections, A and B. In section A, all four instruments play the same note (G4) in unison. In section B, all four instruments play the same note (G5) in octave coupling.

Example 1.14: Fundamental Example — Compound multi-unison and octave registral coupling.

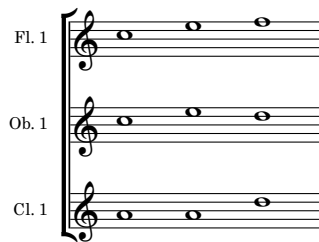
Further commentary: This Fundamental Example (Example 1.14) demonstrates a registral coupling that contains two types of registral coupling: unison and octave, with a unison

appearing in each registral voice. Rehearsal A represents the chordal iteration, and Rehearsal B represents the time-based iteration of the musical line in parallel motion.

Exemplifications: See [Example 1.42](#), [Example 1.50](#), [Example 1.52](#)

1.3.4.3 Compound unison and intervallic registral coupling

Definition: The principle of simultaneously scored intervallic registral couplings (parallel or harmonic), containing unison couplings in one or all of the registral voices.



Example 1.15: Fundamental example — Compound unison and registral coupling

Further commentary: A compound registral coupling will usually contain a unison, octave, or multi-octave coupling, along with specific different-pitch-class intervals. In this Fundamental Example (Example 1.15), the oboe 1 is in unison with either the flute 1 (second note) or the clarinet 1 (third note).

Exemplifications: See [Example 1.43](#), [Example 1.49](#), [Example 1.51](#), [Example 1.53](#), [Example 1.54](#), [Example 1.55](#)

1.3.5 SUMMARY OF REGISTER-BASED COMBINATIONS

By elucidating the component elements that are built with these orchestrational combinations, this taxonomic classification demonstrates the basic principles that construct registral couplings.

A unison coupling combines two or more instruments at pitch, and octave and multi-octave couplings combine pitch classes, whereas intervallic couplings combine different pitch classes; these are all classified under parallel registral couplings. If there are other types of simultaneous motion involved, the registral coupling is categorized as harmonic. As the complexity of orchestral scores are part of the repertoire's creative differences, each of these registral

combinations can be combined simultaneously: compound registral coupling, both parallel and octave.

1.4 ORCHESTRATIONAL COMBINATIONS: INSTRUMENTAL COUPLINGS

Definition: The basic principle of combining two or more instruments in one chord or musical line.

Further commentary: In orchestration, the instruments of the orchestra—each with its own unique timbre, instrumental register limits, and expressive quality (within each register)—are combined by means of registral coupling. To create and properly balance these combinations implies both a science and an art; Gardner Read (2004) appropriately titles his book *Orchestral Combinations: The Science and Art of Instrumental Tone-Color*. He explores examples of two types of orchestrational combinations, what he calls mono-chromatic and dual-chromatic couplings, which he then subcategorizes into unison or octave.

In my taxonomic categorization of instrumental combinations in an orchestral score, I build upon Read's theory; what he refers to as a coupling, I refer to as an instrumental coupling. He defines mono-chromatic as the combination of instruments with "identical or similar timbres": the clarinet and bass clarinet, viola and cello, or oboe and English horn. Dual-chromatic coupling is defined as the coupling of instruments with "two distinct timbres": flute and bassoon or viola and horn (pp. xv-xvi).

Although Read's elucidation and insight into the art of tone-colour combination stands as a very valuable contribution, providing many examples for such combinations, for taxonomic purposes in the context of music, the use of the word *chromatic* is historically too connected to pitch. Building on Read's theory, I will use instead the term *chroma* (Greek: colour), and adapt the terms *mono-chroma*, and *duo-chroma* from Read's concepts of mono-chromatic and dual-chromatic. As all the instruments of the orchestra have different timbres, some similar and others vastly different, the combination of two or more instrument is by default a colour—a timbre—combination. The matter of perception—how closely related or not the instruments are—is the subject of Chapters 3 and 4 and is not of primary importance here; this taxonomy utilizes scoring-based principles, therefore I use mono-chroma coupling to mean the combination of the same instrument, and duo-chroma coupling to mean two different instruments.

Read himself did not expand his theory to other tone-colour combinations, as he considered that the extra colours in more complex combinations could not be perceived.⁹ However, as my categorizations are based on score-based analyses, I adapt and submit additional chroma categories. For taxonomic clarity and for analytic insight into orchestrational methods, I propose to both adapt and expand the labels of instrumental groupings as follows:

- *Mono-chroma*: coupling of the same instruments
- *Duo-chroma*: coupling of two instruments, within or across instrumental family
- *Tri-chroma*: coupling of three instruments, within and/or across instrumental family
- *Tetra-chroma*: coupling of four instruments, within and/or across instrumental family
- *Quinta-chroma*: coupling of five instruments, within and/or across instrumental family
- *Poly-chroma*: coupling of six or more instruments, within and/or across instrumental family

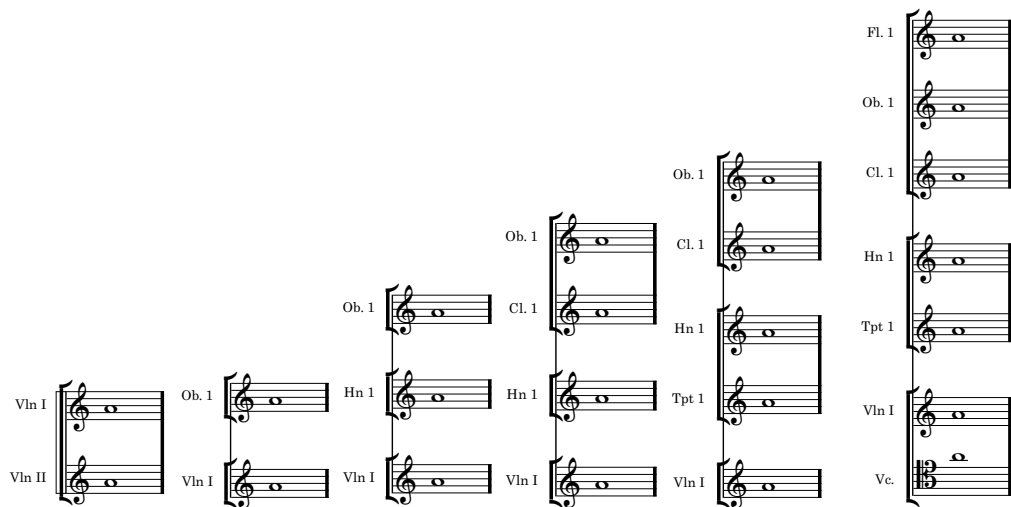
Table 1.2 demonstrates instrumental coupling, in contrast to Table 1.1's registral couplings (Example 1.16 is the score version of the Table). The upper section delineates instrument combination by column: Same instrument, or Different Instruments; and labels the coupling type from mono- to poly-chroma. In the section below the first grey line is the Register-based view: here the pitch "A4" was chosen (for reduction purposes only, it could have been any pitch within the common instrument registers) and is shown by the filled-in box. All the instrumental couplings can be represented by instruments playing the same pitch (note: not pitch class, but pitch). The lower section, below the second grey line, is the Score-base view: instruments involved have their boxes filled in, starting with the mono-chroma coupling of violins I and II all the way to the more complex poly-chroma coupling of flute, oboe, clarinet, horn, trumpet, and violin I. What can be gleaned from this reduction is that one single pitch and

⁹ "It was deemed impractical to go beyond a consideration of two different timbres for the obvious reason that the ear cannot readily distinguish the component contributions of more than two colors. Individual timbre can no longer be discerned, but only sheer weight of sound, tonal mass and density of texture." (Read, 2004, p. vxi)

one single orchestral register (shown in the Register-based view), can be used for mono- to poly-chroma couplings (shown in the Score-based view).

Table 1.2: Orchestration combinations — Instrumental Coupling, Register and Score

Orchestral Combinations						
Instrument combination :	Instrumental coupling					
	same inst.	differnt inst.	differnt inst.	differnt inst.	differnt inst.	differnt inst.
Coupling Type	Mono-chroma	Duo-chroma	Tri-chroma	Tetra-chroma	Quinta-chroma	Poly-chroma
Register-based view						
A5						
G5						
F5						
E5						
D5						
C5						
B4						
A4						
G4						
F4						
E4						
D4						
C4						
B3						
A3						
Score-based view						
Flute 1						
Oboe 1						
Clarinet 1						
Bassoon 1						
Horn 1						
Trumpet 1						
Trombone 1						
Tuba						
Timpani						
Cymbal						
Violin I						
Violin II						
Viola						
Violoncello						
Contrabass						



Example 1.16: Fundamental Example — Chroma-coupling, from mono to poly

1.4.1 MONO-CHROMA

Definition: The principle of combining two of the same instrument together in any type of registral coupling.

Further commentary: Fundamental Example 1.17 shows the Violin I and II playing in unison, the same instrument coupled together.



Example 1.17: Fundamental Example — Mono-chroma coupling

Exemplifications: See [Example 1.23](#), [Example 1.24](#), [Example 1.25](#)

1.4.2 DUO-CHROMA INSTRUMENTAL COUPLING

Definition: The principle of combining of two different instruments together in any type of registral coupling.

Further commentary: Fundamental Example 1.18 shows a unison registral coupling scored with two different instruments, a duo-chroma coupling.



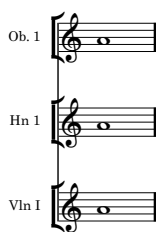
Example 1.18: Fundamental Example — Duo-chroma coupling

Exemplifications: See [Example 1.26](#), [Example 1.27](#), [Example 1.28](#), [Example 1.29](#), [Example 1.30](#), [Example 1.31](#), [Example 1.32](#), [Example 1.33](#), [Example 1.34](#), [Example 1.35](#), [Example 1.36](#)

1.4.3 TRI-CHROMA INSTRUMENTAL COUPLING

Definition: The principle of combining of three different instruments together in any type of registral coupling.

Further commentary: Fundamental Example 1.19 exemplifies a unison registral coupling orchestrated with three different instruments: a tri-chroma coupling across families.



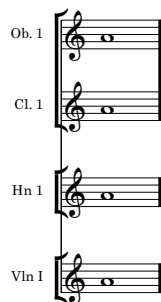
Example 1.19: Fundamental Example — Tri-chroma coupling

Exemplifications: See [Example 1.37](#), [Example 1.38](#), [Example 1.39](#), [Example 1.40](#), [Example 1.41](#), [Example 1.42](#), [Example 1.43](#)

1.4.4 TETRA-CHROMA INSTRUMENTAL COUPLING

Definition: The principle of combining of four different instruments together in any type of registral coupling.

Further commentary: Fundamental Example 1.20 shows the oboe, clarinet, horn, and violin I in a unison registral coupling.



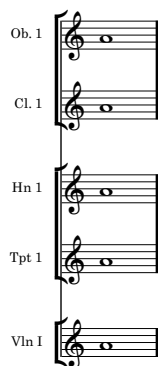
Example 1.20: Fundamental Example — Tetra-chroma coupling

Exemplifications: See [Example 1.35](#), [Example 1.44](#), [Example 1.45](#), [Example 1.46](#), [Example 1.47](#), [Example 1.48](#), [Example 1.49](#)

1.4.5 QUINTA-CHROMA

Definition: The principle of combining of five different instruments together, in any type registral coupling.

Further commentary: Fundamental Example 1.21 shows oboe 1, clarinet 1, horn 1, trumpet 1, and violin 1 combined in a unison registral coupling. These five instruments combined together create a quinta-chroma coupling.



Example 1.21: Fundamental Example — Quinta-chroma coupling

Exemplifications: See [Example 1.50](#), [Example 1.51](#)

1.4.6 POLY-CHROMA INSTRUMENTAL COUPLING

Definition: The principle of combining of six or more different instruments together in any type of registral coupling.

Further commentary: Fundamental Example 1.22 shows flute 1, oboe 1, clarinet 1, horn 1, trumpet 1, violin 1, and cello combined in a unison registral coupling, creating a poly-chroma coupling.



Example 1.22: Fundamental Example — Poly-chroma coupling

Exemplifications: See [Example 1.52](#), [Example 1.53](#), [Example 1.54](#), [Example 1.55](#)

1.4.7 SUMMARY

Registral and instrumental couplings form the foundation of orchestrational combinations. The above section presented the melodic, or temporally extended combinations, where the doubling of the rhythmic line is augmented with registral voices and instrumental parts.

If we refer back to the “Pas de Deux” example (Example 1.6), we can now understand that it demonstrates a complex compound registral and instrumental coupling: a four-octave/four-registral voice, multi-unison and multi-octave, 14-part registral coupling; the instrumental coupling is poly-chroma, composed of 9 different instruments. When we break it down to its component parts, registral-voice 1 is one part, the solo piccolo flute. Registral-voice 2 is comprised of flute 1, flute 2, and violin I, therefore representing a registral coupling of a 3-part unison, with duo-chroma instrumental coupling. In registral-voice 3, comprised of oboe 1, oboe

2, clarinet 1, and violin 2, the registral coupling is a 4-part unison, and the instrumental coupling is tri-chroma. Registral-voice 4 is comprised of the English horn, clarinet 2, bassoon 1, bassoon 2, viola, and cello, and represents a 6-part unison registral coupling and a quinta-chroma instrumental coupling.

1.5 EXEMPLIFICATIONS AND SCORE EXCERPTS

1.5.1 MONO-CHROMA, UNISON COUPLING

Example 1.23: Berlioz's use of four bassoons at m. 25 in the fourth movement of his *Symphonie fantastique* demonstrates a mono-chroma instrumental coupling and a unison registral coupling of the bassoons, in counterpoint with the tri-chroma coupling of viola, cello, and contrabass in harmonic coupling (violins enter at the cadence, creating a tetra-chroma coupling).

Example 1.23 is a musical score excerpt from Hector Berlioz's *Symphonie fantastique*, movement iv, measures 25–31. The tempo is marked "Allegretto non troppo" with a quarter note equal to 72 (♩ = 72). The score shows five staves: Bassoon 1, 2, 3, & 4; Violin I; Violin II; Viola; and Violoncello/Double Bass. The bassoon part is marked "unis. solo" and "mf", with dynamics "cresc.", "f", and "p". The violin parts are marked "pp" at the end. The viola and cello/bass parts are marked "mf", "f", "dim.", "p", and "pp".

Example 1.23: Hector Berlioz, *Symphonie fantastique*, mov. iv, mm. 25–31.

1.5.2 MONO-CHROMA, INTERVALLIC COUPLING

In combining two of the same instruments, Debussy's intervallic coupling in Example 1.24 gives the melodic line a distinctive quality, accentuated by the use of "[t]wo oboes in thirds, or other close intervals, [which] have a tangy quality of tone not possessed by the other woodwinds." (Piston, 1969, p. 156)



Example 1.24: Debussy, *La Mer*, mov. iii, mm. 9–12

1.5.3 MONO-CHROMA, HARMONIC COUPLING

In Example 1.25, from the “Danse des Mirlitons” in Tchaikovsky’s *The Nutcracker*, the flute trio moves in parallel, similar, contrary and oblique motion. This is an example of mono-chroma—the three flutes—and harmonic registral coupling.

Example 1.25: Tchaikovsky, *The Nutcracker*, “Danse des Mirlitons,” mm. 3–10.

1.5.4 DUO-CHROMA, UNISON COUPLING

As Adler (2002) describes, shown here in Example 1.26, what sometimes might seem as a superfluous doubling, or even an error, was planned meticulously by the composer:

Even though the doubling within a passage may look as though it might be ineffective or unnecessary, the resulting timbre would be quite different without the doubling. Let us imagine what the following passage, from Berlioz's *Symphonie fantastique*, would sound like without the unison doubling, a solo flute with a solo violin. This rendition would have neither the warmth nor the richness of Berlioz's version especially in the upper reaches of the melodic line. (p. 276)



Example 1.26: Berlioz, *Symphonie fantastique*, mm. 20–23

In Example 1.27, the opening motif from Mimi’s aria in Puccini’s *La Bohème* is a unison registral coupling of Mimi (solo soprano voice) and the violin 1 section. Articulations and dynamics are slightly different but each line is the same in pitch and rhythm (except the opening rhythm).



Example 1.27: Puccini, *La Bohème*, “Sì, mi chiamano Mimì,” one measure after rehearsal 34.

Example 1.28, adapted from Piston (1969), demonstrates registral coupling of the flute 1 and harp lines at the unison in Debussy’s *Nocturnes*, “Nuages,” mm. 75–78. The harp changes to harmonics at m. 77 but stays in unison. As Piston describes: “Another color is made by the unison of the normal harp tone with the harmonic played on the string an octave below. Harp harmonics combine well as decorative melodic doubling of other instruments, such as muted violas, and especially the flute.” (p. 334)



Example 1.28: Debussy, *Nocturnes*, “Nuages,” mm. 75–78.

Example 1.29 presents a unison registral coupling of three flutes and two bassoons. There are five parts on one voice, the flutes in their low register and the bassoons in their upper register.

Adagio (♩ = 54)

Example 1.29: Tchaikovsky, Symphony No. 6 in B minor, mov. iv, mm. 1–8.

In Example 1.30, adapted from Read, the muted trumpet and cellos share the same dynamics and phrasing and are scored in a unison registral coupling. This pairing of two instrumental families creates a duo-chroma instrumental coupling across families.

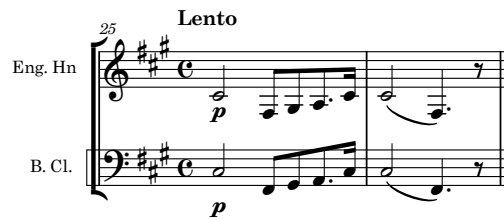
Viertel Etwas Langsamer
mit Dämpfer

Example 1.30: Schoenberg, *Five pieces for orchestra*, II (1909), m. 41. (Score in C)

1.5.5 DUO-CHROMA, OCTAVE COUPLING

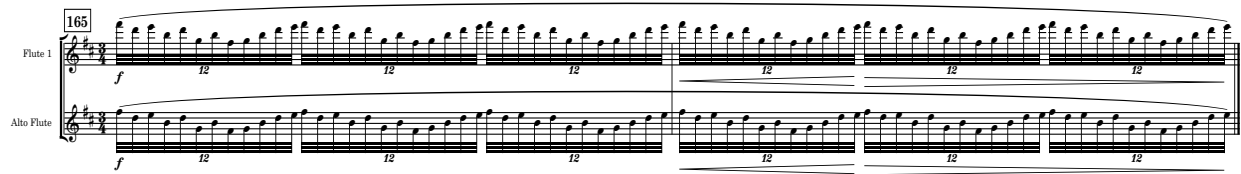
Example 1.31 is an octave registral coupling of the English horn and bass clarinet, adapted from Forsyth, in what he calls an “octave-unison” (1914). Although an interesting example, from a taxonomic and pedagogical perspective his terminology is confusing. He attempts to explain that the octave doubling is a pitch-class doubling, hence his use of “octave-unison,” which appears to be a contradiction in terms: “In Lohengrin (Act II), Wagner uses the

same dark and immovable tone-colour for the expression of doubt and uneasiness. This time the melody is assigned to an effective octave-unison of Bass-Clarinet and English-Horn.” (p. 277)



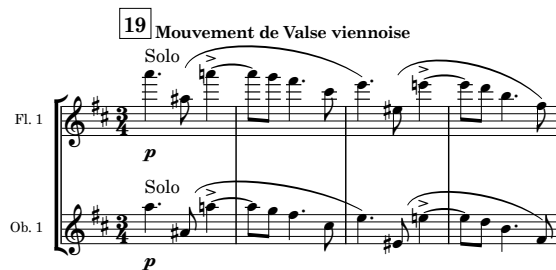
Example 1.31: Wagner, *Lohengrin*, mm. 25–26. (Score in C)

Example 1.32, a rapid figuration from rehearsal no. 165 of Ravel’s *Daphnis et Chloé*, is adapted from Adler (2002, p. 188). Interestingly, this octave registral coupling is scored with very similar instruments: flute and alto flute.



Example 1.32: Ravel, *Daphnis and Chloe*, at Rehearsal 165. (Score in C)

The flute and oboe are combined in a solo passage of Ravel’s *La valse* (Example 1.33), in which the registral coupling in parallel octaves highlights contrasting but characteristic ranges in each of the instruments’ registers.



Example 1.33: Ravel, *La valse*, at rehearsal 19.

In Example 1.34, from Tchaikovsky's *Capriccio Italien*, mm. 77–83, the English horn and bassoon play in parallel octaves, in a duo-chroma instrumental coupling.

75 (♩ = 66)

C. A.

Bsn 1

p *più f* *p* *più f sfz*

Example 1.34: Tchaikovsky, *Capriccio Italien*, mm. 77–83. (Score in C)

1.5.6 DUO-CHROMA, MULTI-UNISON AND OCTAVE COUPLING

Example 1.35, from Rimsky-Korsakov's *Scheherazade*, mm. 123–126, is a multi-unison and octave registral coupling, and tetra-chroma instrumental coupling, within and across families, where the three upper woodwinds are coupled with the violins. They are scored in parallel octaves, with flute 1 and violin I on the upper octave as a duo-chroma instrumental coupling and unison registral coupling; on the lower octave, a tri-chroma instrumental coupling and unison registral coupling is created between the oboes, clarinets, and bassoons. As an exemplification of Rimsky-Korsakov's colourful orchestration, this example contains two registral voices (one octave apart) but a total of seven instrumental parts.

Example 1.35: Rimsky-Korsakov, *Scheherazade*, mov. i, mm. 123–126. (Score in C)

1.5.7 DUO-CHROMA, MULTI-OCTAVE COUPLING, THINNED OUT

Example 1.36 from Bizet's *Carmen* demonstrates an octave registral coupling separated by two octaves, creating a thinned out multi-octave coupling between the piccolo (sounding an octave above written) and the clarinet. Forsyth describes it as follows:

In these combinations one occasionally finds the middle octave omitted altogether. The Piccolo then doubles the Wood-Wind phrase at the 16th. For instance, in the Entr'acte before Act IV of *Carmen* the Clarinet has a *pp* semiquaver passage in its middle octave while the Piccolo has the same series of notes *p* two octaves higher. The effect is curiously and characteristically French. (1914, p. 201)

Example 1.36: Bizet, *Carmen*, Entr'acte between acts III and IV - mm. 25–32. (Score in C)

1.5.8 TRI-CHROMA, UNISON COUPLING

In Example 1.37, the main theme from the Overture to Mozart's *The Magic Flute*, the bassoons, viola, and cello play repetitions of the main theme, a unison registral coupling. All dynamics and articulations in this case are the same.

The musical score for Example 1.37 is for the Overture to Mozart's *The Magic Flute*, measures 27–28. It features three staves: Bassoon 1 (Bsn 1), Bassoon 2 (Bsn 2), and Viola (Vla). The cello (Vc.) part is also present but not shown in the image. The tempo is marked 'Allegro'. The key signature has two flats (B-flat and E-flat). The time signature is common time (C). The music consists of a unison theme played by the bassoons, viola, and cello. The dynamics are marked *p* (piano) and *f* (forte) in a repeating pattern. The articulation is consistent across all instruments.

Example 1.37: Mozart, *The Magic Flute*, Overture, mm. 27–28.

In Example 1.38, from Alban Berg's Violin concerto (adapted from Read, 2004, p. 6), the clarinet in Bb, clarinet in A (these clarinets have slightly different timbres) and bass clarinet play in a unison registral coupling in the clarinets' low-mid register and in the bass clarinet's upper-mid register.

The musical score for Example 1.38 is from Alban Berg's Violin Concerto, measures 72–74. It features three staves: Clarinet in Bb 1, Clarinet in A 2, and Bass Clarinet. The tempo is marked 'Allegro' (♩ = 56). The key signature has two sharps (F# and C#). The time signature is 2/4. The music consists of a unison theme played by the clarinets and bass clarinet. The dynamics are marked *p* (piano). The articulation is consistent across all instruments.

Example 1.38: Berg, *Violin Concerto*, mm. 72–74. (Score in C)

In Example 1.39, the “Sultan theme” from Rimsky-Korsakov's *Scheherazade*, mov. I, mm. 46–49, is orchestrated with oboe 1, clarinet 1, and violins I and II in a tri-chroma instrumental coupling (and in a unison registral coupling). All instruments share the same dynamics and also the same articulations, however the line is in different instrumental registers for each instrument.



Example 1.39: Rimsky-Korsakov, *Scheherazade*, mov. i, mm. 46–49. (Score in C)

1.5.9 TRI-CHROMA, UNISON AND OCTAVE COUPLING

In Example 1.40, an excerpt taken from just a few measures after Example 1.37 in the *Magic Flute* Overture, the orchestration has changed. Mozart has now removed bassoon 2, and added the contrabass at the octave below (*cf.* Example 1.37) creating a new coupling at the octave. The bassoon 1 and cello still play in unison; this registral coupling at the unison is contrasted with the single part of the contrabass. Thus, Mozart creates a two-registral-voice octave coupling using three parts.

33 Allegro

Example 1.40: Mozart, *The Magic Flute*, Overture, m. 33

1.5.10 TRI-CHROMA, OCTAVE AND INTERVALLIC COUPLING

The next example, Example 1.41 taken from m. 149 of Ravel's *Boléro*, is perhaps the most famous example of parallel-interval registral coupling, and it displays a great example of a tri-chroma instrumental coupling, combining instruments from three families: woodwinds, brass,

and percussion. The horn (C5) is coupled first at the octave by the left hand of the celesta (C6), then at two octaves by the right hand (C7). The piccolo 2 plays at one octave and a fifth above (G6; heard one octave higher than written), and the piccolo 1 a third above the second octave (E7; heard one octave higher than written). The intervallic relationships mirror the vertical arrangement of the harmonic series, now a relatively common practice in orchestrational combinations (however, the use of parallel—rather than diatonic—major thirds and parallel fifths were rare at the time *Boléro* was composed).

Example 1.41: Ravel, *Boléro*, mm. 149–156. (Score in C)¹⁰

1.5.11 TRI-CHROMA, MULTI-UNISON AND OCTAVE COUPLING

Example 1.42 is a multi-unison octave coupling from Wagner's "Prelude" to *Tristan und Isolde*. The oboe 1 and clarinet 1 are unison coupled in the upper registral voice, with clarinet 2 and horn 1 coupled in the lower registral voice.

¹⁰ The key signatures on the piccolo and flute are notated since Ravel intended them to ensure perfect parallelism.

Langsam und Schmachkend

Ob. 1

Cl. in A 1.2

Hn in F 1

Example 1.42: Wagner, *Tristan und Isolde*, “Prelude,” mm. 32–36. (Score in C)

1.5.12 TRI-CHROMA, MULTI-UNISON AND HARMONIC COUPLING

In Example 1.43, from Strauss’ *Till Eulenspiegel*, Forsyth (1914) refers to the solo violins as not being important to the overall sound but just serving to steady and balance the brass. This represents a multi-unison and harmonic registral coupling of the horn, trumpets, and solo violins. The upper two registral voices are in unison between the trumpets 1 and 2 and solo violins 1 and 2; the lower two registral voices are unisons between horns 1 and 2 and solo violins 3 and 4. Each of these unison couplings is a duo-chroma coupling across families, yet the overall combination can be labelled as a compound tri-chroma, multi-unison and harmonic coupling.

Gemächlich
con sord.

doppelt so schnell

Hn in F 1.2

Tpt in F 1.2

Solo 1

Solo 2

4 erste Solo viol.

Solo 3

Solo 4

Example 1.43: Strauss, *Till Eulenspiegel*. (Score in C)

1.5.13 TETRA-CHROMA, MULTI-OCTAVE COUPLING

Example 1.44, shows the addition of a new registral voice—octave registral couplings—in each instrumental entry: from solo violin I, to first octave registral coupling entry of violin II at m. 522, to three-octave registral coupling at the entry of the viola in m. 25. The cello and contrabass enter simultaneously at m. 529, creating a five-octave registral coupling. This kind of multi-octave registral coupling, with one instrument in each voice, is a good contrast to other examples where multiple parts will share one voice (i.e., a compound, multi-octave registral coupling). “Composers have reinforced melodic material through doublings in a number of ways. In Beethoven's *Leonore Overture No. 3*, octaves are added to the initial melodic line until the dynamic of triple forte is reached.” (Adler, 2002, pp. 130–131)

Example 1.44: Beethoven, *Leonore*, Overture, mm. 514–532.

In Example 1.45, Rimsky-Korsakov speaks about the “lack of balance” in each registral voice: the upper voice a duo-chroma unison coupling, the middle a mono-chroma unison coupling of the cellos, the lowest a mono-chroma unison coupling of the basses. Overall it is tetra-chroma, but the various registral and instrumental couplings work together to create the “rough and severe” character that Rimsky-Korsakov is going for (p. 44).

215 Vivace ♩ = 160

Example 1.45: Rimsky-Korsakov, *Snegourotchka*, rehearsal 215.

1.5.14 TETRA-CHROMA, HARMONIC COUPLING

In the fourth movement of Tchaikovsky's 6th symphony, there are two excellent examples of harmonic registral coupling. We must first look at the excerpt that occurs later in the movement, starting from m. 90, Example 1.46, where we see the rhythmic doubling of violin I and II, viola, and cello, at first moving in parallel motion, then oblique and contrary. In m. 94, the contrabass joins in octaves with the cello.

90 Andante non tanto ♩ = 60

Example 1.46: Tchaikovsky, Symphony no.6, mov. iv, mm. 90–95.

Contrast this example with the opening measures of the movement, shown in Example 1.47, where Tchaikovsky takes this exact melodic line and arpeggiates the harmony in a unique way, alternating the parts between voices: the voice and parts are 1:1 or coequal in Example 1.46, whereas in Example 1.47 the voices remain the same—the exact same pitches as m. 90—

but violin I and II alternate and viola and cello alternate, giving each successive note of the melody to these respective different instruments. Tchaikovsky is aware, as a master orchestrator, that the listener will perceive the descending melodic line—the upper surface of the music. Used within a relatively homogeneous timbral ensemble, the orchestrational quality of the harmonic registral coupling renders it very effective (all the while providing some spatial ambiguity when violins 1 and 2 are on opposite sides of the stage as in many European orchestras).

Adagio lamentoso $\text{♩} = 54$

largamento affrettando

Vln I

Vln II

Vla

Vc.

Cb.

f *mf* *p* *mp*

Example 1.47: Tchaikovsky, Symphony no.6, mov. iv, mm. 1–8.

1.5.15 TETRA-CHROMA, UNISON AND MULTI-OCTAVE COUPLING

In Example 1.48, Tchaikovsky scores violin 1 in the upper registral voice, violin 2 in the middle registral voice one octave below, and viola and cello a further octave below in unison in *Romeo and Juliet*.

Allegro giusto

Vln I

Vln II

Vla

Vc.

f

Example 1.48: Tchaikovsky, *Romeo and Juliet*, mm. 388–395.

1.5.16 TETRA-CHROMA, UNISON AND PARALLEL INTERVALLIC COUPLING

Piston (1969), in discussing repertoire for the trombone, describes the excerpt in Example 1.49 as a “[c]olorful phrase in parallel chords” (p. 280). Although he mentions that the oboe, English horn, and clarinets “doubl[e] an octave above,” this is another example where the terminology and descriptiveness of the catch-all term “doubling” falls short. It is only the trombone 1 and 2 that are doubled at the octave: trombone 1 at the octave by the oboe 1 and clarinet 1 in unison, and trombone 2 by the oboe 2 and clarinet 2 in unison. Clarinet 3 is in unison with trombone 1, and the English horn is also at the unison with trombone 1 (possibly an oversight by Piston to lump it into the octave doubling).

The image shows a musical score for Rehearsal 23 of Debussy's *Images pour orchestre*, "Iberia." The score is in 2/4 time and features four staves: Oboe 1 and 2 (Ob. 1, 2), Clarinet in A (C. A.), Clarinet in Bb (Cl. in Bb 1, 2, 3), and Trombone 1 and 2 (Tbn 1, 2, 3). The tempo is marked "Rubato" with a metronome marking of ♩ = c. 132, followed by "expressif et soutenu" and then "A tempo." The music consists of parallel chords, with the oboe, clarinet, and trombone parts playing in unison. The score includes dynamic markings of *p* (piano) and *très doux et très souple* (very soft and very supple). The rehearsal number 23 is indicated in a box at the top left.

Example 1.49: Debussy, *Images pour orchestre*, “Iberia,” Rehearsal 23. (Score in C)

1.5.17 QUINTA-CHROMA, MULTI-UNISON AND MULTI-OCTAVE COUPLING

From Smetana’s “Overture” to *The Bartered Bride*, in the melody excerpt shown in Example 1.50, we examine a multi-unison and multi-octave registral coupling. Overall it is a quinta-chroma instrumental coupling, but it can be analyzed by looking at the three registral voices: piccolo solo on the upper registral voice, flutes 1 and 2 unison coupled with the clarinet 1 as a duo-chroma on the soprano registral-voice, oboe 1 and 2 and clarinet 2 unison coupled as a duo-chroma on the alto registral-voice, and bassoons 1 and 2 in unison on the tenor registral-voice in a mono-chroma coupling.

Vivacissimo

Fl. 1.2
Picc.
Ob. 1.2
Cl. in C 1.2
Bsn. 1.2

Example 1.50: Smetana, *Bartered Bride*, Overture, mm. 459–461. (Score in C)

1.5.18 QUINTA-CHROMA, UNISON AND HARMONIC COUPLING

Example 1.51, adapted from Gevaert (1885), comes from Meyerbeer's opera *Robert le Diable*, in the “*Bacchanale des nonnes damnées*” (1831). This example highlights the use of rhythmic unison, which unifies the excerpt. Gevaert speaks about the piccolo's combination with the triangle, creating a “metallic timbre” (p. 132). The triangle contributes to the instrumental coupling, but not necessarily to the harmonic coupling given that as an unpitched percussive instrument it does not explicitly contribute to the registral coupling. However, due to its instrumental register (which resides in the high orchestral register), it does blend with the piccolo (see chapters 3 and 4, timbral relationships and auditory fusion).

Alla breve con moto

Fl. 1.2
Picc.
Ob. 1.2
Cl. in A 1.2
Tri.

Example 1.51: Meyerbeer, *Robert le diable*: “*Bacchanale des nonnes damnées*,” p. 543 of the score. (Score in C)

1.5.19 POLY-CHROMA, MULTI-UNISON AND MULTI-OCTAVE COUPLING

At a large arrival point, shown in Example 1.52, in the aria “E lucevan le stelle” from Puccini’s *Tosca*, Cavaradossi (tenor voice) is joined by the woodwinds and strings in a poly-chroma multi-unison and multi-octave coupling. The flutes 1 and 2 and violin 1 appear in unison on the upper registral voice. Flute 3, oboe 1 and 2, clarinet 1 and 2, and violin 2 occur in unison on the middle registral voice. And finally, Cavaradossi sings in unison with bassoon 1 and 2, viola, and cello.

Andante lento appassionato molto
Sostenuto cresc. con slancio

(13)

Example 1.52: Puccini, *Tosca*, “E lucevan le stelle,” rehearsal 13. (Score in C)

1.5.20 POLY-CHROMA, COMPOUND, UNISON AND OCTAVE AND HARMONIC COUPLING

Another example from *Boléro*, from theme “B” at m. 203, contains parallel, similar, and oblique motion, as well as unison and octave couplings. Therefore, it is categorized as a

compound harmonic coupling and is shown in Example 1.53, with all its components. It is a multi-unison, multi-octave, multi-interval, and harmonic coupling: clarinet 2 and tenor sax are in unison on Bb4, English horn is solo on E5, oboe 2 is solo on G5, oboe 1 and clarinet 1 are in unison on Bb5, flute 2 is solo on E6, flute 1 is solo on G6, and piccolo is solo on Bb6. In m. 206, these registral voice couplings stay consistent, but the simultaneous motion changes from parallel to oblique motion, making this passage overall a harmonic registral coupling (the flute 2 and English horn only rise by the interval of a second, while the other instruments rise by a third).

Example 1.53: Ravel, *Boléro*, mm. 203–210. (Score in C)

From Mahler's Fourth Symphony, movement iv, Example 1.54 demonstrates a polychroma coupling with the piccolo, harp, strings and soprano voice. It is a multi-unison, multi-octave, harmonic coupling.

Wieder zurückhaltend

73

Picc. *mf*

Hp I *pp* nicht brechen

Sop. solo
die Eng - lein, die ba - cken das Brot.
mit Dämpfer

Vln I *pp* mit Dämpfer

Vln II *pp* mit Dämpfer

Vla *pp* mit Dämpfer

Vc. *pp* mit Dämpfer

Cb. *pp*

Example 1.54: Mahler, Symphony no. 4, mov. iv, mm. 73–74

In Example 1.55, the famous excerpt from Rossini’s *William Tell* “Overture,” a poly-chroma coupling of the woodwinds, horns, trumpets, and strings, with multi-unisons and multi-octave registral couplings moving in parallel motion, combines with other intervals moving in parallel, similar, and oblique motion to create the harmonic coupling.

Allegro Vivace

Fl. 1
Picc.
Ob. 1, 2
Cl. in A 1, 2
Bsn. 1, 2
Hn in G 1, 2
Hn in E 3, 4
Tpt in C 1, 2
Vln I
Vln II
Vla 1a, 1b
Vc.
Cb.

Example 1.55: Rossini, *William Tell*, “Overture” (Score in C)

1.6 ORCHESTRATIONAL COMBINATIONS: VERTICAL STRUCTURING

This section expounds upon basic principles of registral and instrumental combinations, in the context of their *vertical structuring* and *interrelationships*. Much has been written about balance and tonal emphasis in the creating and scoring of an orchestral *tutti* musical passage like the one in Example 1.56 (Berlioz, 1948; Adler, 2002; Piston, 1969; Brant, 2009; Kennan & Grantham, 2002; Rimsky-Korsakov, 1912; Jacob, 1982).

Example 1.56: Mozart, *Don Giovanni*, “Overture.” Final chord of concert version. (Score in C)

As orchestral *tutti* chords are constructed of both registral and instrumental couplings, the term doubling in respect to pitch and to instrumentation can be better served in these detailed vertical chordal structures, as standard orchestral chords are created by repeating pitch material across many registers. The re-voicing of the chord is already unique (e.g., either in root position 5/3, first inversion 6/3, second inversion 6/4, etc.). But with the orchestral registral palette, these doublings (or triplings, etc.) of the pitch (register-based) material also reiterate or restate

intervallic sonorities that are complemented, or contrasted by, the instrumental-based couplings used in the orchestration.

The interaction of the intervals—unison, third, fourth, fifth, sixth, octave, and compound intervals—combined with tone-colour of the instrumentation define the character of these kinds of large-scale orchestral chords (Cordero, Paris 2016). With the deliberate placement of instrumental timbre in specific orchestral registers, these chords reflect a correlation between registral placement height and instrumental differences. This can function much like a sonic fingerprint as well: composers have idiosyncratic ways of voicing. It is the combination of these regions—of specific registral couplings combined with instrumental couplings—that can be defined as *regions of contact* (see section 1.6.3). In example 1.56, from Domenico Cimarosa’s *Il matrimonio segreto* (1792), the D major chord is voiced differently in each restatement. The opening chord can be analyzed from the low to high registers—to see the vertical distribution of the timbral and registral relationships—as containing the following compound registral couplings:¹¹

- a tetra-chroma octave coupling of the mono-chroma unison contrabass with the tri-chroma unison of cello and timpani and bassoon 1 and 2 (D2 with D3);
- a quinta-chroma intervallic (third) coupling between the tri-chroma unison coupling of cello and timpani and bassoon 1 and 2 with a duo-chroma unison coupling of the bass note of the viola and horn 2 (D3 with F#3);
- a duo-chroma intervallic (sixth) coupling between the duo-chroma unison coupling of the bass note of the viola and horn 2 with a duo-chroma unison coupling of the upper note of the viola and horn 1 (F#3 with D4);
- a poly-chroma intervallic (third) coupling between this duo-chroma unison coupling of the upper note of the viola and horn 1 with the tetra-chroma unison coupling of the violin 1, violin 2, trumpet 2, clarinet 2, and oboe 1 and 2 (D4 with F#4);

¹¹ For the sake of text space and clarity, the chroma coupling is implied with the statement of the instrument names

- a tri-chroma intervallic (third) coupling between the tri-chroma unison coupling of the violin 1, violin 2, clarinet 2, and oboe 1 and 2 with the mono-chroma unison coupling of the violin 2 (F#4 with A4);
- a poly-chroma intervallic (fourth) coupling between the mono-chroma unison coupling of the violin 2 and the tetra-chroma unison coupling of violin 1, trumpet 1, clarinet 1, and flute 1 and 2 (A4 with D5).

There are as well the combinatorial qualities that all of these couplings have with one another. These orchestral voicings change in the second and third statements of the chord as it rises.

Largo

The musical score is for an orchestral passage in C major, measures 1-3, marked 'Largo'. The instruments listed on the left are: Fl. 1.2, Ob. 1.2, Cl. in A 1.2, Bsn 1.2, Hn in D 1.2, Tpt in D 1.2, Timp., Vln I, Vln II, Vla, Vc., and Cb. The score shows a chordal texture with various instruments playing sustained notes and some moving lines. Dynamics include 'f' (forte) and 'a 2' (second octave).

Example 1.57: Domenico Cimarosa, *Il matrimonio segreto*, mm. 1–3 (Score in C)

1.6.1 VERTICAL DISTRIBUTION, BACKGROUND AND CURRENT TERMINOLOGY

Rimsky-Korsakov proposed three types of vertical distribution:

- Superposition or Overlaying (following the order of register per instrument; one instrument overlaid on top of another)
- Crossing
- Enclosure of parts

In Example 1.58, “Overlaying,” the pitches of the clarinet are above those of the bassoon—an octave and duo-chroma coupling between bassoon 2 and clarinet 2, and various intervallic couplings.¹² “Crossing” shows the layering of instruments in the orchestral register—clarinet 2, oboe 2, clarinet 1, then oboe 1—again an octave and duo-chroma coupling of clarinet 2 and oboe 1, and various other different-pitch-class intervallic couplings; “Enclosure” demonstrates the flutes scored in a register that is between where the oboes are scored—this time an octave and mono-chroma coupling between the oboes, and then various intervallic couplings. Rimsky-Korsakov (1912) addresses the issue of balance and instrumental register in the construction of these chords:

The last two methods involve a certain disturbance of the natural order of register [...]. In choosing one of these three methods the following points must not be forgotten: a) the register of a particular isolated chord; the soft and weak register of an instrument should not be coupled with the powerful and piercing range of another. [...] (p. 73)

¹² In chordal structures, an exhaustive list of the interval relationships is too exhaustive to list since they increase quadratically with the number of pitches.

	Overlaying	Crossing	Enclosure
Fl. 1.2			
Ob. 1.2			
Cl. in Bb 1.2			
Bsn 1.2			

Example 1.58: Rimsky-Korsakov, *Principles of Orchestration*, “Vertical Distribution.,” p. 73.
(Score in C)

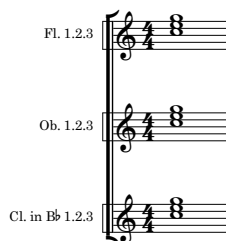
The current standard terms (Berlioz, 1948; Piston, 1969; Adler, 2002; Brant, 2009; Kennan & Grantham, 2002; Rimsky-Korsakov, 1912; Jacob, 1982) used to describe the vertical distribution of instruments are:

- Juxtaposition, superimposing, or overlaying
- Interlocking, crossing, or dovetailing
- Enclosure
- Overlapping

Piston explains these four categories:

Vertical relationships between instrumental tones are important in securing an even vertical plane of sound, without noticeable breaks where one tone color adjoins another. It is customary to distinguish, in addition to octave and unison doubling, four relationships that may exist vertically between pairs of instruments. These are overlapping, superposition, interlocking, and enclosing. (Piston, 1969, p. 396)

I, however, propose a fifth term: *Matching*. Matching occurs where the same instruments play two or more notes. Even Rimsky-Korsakov presents a similar idea as “matching” but does not give it a clear category, and calls it, for example, a *three-fold duplication*: “Wood-wind in three’s admit of perfectly balanced mixed timbres in chords of three-part harmony [...] These timbres may even originate from three-fold duplication.” (1912, p. 78). (See Example 1.59)



Example 1.59: Rimsky-Korsakov, *Principles of Orchestration*, “Three-fold distribution,” p. 78.
(Score in C)

1.6.2 VERTICAL STRUCTURING

Juxtaposition, interlocking, and enclosure describe *registral couplings* between different instruments, and on their own always have registral-coupling relationships other than unison. Overlapping and matching are *compound registral couplings*: overlapping contains unison as well as other non-unison couplings, while matching always has unison couplings that are in turn coupled with other unison couplings (multi-unison and other types of couplings). This method of voicing chords is illustrated in Fundamental Example 1.60.

	A	B	C	D	E
Ob. 1					
Ob. 2					
Ob. 3					
Cl. in C 1					
Cl. in C 2					
Cl. in C 3					

Example 1.60: Fundamental Example — Vertical Structures. A: Juxtaposed; B: Interlocked; C: Enclosure; D: Overlapping; E: Matching

Table 1.3 shows the corresponding Fundamental Example for possible vertical structures in orchestration. In the register-based view, the rows represent pitches spanning one octave, and the columns the five types of vertical structuring. This view seems at first to be not very insightful as the pitches are the same for each category, but this is actually the interesting fact, as

will be understood by analyzing the score-based view. The rows in the score-based view are the instruments, and the columns are the vertical structuring types with the pitch names that are being played by each instrument, colour-coded to match the pitch names in the register-based view. For the first three examples—Juxtaposition, Interlocking, and Enclosure—the same instruments are orchestrated in different registers; this is the essence of vertical structuring, pitch class and different-pitch-class registral coupling. For the last two categories—overlapping and matching—the third instrument from each section is added to the mix. This is because these two categories add the qualities of unison coupling to the intervallic coupling.

Table 1.3: Fundamental Example — Vertical Structures

Register-based view					
	Juxtaposition	Interlocking	Enclosure	Overlapping	Matching
E					
D					
C					
B					
A					
G					
F					
E					
Score-based view					
Oboe 1	E	E	C	E	C
Oboe 2	C	G	G	C	G
Oboe 3	(tacet)	(tacet)	(tacet)	G	E
Clarinet 1	G	C	E	C	C
Clarinet 2	E	E	E	G	G
Clarinet 3	(tacet)	(tacet)	(tacet)	E	E

Vertical structures summary:

- Juxtaposing/Overlaying: two or more instruments, with register and instrumental couplings that are “stacked” vertically.
- Interlocking: two or more instruments where the instrument is separated in the orchestral register by another instrument, hence the moniker of *interlocked* as the registers of the instruments are interlocked at specific pitch heights in the orchestral register.
- Enclosing: two or more instruments where one instrument is scored in the orchestral register between where the other instrument is scored.
- Overlapping: Similar to juxtaposition, two or more instruments, with register and instrumental couplings that are “stacked” vertically, except that there is an overlapping of

the orchestral registers where these instruments are scored, and therefore a unison coupling at the overlapping point is a key feature of this type of structuring.

- Matching: two or more instruments which are scored at the same register—with the same pitches—therefore creating unison couplings.

1.6.2.1 Obfuscation of terminologies

The standard terms—juxtaposing, interlocking, and enclosing—that authors, such as Read (2204) and Brant (2009), use to talk about the structuring of these orchestral chords, however, are somewhat ensnared in a type of multi-modality; they refer to both instrumental and registral combinations by using terms that only represent registral relationship combinations.

The terms are somewhat misleading as they refer to the pitch height/registral (instrumental or orchestral registral) contrasts; all of the timbres are “juxtaposed” upon the ear if they are attacked and sustained together, whether or not their vertical placement is juxtaposed, interlocked, enclosed, or overlapped (it is only in overlapped chords that there is a doubling along with the coupling). This distinction is useful to highlight how instruments can be organized (i.e., coupled) vertically, and how a particular arrangement of timbres might be organized.

These terms are not used consistently in the literature, as Read (2004), for example, employs the term juxtaposition to refer to unison instrumental couplings—“the juxtaposition of flute and oboe timbre will result in sharpness added to the former and sweetness blended into the latter” (p. 26), and “Whether single- or double-reed or flute, the woodwinds can only provide one of the two timbres desired in any unison juxtaposition.” (p. 106)—and to octave coupling or vertical juxtaposition:

Octave doubling among instruments of similar timbre is a fairly common orchestrational practice. Usually the several instruments involved are in normal juxtaposition one to the other: piccolo above flute, clarinet above bass clarinet, and so on. (Read, 2004, p. 113)

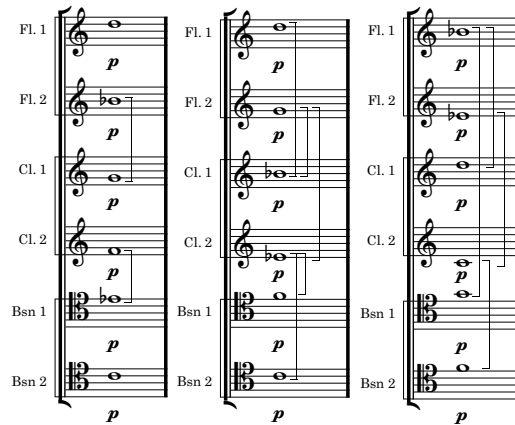
Therefore, one needs to be aware that a particular use of the term indicates juxtaposing orchestral registers and instrumental qualities, and another use solely concerns juxtaposing timbral qualities. In this thesis, I will only call upon the term juxtaposition to refer to the former; orchestral registral (pitch) juxtapositions.

1.6.3 REGIONS OF CONTACT

Brant's (2009) insight into the vertical boundary between timbres is a welcomed addition to the understanding of how vertical arrangements can affect balance and blend; he labels the vertical boundary between instruments the *interval of contact*:

In harmonic situations a significant factor is the *interval of contact*. This is formed between adjacent instruments of different tone-quality in the same chord. Such intervals create the points at which any dissimilarity in timbre might become noticeable. If identical instruments are not available, then *juxtaposing similar tone qualities* is the best way to realize harmonic textures. Juxtaposition gives a clearer harmonic effect than interlocking or enclosure, because it produces few intervals of contact and consequently creates fewer internal differences of timbre in the vertical combination. (p. 11)

As seen in Example 1.61, from Brant's book, *Textures and Timbres*, there are six pitches (spanning a 9th from C4 to D5) and three timbres (the flute, clarinet, and bassoon). In chord #1 (the chord on the left), from top to bottom: the two flutes are on D5 and Bb4, the two clarinets on G4 and F4, and the two bassoons on Eb4 and C4. This is a *juxtaposed coupling* of register and instrument-based qualities. In chord #2 (the middle chord), each change of vertical pitch now contains a different timbre: the two flutes are on D5 and G4, the two clarinets on Bb4 and Eb4, and the two bassoons on F4 and C4. This is an *interlocked coupling* of register and instrument-based qualities. In chord #3 (the chord on the right), from top to bottom: the clarinets now have the outer voices, on D5 and C4, the two flutes are on Bb4 and Eb4, and the two bassoons have the inner voices on G4 and F4. This is an *enclosed coupling* of register and instrument-based qualities. Therefore, chord #1 (juxtaposition) had the least *intervals of contact*, chord #2 (interlocking) the most. *Interlocked coupling* therefore creates the most intervals of contact, as each tone-quality is contrasted by another. This example is tri-chroma coupling, within-instrument-family.



Example 1.61: Adapted from Brant (2009, p. 11), intervals of contact.

It is unclear, however, why Brant selects the term “interval” in order to define an instrumental or timbral quality. I propose an updated term: *Region of contact*. The *region of contact* refers to both the orchestral register(s) and the instrument(s) involved. Regions of contact are an important principle that affect the balance and coloristic qualities of an orchestral chord. This insight is important because it points out the important quality of where the registral and instrumental interact.

Piston speaks about regions of contact as the location where tone-colours are adjointed:

Vertical relationships between instrumental tones are important in securing an even vertical plane of sound, without noticeable breaks where one tone color adjoins another. It is customary to distinguish, in addition to octave and unison doubling, four relationships that may exist vertically between pairs of instruments. These are overlapping, superposition, interlocking, and enclosing[...]. Overlapping occurs when the lower of one pair of instruments is in unison with the upper of a second pair. (1969, p. 396)

1.6.4 COMBINATION OF VERTICAL STRUCTURES:

Vertical structuring qualities usually do not happen in isolation (i.e., instruments that are solely juxtaposed); composers use these principles to build parts of a chord, depending on register, instrument, and most importantly, compositional context.

The following *tutti* example from Appendix III of Rimsky-Korsakov’s treatise, the final chord of the *Tsar’s Bride* “Overture,” shows the horns *enclosing* the bassoon, with each subsequent vertical relationship *juxtaposed*; the clarinets are scored above the horns and

bassoons, the oboes above the clarinets, the flutes above the oboes. There are no unisons in this chord.

Fl. 1.2

Ob. 1.2

Cl. in A 1.2

Bsn 1.2

Hn in F 1.2

Example 1.62: Rimsky-Korsakov, *Principles of Orchestration*, “*The Tsar’s Bride*,” Appendix III, ex. 14. (Score in C)

In the following example from Beethoven’s *Eroica*, the overall structuring is overlapping and interlocking, as there is a fair number of unisons as well as instruments sharing specific locations in the orchestral register.

Allegro con brio $\text{♩} = 60$

Example 1.63: Beethoven, Symphony no. 3, “Eroica,” mov. 1, m. 1. (Score in C)

1.6.5 CASE STUDY: RIMSKY-KORSAKOV C MAJOR CHORD

From Appendix I of Rimsky-Korsakov’s treatise, the first of the examples of the 20 “single *tutti* chords” is a C major chord from *La Nuit de Mai*, containing just three pitch classes that are spread out in ten orchestral registral voicings and built with 23 instrumental parts (Example 1.64). There are eight unisons and two solo instruments that create these registral voices, and from the low to high orchestral register they are:

- Unison on C2 by contrabass and bassoon 2 — duo-chroma coupling
- Unison on C3 by cello, timpani, trombone 3, and bassoon 1 — tetra-chroma coupling

- Unison on G3 by bass note of viola dyad and trombone 2 — duo-chroma coupling
- Unison on C4 by violin 2 and horn 2 — duo-chroma coupling
- Unison on E4 by upper note of viola dyad, violin 1, trombone 1, and horn 1 — tetra-chroma coupling
- Unison on G4 by horn 3 and 4 — mono-chroma coupling
- Unison on C5 by trumpet 2, clarinet 2, and oboe 2 — tri-chroma coupling
- Unison on E5 by trumpet 1, clarinet 1, and oboe 1 — tri-chroma coupling
- Solo instrument on C6 by flute 2
- Solo instrument on E6 by flute 1

The image shows a musical score for Example 1.64, titled "La Nuit de Mai," from Appendix I, ex. 1 (Score in C). The score is written for a full orchestra, including Flute 1.2, Oboe 1.2, Clarinet in Bb 1.2, Bassoon 1.2, Horn in F 1.2, Horn in F 3.4, Trumpet in C 1.2, Trombone 1.2.3, Timpani, Violin I, Violin II, Viola, Violoncello, and Contrabass. The score is marked with a forte (ff) dynamic. The instruments are arranged in a vertical stack, with the Flute 1.2 at the top and the Contrabass at the bottom. The score is written in C major, 4/4 time, and features a unison of G3 across multiple instruments.

Example 1.64: Rimsky-Korsakov, *Principles of Orchestration*, “La Nuit de Mai,” Appendix I, ex. 1 (Score in C)

In terms of the doubling of pitch material, or pitch-class couplings, the following are the components of the five-octave registral coupling and poly-chroma couplings for the pitch class of “C”, the root note of the orchestral chord (Example 1.65):

- C2 by contrabass and bassoon 2
- C3 by cello, timpani, trombone 3, and bassoon 1
- C4 by violin 2 and horn
- C5 by trumpet 2, clarinet 2, and oboe 2
- C6 by flute 2

The image displays a musical score for various instruments, all playing the pitch class 'C' (middle C) with a forte (ff) dynamic. The instruments and their corresponding staves are: Flute 2 (Fl. 2), Oboe 2 (Ob. 2), Clarinet in B-flat 2 (Cl. in B♭ 2), Bassoon 1 (Bsn 1), Bassoon 2 (Bsn 2), Horn in F 2 (Hn in F 2), Trumpet in C 2 (Tpt in C 2), Trombone 3 (Tbn 3), Timpani (Timp.), Violin II (Vln II), Viola (Vc.), and Contrabass (Cb.). The score is written in a vertical format, with each instrument's staff showing a single note on a ledger line or staff line, all marked with a forte (ff) dynamic.

Example 1.65: Rimsky-Korsakov, *Principles of Orchestration*, “La Nuit de Mai,” Appendix I, pitch class “C” (Score in C)

For the pitch class E, the third of the chord, a three-octave registral coupling, poly-chroma (Example 1.66):

- E4 by upper note of viola dyad, violin 1, trombone 1, and horn 1
- E5 by trumpet 1, clarinet 1, and oboe 1
- E6 by flute 1

Musical score for Example 1.66, showing pitch class E across various instruments. The instruments listed are Fl. 1, Ob. 1, Cl. in B♭ 1, Hn in F 1, Tpt in C 1, Tbn 1, Vln I, and Vla. Each instrument part shows a single note on a staff, all marked with a forte (ff) dynamic. The notes are: Fl. 1 (E6), Ob. 1 (E5), Cl. in B♭ 1 (E5), Hn in F 1 (E4), Tpt in C 1 (E5), Tbn 1 (E4), Vln I (E4), and Vla (E4).

Example 1.66: Rimsky-Korsakov, *Principles of Orchestration*, “*La Nuit de Mai*,” Appendix I, pitch class E (Score in C)

And for the pitch class G, the fifth of the chord, a two-octave registral coupling, trichroma (Example 1.67):

- G3 by bass note of viola dyad and trombone 2
- G4 by horns 3 and 4

Musical score for Example 1.67, showing pitch class G across various instruments. The instruments listed are Hn in F 3, Hn in F 4, Tbn 2, and Vla. Each instrument part shows a single note on a staff, all marked with a forte (ff) dynamic. The notes are: Hn in F 3 (G4), Hn in F 4 (G4), Tbn 2 (G3), and Vla (G3).

Example 1.67: Rimsky-Korsakov, *Principles of Orchestration*, “*La Nuit de Mai*,” Appendix I, pitch class G (Score in C)

The harmonic relationships between these chord tones create different-pitch-class couplings of thirds, fourths, fifths, sixths:

- Fifth: Unison of C3 by cello, timpani, trombone 3, and bassoon 1 with unison on G3 by bass note of viola dyad and trombone 2
- Fourth: Unison on G3 by bass note of viola dyad and trombone 2 with unison on C4 by violin 2 and horn 2
- Third: Unison on C4 by violin 2 and horn 2 with unison on E4 upper note of viola dyad, violin 1, trombone 1, and horn 1
- Third: Unison on E4 upper note of viola dyad, violin 1, trombone 1, and horn 1 with unison on G4 by horn 3 and 4
- Fourth: Unison on G4 by horn 3 and 4 with unison on C5 by trumpet 2, clarinet 2, and oboe 2
- Third: Unison on C5 by trumpet 2, clarinet 2, and oboe 2 with unison on E5 by trumpet 1, clarinet 1, and oboe 1
- Sixth: Unison on E5 by trumpet 1, clarinet 1, and oboe 1 with solo on C6 by flute 2
- Third: Solo on C6 by flute 2 with solo on E6 by flute 1

With respect to vertically structuring terms, there is no clear juxtaposing, interlocking, enclosing, overlapping, or matching, as all the instruments are involved in registral couplings. Therefore, the vertical structure is built on compound versions of these structuring concepts: the *tutti* (minus flutes 1 and 2) is juxtaposed vertically against the flutes.

1.6.6 SUMMARY OF VERTICAL STRUCTURES

As should now be apparent, there is a multitude of ways that the vertical structuring of Orchestration combinations of a chord can be broken apart and analyzed. These vertical structures are built with registral and instrumental couplings, organized vertically into registral layers labeled according to how the instruments intersect with each other in the orchestral register.

Combinations of compound vertical structures show the depth of detail and interrelationships involved in the vertical structuring of orchestral chords.

Once the principles underlying the combinations of vertical structures are understood, the next step would be to understand the orchestrational technique and orchestrational goals involved in the combining of certain instruments. This taxonomy provides the tools to systematically understand the underlying mechanisms involved in these orchestrational combinations.

1.7 CONCLUSION: ORCHESTRATIONAL COMBINATIONS

The examples explored in this chapter demonstrate the range of basic principles that are needed to understand Orchestrational Combinations: the complex joining of registral, rhythmic, and instrumental qualities. These combinations are the foundation upon which an orchestration is built. A taxonomy that elucidates the component elements that go into creating these combinations also provides the possibility to analyze and further understand the orchestral colours used by the great masters of the orchestral repertoire. By elucidating and developing these taxonomic categories, the composer, researcher, orchestrator, or student derives further insight into the creative process that goes into the art of Orchestrational Combinations.

2 BASIC PRINCIPLES OF ORCHESTRATIONAL TRANSFORMATIONS

This chapter examines and explains the basic principles of relationships between changes in orchestrational combinations and presents a taxonomic categorization of these transformations. This categorization illustrates methodical ways that composers create changes in orchestration (combinations and orchestral textures) that have similar structures both locally and across the duration of an entire work.

In order to create contrasting ideas in orchestration, the fundamental elements of change are: 1) changing of the instrumentation; 2) addition or removal of instruments to or from a registral voice; and finally, 3) changing where specific instrumentations and orchestrational combinations are placed in the overall orchestral register. These categories can be combined to create compound changes and denote the primary methods—as seen in the orchestral repertoire—for building an orchestration and changing it over time. They are what I call *Orchestrational Transformations*.

2.1 SUCCESSIVE ORCHESTRATION: ORCHESTRATIONAL TRANSFORMATIONS OF LOCAL MUSICAL ELEMENTS

To grasp the nature of such local (as well as large-scale) orchestrational transformations, a particular approach to score-based analysis is required in an effort to understand a composer's scoring principles and how such local and global scoring approaches relate to one another. To better understand timbral and therefore orchestrational transformations, we need to look into historical practices in order to examine how musical variations of the key parameters of music have been created, these parameters being pitch, rhythm, dynamic, articulation, meter, and, last but not least, instrumentation.

2.1.1 THEMATIC TRANSFORMATION

A contrasting yet complementary theory of formal hierarchy employed widely in nineteenth century music is thematic transformation, also known as monothematicism, or thematic development or treatment (Gehrken, 1914; Samson, 2003; Rea, 1978; Searle, 1955; Wohlfahrt, 1859). Here the basic internal components of the motive/theme become altered or varied by way of augmentations and diminutions, transpositions or expansions, with concomitant changes in expressive intention, so that “thematic development consists in taking a short theme

(or several short themes) and by means of transposition, interval expansion and contraction, rhythmic augmentation and diminution, inversion, tonality changes, etc., building out of it a lengthy composition or section of a composition” (Gehrken, 1914, p. 69). Macdonald (2001: online article) describes “thematic transformation” as a “term used to define the process of modifying a theme so that in a new context it is different but yet manifestly made of the same elements; a variant term is ‘thematic metamorphosis.’”

To summarize, thematic transformation generally refers to the action whereby a musical motive is changed either vertically (changing the relations of the pitches in register) or horizontally (changing or stretching their temporal relationships).

Wohlfahrt (1859) listed eleven principal ways of transforming and thus developing a theme, and it was his opinion that “the repeated thought should not be employed always in its first form; it should be *altered, transformed*, but always so that it may still be recognized. In this way its appearance every time excites a new interest. The art of working up a theme in this way is called *thematic treatment*” (Wohlfahrt, 1859: 9-13 – his emphasis). Here are Wohlfahrt’s eleven ways to develop a theme:

- Transposition
- Expansion
- Contraction
- Augmentation
- Diminution
- Repetition
- Omission
- Changing the Order of Tones
- Reversing the Order of Tones
- Combining Fragments of different Motives
- Inversion

Naturally, all of these changes or transformations are time-based changes. However they can be separated based on whether they are solely time-based or if they additionally have a change of orchestral register. The time and register-based transformations are:

- Transposition
- Expansion
- Contraction

These time- and register-based transformations illuminate basic principles of musical transformation that can be applied to a piece of orchestral music; changes in orchestral register represent changes in orchestration, as they change how, or how much of, the orchestral register is used or not used compared to the previous section of music.

2.1.2 ORCHESTRATIONAL CHANGES

The idea of changing/developing musical material in the form of orchestration is not new. Systematization of such behaviour does seem to be lacking, however, since there is currently no theory that can explain the connection and interrelationship created by orchestrational changes in a composition through the transformation of orchestral elements along with pitch/register and rhythmic elements.

As far back as the late 1800's, Rimsky-Korsakov proposed methods of orchestrating the same music in various ways, however these methodologies of linking successive orchestration together were not followed up and expounded upon by the following multiple generations of orchestration scholars:

The best means of orchestrating the same musical idea in various ways is by the adaptation of the musical matter. This can be done by the following operations: a) complete or partial transference into other octaves; b) repetition in a different key; c) extension of the whole range by the addition of octaves to the upper and lower parts; d) alteration of details (the most frequent method); e) variation of the general dynamic scheme, e.g. repeating a phrase piano, which has already been played forte. (Rimsky-Korsakov, 1912, p. 100)

Here, Rimsky-Korsakov describes registral and instrumental transformations of the same musical idea within an orchestration. Such orchestrational principles resemble quite well the thematic transformations listed by Wohlfahrt: the repetition in a different key is similar to transposition (because of the change of orchestral register it represents an orchestrational change), and extension of the range is similar to expansion, for example.

2.1.3 TRANSFORMING ORCHESTRATIONAL IDEAS

By combining Rimsky-Korsakov's ideas with Wohlfahrt's terminologies, as well as adapting the orchestrational combinations concepts introduced in Chapter 1, I propose new terminology based on transformations of orchestrational ideas that can be easily correlated in order to describe instrumental as well as orchestral register changes. Thus, I propose the following subsidiary terminologies within the overall notion of *Orchestrational Transformations*:

- Alteration: instrument change
- Addition: addition of an instrumental part to an existing registral voice
- Reduction: reduction of an instrumental part from an existing registral voice
- Transposition: transposition of orchestral register
- Expansion: expansion of the orchestral register (creation of new registral voices)
- Contraction: contraction of the orchestral register (removing/condensing registral voices into each other)

The following table, Table 2.1, illustrates the reductions and Fundamental Examples of these Orchestrational Transformations and will be examined in more detail in the following sections. Similar to the tables in Orchestrational Combinations, the upper half is the register-based view, and the lower half the score-based view. In this table however, another subdivision is made: the left-hand side shows instrument-specific transformations, and the right-hand side shows the register-specific transformations.

Table 2.1: Orchestration Transformations — Register and Score-based views

Orchestration Transformations													
Register-based view													
Transformation type	Instrument-specific transformations						Register-specific transformations						
	Alteration		Addition		Reduction		Transposition		Expansion		Contraction		
Time-based principles	Time →		Time →		Time →		Time →		Time →		Time →		
Hypothetical measure	Measure A	Measure B	Measure A	Measure B	Measure A	Measure B	Measure A	Measure B	Measure A	Measure B	Measure A	Measure B	Measure B
Instrumentation type:	Different Instrument		Different Instruments		Different Instruments		Same Instrument		Same InstrumentS		Same Instruments		
A5													
G5													
F5													
E5													
D5													
C5													
B4													
A4													
G4													
F4													
E4													
D4													
C4													
B3													
A3													
Score-based view													
	Instrument-specific transformations						Register-specific transformations						
	Alteration		Addition		Reduction		Transposition		Expansion		Contraction		
Flute 1													
Oboe 1													
Clarinet 1													
Bassoon 1													
Horn 1													
Trumpet 1													
Trombone 1													
Tuba													
Timpani													
Cymbal													
Violin I													
Violin II													
Viola													
Violoncello													
Contrabass													

2.2 ORCHESTRATIONAL TRANSFORMATIONS

This section examines time-based changes in orchestration, divided into instrument-specific transformations and register-specific transformations.

2.2.1 INSTRUMENT-SPECIFIC TRANSFORMATIONS

This section examines instrument-specific changes in orchestration.

2.2.1.1 Alteration

Definition: a time-based principle in orchestration practice consisting of an alteration or change of instruments from a preceding section of music.



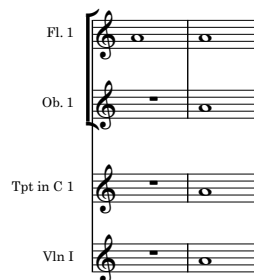
Example 2.1: Fundamental Example — Alteration

Further commentary: Alteration represents a complete change of instrumentation between the two or more excerpts of music. Fundamental Example 2.1 demonstrates the basic principle of *instrumental alteration*: the change of instrument, from flute to oboe.

Exemplifications: See Example 2.10, in Example 2.11, Example 2.12, Example 2.13, Example 2.14, Example 2.15, Example 2.16, Example 2.20, Example 2.21, Example 2.22.

2.2.1.2 Addition

Definition: a time-based principle in orchestration practice consisting of an addition in the number of instruments from a preceding section of music. In orchestral music, this is the addition of one or more instrumental parts to a pre-existing registral voice.



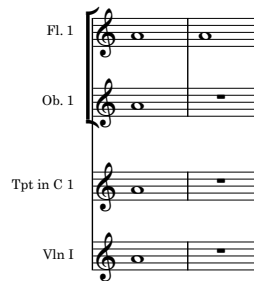
Example 2.2: Fundamental Example — Addition

Further commentary: The taxonomic category of addition results in the creation of a *unison registral coupling* in combination with an *instrumental coupling*. When it involves additions other than unison it is a compound change of instrumental addition and registral addition (see *expansion* in section 2.2.2.2). In Fundamental Example 2.2, one instrument—the flute, in the first measure—is joined by three other instruments at the unison in the second measure. As shown in the Table 2.1 (above) the register-based view looks the same, but the score-based view is much different with the addition of these instruments at pitch.

Exemplifications: See Example 2.17.

2.2.1.3 Reduction

Definition: a time-based principle in orchestration practice consisting of a reduction in number of instruments or timbres from a preceding section of music. In orchestral music, this is the reduction, or subtraction, of one or more instrumental parts from a pre-existing registral voice.



Example 2.3: Fundamental Example — Reduction

Further commentary: Fundamental Example 2.3 demonstrates a tetra-chroma unison coupling of four instruments reduced to solo flute—many parts on one registral voice transforming to one part. The opposite of addition, the FE and the Table 2.1 (above) demonstrate that at its simplest the register can stay the same, but with large (or small) changes of instrumentation.

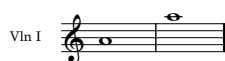
Exemplifications: See Example 2.9, Example 2.15, Example 2.19

2.2.2 REGISTER-SPECIFIC TRANSFORMATIONS

This section discusses orchestrational transformations concerning differences in orchestral register. Changes of orchestral register, either by transposing registers or expanding them to cover a greater or lesser extent of the orchestral register—and either thickening or thinning the texture—affect the orchestration and thus the timbre.

2.2.2.1 Transposition

Definition: a time-based principle in orchestration practice consisting of a change or transposition of orchestral register by either the same instrument or group of instruments from a preceding section of music.



Example 2.4: Fundamental Example — Transposition

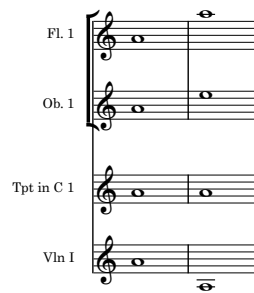
Further commentary: This category is a familiar one, as it represents the standard practice of transposing pitch. However, it is an orchestrational category as well because timbre co-varies with pitch (McAdams, 2013). Therefore, a change in orchestral and instrumental register results in a change of timbre. Changing the orchestral register thus changes the orchestration.

Transposition usually works in concert with instrumental alteration (see Example 2.14, with regard to an example from Saint-Saëns) or happens in isolation, as in the violin I example from Rimsky-Korsakov in Example 2.13. Fundamental Example 2.4 shows violin I playing first on A4, followed by an octave above on A5.

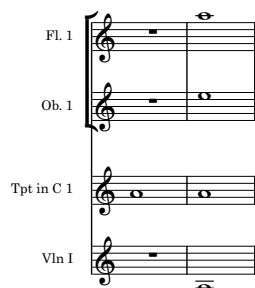
Exemplifications: Example 2.8, Example 2.10, in Example 2.11, Example 2.12, Example 2.13, Example 2.14, Example 2.20

2.2.2.2 Expansion

Definition: a time-based principle in orchestration practice consisting of the broadening of the orchestral registers, as well as the creation of new registral voices, as compared to a preceding section of music. When it includes the taxonomic category of *addition*, expansion becomes a compound orchestrational transformation, as it involves two processes, for *expansion* can *thin* or *thicken* instrumental and pitch occupation of the orchestral register.



Example 2.5: Fundamental Example — Expansion



Example 2.6: Fundamental Example — Compound Expansion

Further commentary: The taxonomic category of *expansion* explains the common feature of orchestral writing where the instrumentation and pitch employment are extended across many registers. This principle is made possible by the wide range of instrumental registers available to an orchestrator, from the creation of octave couplings, to multi-octave couplings, or furthermore in the addition of voices or layers opening up to higher or lower registers. Orchestral parts can move to the new registral voices, therefore no *addition* is necessary for *expansion*. The parts move easily between registral voices, changing the colour, weight, or density of the voice to which they proceed (Rea, 2009). Fundamental Example 2.5 shows the change of the flute, oboe, trumpet, and violin in a unison registral coupling to a compound registral coupling— multi-octave and intervallic. In the next variant of this category—*compound expansion*— as shown in Fundamental Example 2.6, the solo trumpet is transformed by adding three instruments, and all three instruments create their own new registral voices.

Exemplifications: See Example 2.16, Example 2.17, Example 2.20, Example 2.21, Example 2.22

2.2.2.3 Contraction

Definition: a time-based principle in orchestration practice consisting of the narrowing of orchestral registers, from a preceding section of music. When it includes the taxonomic category of *reduction*, the subtraction of voices or parts, it becomes a compound *orchestrational transformation*, as it involves two processes. *Contraction*, like *expansion*, can *thin* or *thicken* the timbral and pitch occupation of the orchestral register.

Further commentary: Contraction may be orchestrated by reducing the registral spread of octave, multi-octave, intervallic, or harmonic registral coupling, and/or instrumental coupling. Fundamental Example 2.7 shows the changes from a multi-octave and intervallic registral

coupling, and tetra-chroma instrumental coupling, to a unison on A4.

The image shows a musical score for four instruments: Fl. 1, Ob. 1, Tpt in C 1, and Vln I. Each instrument has a single note on a whole rest, indicating a unison coupling.

Example 2.7: Fundamental Example — Contraction

Exemplifications: See Example 2.19, Example 2.21, Example 2.22

2.2.3 COMPOUND TRANSFORMATIONS:

As most orchestrations are quite complex, many *orchestrational transformations* are *compound orchestrational transformations*, that is, combinations of transformations, such as often used transformation of Alteration and Transposition (e.g., the instrumentation changes and the register changes), Expansion and Addition (e.g., adding an instrument at an octave above), and Contraction and Reduction (e.g., removing an instrument and a return to a unison coupling).

2.3 EXEMPLIFICATIONS OF ORCHESTRATIONAL TRANSFORMATIONS

The Fundamental Examples above demonstrated reduced and simplified examples of possible orchestrational transformations. The following sections contain examples from the repertoire, many as compound orchestrational transformations. They are organized first by single occurrences, then by the amount of compound qualities they contain.

2.3.1 LOCAL ORCHESTRATIONAL CHANGES

This section contains excerpts from local sections of music, sequential sections of music; where the orchestrational transformations occur amongst local elements.

2.3.1.1 Transposition

An elegant example of transposition of orchestral register used as a principle of orchestration, from the ending of Rimsky-Korsakov's *Scheherazade* (1888), the violin solo line repeats the melody (which has been orchestrated in many ways already throughout the movement, see Chapter 5) at the octave below (Example 2.8).

216 solo
Vln I *p dolce*

220 *p dolce*

Example 2.8: Rimsky-Korsakov, *Scheherazade*, mm. 216–223.

2.3.1.2 Reduction

A clear example of *reduction* can be heard in d'Indy's 1896 composition, *Istar*. The 18-part unison is reduced to ten parts just after Rehearsal S. This change shown in Example 2.9 involves mostly the removal of doubling instruments.



Example 2.10: Meyerbeer, *Dinorah*. (Score in C)

“No composer ever understood the management of contrast and colour better than Auber” (Prout, 1899: 130). The following example in Example 2.11, from Auber’s opera *Actéon* (1836), contains an *instrumental alteration*, first as a subtle alteration between closely related timbres of the piccolo and flute, then as a larger contrast with an *instrumental alteration* and *transposition* down to the oboe, which passes the melodic motif to the clarinet. The transformation happens discretely rather than continuously (McAdams and Goodchild, 2017), as does the above example from Meyerbeer.

Example 2.11: Auber, *Actéon*, mm. 58–62. (Score in C)

An example of an unsuccessful, or poorly scored, instrumental alteration, is also provided by Prout (1899) in his textbook: “Here the effect of the scales in thirds is decidedly ‘patchy,’ because of the sudden changes in the quality of tone, and it is made still more conspicuous by the

points at which the changes are made” (p. 28). The *unison coupling* of the flute and piccolo is contrasted with the *parallel intervallic coupling* of the oboes in parallel thirds, and this without a liaison or dovetailing of their entries. This makes for the abrupt or “patchy” continuity of the line (Example 2.12).

The musical score for Example 2.12 is written for four instruments: Piccolo, Flute 1, Oboe 1 & 2, and Clarinet in B-flat 1 & 2. The tempo is marked 'Allegro' and the key signature has one flat. The Piccolo and Flute 1 parts play a melody in parallel thirds, both marked 'p'. The Oboe 1 & 2 part enters in the second measure with a similar melody, also marked 'p'. The Clarinet in B-flat 1 & 2 part enters in the fourth measure with a lower melody, marked 'p'.

Example 2.12: Hérold, *Le Pré aux Clercs*. (Score in C)

Example 2.13 is taken from the end of the first movement of *Scheherazade* (1888). Rimsky-Korsakov transforms this theme over 26 times in the first movement, each iteration with a different orchestration (more on this in Chapter 5). This example shows the beautiful simplicity of an instrumental alteration: the melody begins in the flute and is passed to the oboe in the following measure. The change in orchestral register is not large, just a perfect fourth, but the timbre of the oboe in the instrumental register it was scored in is much richer than if it had started on the E6.

Tranquillo

206

Fl. 1

Ob. 1

210

Fl. 1

Ob. 1

p dolce

p dolce

Example 2.13: Rimsky-Korsakov, *Scheherazade*, mm. 206–213.

A frequent scoring technique concerns the use of a pizzicato bass punctuating the downbeat. Example 2.14 (adapted from Prout, 1899, p. 153) exemplifies this change of orchestral registers, as well as the *instrumental alteration* that is so often involved: the downbeat in a low orchestral register is combined with the cymbals, and then contrasted with the mid orchestral register of the solo violin and accompaniment.

Mouvement modéré de Valse
Une cymbale frappée avec une baguette

Cym.

3/4

pp

Solo Vln

f marcato

pizz.

Vln I

mf

pizz.

Vln II

mf

pizz.

Vla

mf

pizz.

Cb.

mf

Example 2.14: Saint-Saëns, *Danse Macabre*.

2.3.1.4 Alteration, Reduction

In an example from the 4th movement of *Scheherazade*, seen in Example 2.15, Rimsky-Korsakov demonstrates what he calls an echo-like effect by changing the orchestration of the motif from unison clarinet and trumpet, with *mf* and *p* dynamics, respectively, to horn at *p*. This is a *compound instrumental alteration*, as it is also a *reduction* of parts.

Clarinet in A 1

Horn in F 1

Trumpet in C 1

Example 2.15: Rimsky-Korsakov, *Scheherazade*, mov. iv, movement before Rehearsal O. (Score in C)

2.3.1.5 Alteration, Expansion

An early example of orchestrational changes in the orchestral texture is taken from Lully's *Armide*, (1686). It appears below in Example 2.16. The range at the opening of the flute 1, flute 2, and English horn passage is just one octave. The strings pick up the music, and the range becomes two octaves, then opens up to three octaves by the end of the line. This is an example of *instrumental alteration*, between families, and an *expansion* of the orchestral register.

Fl. 1

Fl. 2

C. A.

Vla.

Via da G.

Vc.

Cb.

Example 2.16: Lully, *Armide*. Adapted from Read (1979, p. 19). (Score in C)

2.3.1.6 Addition, Expansion

A brilliant example of an orchestral *crescendo* (Example 2.17) from Rossini is heard in the Overture to *La Gazza Ladra*. With his trademark style, Rossini *adds* instruments to each line as part of the crescendo, creating and adding to multi-unison couplings, then *expands* the upper octave at the penultimate point of the crescendo, with the *addition* of the piccolo.

Allegro

The musical score is for the Overture to *La Gazza Ladra* by Rossini, marked Allegro. It features a crescendo where instruments are added to each line. The score includes parts for Flute 1, Piccolo, Oboe 1, Oboe 2, Clarinet in A 1, Clarinet in A 2, Bassoon 1, Horn in E 1, Horn in E 2, Horn in G 1, Horn in G 2, Trumpet in A 1, Violin I, Violin II, Viola, Violoncello, and Contrabass. The tempo is marked Allegro. The score shows a crescendo where instruments are added to each line, creating and adding to multi-unison couplings, and then expanding the upper octave at the penultimate point of the crescendo with the addition of the piccolo.

Example 2.17: Rossini, Overture, *La Gazza Ladra*. Adapted from Read (1979, p 60). (Score in

C)

2.3.1.7 *Reduction, Contraction*

Schubert orchestrates a brilliant *contraction* and *reduction* as heard in Example 2.18, for the incidental music to *Rosamunde* (1823). From an orchestral *tutti* with nineteen parts in five voices, he makes a *decrescendo* to four parts in two voices. He does this “stepwise” with instruments removed from the line at m. 116 and again at m. 119. Schubert adds a touch of extra musicality to the line by *adding* and *reducing* the trumpets and timpani in mm. 115 and 117.

114 Allegro molto moderato

This musical score is for the 'Entr'acte I' from Schubert's *Rosamunde*. It is marked 'Allegro molto moderato' and begins at measure 114. The score is written for a full orchestra and includes the following parts:

- Flutes (Fl. 1, Fl. 2):** Both parts play a melodic line starting with a forte (*f*) dynamic, which then transitions to piano (*p*) in the final measures.
- Oboes (Ob. 1, Ob. 2):** Both parts play a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Clarinets in A (Cl. in A 1, Cl. in A 2):** Both parts play a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Bassoons (Bsn 1, Bsn 2):** Both parts play a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Trumpets in E (Tpt in E 1, Tpt in E 2):** Both parts play a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Trumpets in B-flat (Tbn 1, Tbn 2, Tbn 3):** All three parts play a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Timpani (Timp.):** The timpani part consists of a series of rhythmic pulses, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Violins (Vln I, Vln II):** Both parts play a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Viola (Vla.):** The viola part plays a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Violoncello (Vc.):** The cello part plays a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.
- Double Bass (Cb.):** The double bass part plays a melodic line, starting with a forte (*f*) dynamic and transitioning to piano (*p*) in the final measures.

The score is written in 2/4 time and features a key signature of one sharp (F#). The dynamics range from forte (*f*) to piano (*p*).

Example 2.18: Schubert, *Rosamunde*, “Entr’acte I.” Adapted from Adler (2002, p. 384). (Score in C)

In the cavatina *Casta Diva*, from Act one of Vincenzo Bellini's opera *Norma*, from measures 35 to 37, Norma is supported by a tri-chroma unison and octave coupling in the woodwinds. Flute 1, oboe 1, oboe 2, and clarinet 1 are in unison with the soprano, and clarinet 2 supports the line from the octave below. During Norma's melisma, the flute 1 drops out in m. 36 and the clarinet 2 joins in unison with the oboes and clarinet 1 and the soprano, a *reduction* and a *contraction* from the previous couplings (see Example 2.19). These combinations are repeated from mm. 60-62.

Maestoso e deciso
sempre cres. sino al... *ff*

Fl. 1
Ob. 1
Ob. 2
Cl. in C 1
Cl. in C 2
Norma

p *ff* *ff* *ff* *ff*

sempre cres. sino al... *ff*

-bi - an - - - - - te, il bel sem - bian - te - sen - za - nu - be e sen - za vel.

Example 2.19: Bellini, *Norma*, “Casta Diva,” mm. 35–37.

2.3.1.8 Alteration, Transposition, Expansion

Haydn's Symphony 100, 1st movement, again provides us with another great case in Example 2.20. This is *instrumental alteration* from flute and oboes 1 and 2 (in the upper system), to the string section (in the lower system). There is also a *transposition* and an *expansion* of the orchestral register, from covering just a small area of the mid-high register in m. 24, to occupying two octaves or more in m. 32 and onwards.

Largo

The musical score for Example 2.22, Prout's *Alfred*, is written for a full orchestra. The tempo is marked 'Largo' and the time signature is 4/4. The key signature is one flat (B-flat major or F minor). The score includes parts for Oboe 1 and 2, Clarinet in B-flat 1 and 2, Bassoon 1 and 2, Horn in F 1 and 2, Horn in E-flat 3 and 4, Tuba, and Harp. The woodwinds and horns play sustained notes, while the harp plays a continuous arpeggiated figure. The score is in C major.

Example 2.22: Prout, *Alfred*. Adapted from Prout (1899, p. 159). (Score in C)

The next example, Example 2.23, taken from Gluck's opera *Alceste* (1776), displays an orchestration being transformed by the *contraction* of the orchestral register from two octaves to a single line. The *instrumental alteration* between voice and string section is an important facet of this example as well.

47

ments, et des si - gnes cer - tains m'en don - nent l'as - su - ran - ce.

54

Plein de l'es - prit di - vin qu'in - spi - re sa pré - sen - - ce je me sens é - le

Example 2.23: Gluck, *Alceste*. Adapted from Read (1979, p. 29). (Score in C)

2.3.1.10 Alteration, Transposition, Expansion, Contraction

Haydn's Symphony no. 100, "Military," first movement, provides in Example 2.24 an example of instrumental alteration occurring between families of instruments: this local change of timbre displays an exchange of musical material between woodwinds and strings. This is a very standard procedure in scoring nowadays, but in the late eighteenth century Haydn stood as a key leader in making this kind of alteration of sections or families—and therefore timbre—a crucial feature and structural facet of his orchestral music (Dolan, 2013).

Example 2.24: Haydn, Military Symphony, mov. I, mm. 170–177.

2.3.1.11 Addition, Expansion, Reduction, Contraction

Example 2.25 exhibits a case from Mozart’s Symphony no. 35, at the opening of the third movement. This musical excerpt happens to be the first example that Gardner Read offers in his 1979 treatise “Style and Orchestration” (p. 3). He describes the passage as having “melodic purity, harmonic simplicity, rhythmic regularity, and textural transparency” (p. 2). Because of this textural clarity, it is an excellent case study of orchestrational transformations. The arpeggiation of the D major triad in measure 1 fills up the open registral voicing (D major orchestrated across four octaves) of the first beat. The texture *contracts* and *reduces* to just the violins in measure 2, before *expanding* and *adding* back to the *tutti* in measure 3. In measure 5 the texture thins out, with a sustained triad covering just over three octaves; the G2 in the contrabass is pitch-coupled at the octave by the unison and instrumental coupling of the bassoons and cello. At the interval of a 10th and an octave above this are found violins I and II. The chromatic rising notes of the viola at D4 in the middle of the orchestral register cuts through this slender but beautiful sustained triad. The brief registral *contraction* and *reduction* to the parallel octave descending passage (of the violins in m. 6) is then contrasted by an *expansion* and an

addition in measure seven. A descending arpeggio further accents the *contraction* of register and a *reduction* in the same measure.

Menuetto

The musical score for the Minuet in D major, 3rd movement of Mozart's Symphony No. 35, is presented in a full orchestral arrangement. The score is in 3/4 time and D major. The woodwinds (Ob. 1.2, Bsn 1.2, Hn in D 1.2, Tpt in D 1.2) and strings (Vln I, Vln II, Vla, Vc, Cb) all play a strong, rhythmic pattern of eighth notes in the first four measures, marked with a forte (f) dynamic. In measure five, the woodwinds drop out, and the strings continue their pattern, marked with a piano (p) dynamic. In measure six, the woodwinds re-enter, playing a descending arpeggio, marked with a forte (f) dynamic. In measure seven, the woodwinds drop out again, and the strings continue their pattern, marked with a piano (p) dynamic. The score ends in measure eight with a final chord.

Example 2.25: Mozart, Symphony No. 35 in D major, 3rd movement (1782). (Score in C)

2.3.1.12 Alteration, Addition, Reduction, Expansion, Contraction

An ingenuous use of orchestral colour from *Médée* (1797) by Luigi Cherubini appears in Example 2.26 (adapted from Prout (1899, p. 120). From the unison violins accented by the viola and timpani, the cellos and bass enter at the octave then descend the octave. In the pickup to m. 8, the clarinets and oboes enter on the fifth, playing in parallel octaves, and the flutes rise starting from the C6 as the oboes and clarinets descend. The horns enter as the woodwinds drop out. This

example shows *addition* (m. 1) as well as *expansion* (mm. 1–3) then *reduction, contraction* and *alteration*. The orchestrational transformations then repeat.

5 Allegro

Fl. 1

Fl. 2

Ob. 1

Ob. 2

CL in C 1

CL in C 2

Hn in C 1

Hn in C 2

Hn in E♭ 3

Hn in E♭ 4

Timp.

Vln I

Vln II

Vla

Vc

Cb.

Example 2.26: Cherubini, *Médée*. (Score in C)

This *instrumental alteration* from a large ensemble to solo timpani occurs in Beethoven's Symphony no. 9, second movement (Example 2.27). It is a great illustration of the quality of contrast that can be achieved with orchestrational change: from covering approximately three octaves then *contracting* to the low register, there is also an *instrumental alteration* from the woodwinds, brass and strings to a pitched percussion instrument, followed by an *expansion* back to the *tutti*, repeating the *contraction* and *alteration*. In m. 202, the *addition* of flute 2 and oboe 2 in unison (but in intervallic pitch-coupling relationships with the other woodwinds) fills in the orchestral texture.

[illegible]

In an excerpt from Haydn's Symphony no. 99, third movement, we observe in Example 2.29 a transitional section between two repeats. In the first section of this excerpt, the *addition* that occurs between measures 58 and 62 seems more significant than the *expansion* that is part of this arc. The string section *expands* the use of the orchestral register from two to three octaves, staying at a *p* dynamic, then with the addition of parts at m. 61 changes to *f* dynamic, followed by the *addition* of woodwinds at m. 62. In m. 68, the oboes repeat Gs in octaves, then oboe 1 joins the first violins in rhythmic and pitch unison, a duo-chroma coupling. This contrast, the *reduction* and *contraction* to a solo oboe, sounds very effective.

2.3.2 PHRASE-BASED OR SECTION-BASED ORCHESTRATIONAL TRANSFORMATIONS

2.3.2.1 Orchestration Example: Addition, Expansion, Reduction, Contraction

An example of writing for woodwinds comes from the opening of the fourth movement of Tchaikovsky's Symphony no. 6, with woodwind-only accompaniment of the melody in the string section (Example 2.30). Each change of orchestration is unobtrusive and is necessitated by the phrase, inasmuch as it is part of the phrase structure. It changes from the duo-chroma unison registral coupling of flutes 1, 2, and 3 and bassoons 1 and 2, to the *addition* of clarinets in octaves, with flutes and bassoons split into octaves. This *addition* and *expansion* of the line is then built upon by the *addition* of oboes at the octave, and we now have multi-unison octave registral coupling: the flutes, oboe 1, and clarinet 1 on the upper octave, and oboe 2, clarinet 2, and bassoons on the lower octave. The orchestrational transformation then occurs in reverse, and returns back to the flutes and bassoons in unison.

IV. Finale

Example 2.30: Tchaikovsky, Symphony no. 6, mov. iv, mm. 1–18. (Score in C)

2.3.2.2 Orchestration Example: Alteration, Addition, Reduction, Expansion, Contraction

From a *tutti* covering three octaves—in this example from Beethoven's Symphony no. 5 in C minor, first movement—there is a *sudden reduction* (Goodchild 2016) and *contraction* of the orchestral register from *tutti* to horns 1 and 2 playing unison in m. 60 (Example 2.31). Following this passage at m. 64 onwards, there is the slow *addition* and *expansion* as well as a timbral shift (McAdams and Goodchild, 2017) of the melody between the violin 1 and clarinet 1,

which then itself *expands* with the *addition* of the flute 1 at the octave of the violin line, an *instrumental alteration* from violin to clarinet to the combination—octave registral coupling and duo-chroma instrumental coupling—of violin and flute.

53 Allegro con brio ($\text{♩} = 108$)

The score is divided into two systems. The first system (measures 53-59) is marked 'Allegro con brio' with a tempo of 108 beats per minute. It features a full orchestra playing fortissimo (ff). The second system (measures 60-75) shows a dynamic shift to piano (p) and p dolce. The flute 1 part is highlighted with a slur and a 'p' dynamic marking in measure 60.

53

Fl. 1.2

Ob. 1.2

Cl. in F# 1.2

Bsn. 1.2

Hn in E# 1

Hn in E# 2

Tpt in C 1.2

Timp.

Vln I

Vln II

Vla

Vc

Ch.

60

Fl. 1.2

Cl. in F# 1.2

Bsn. 1.2

Hn in E# 1

Hn in E# 2

Vln I

Vln II

Vla

Vc

Ch.

Example 2.31: Beethoven, Symphony no. 5, mov. I, mm. 53–75. (Score in C)

2.3.2.3 Orchestration Example: Reduction, Contraction

Goodchild's (2016) example of gradual *reduction* comes from Ravel's orchestration of Mussorgsky's *Pictures at an Exhibition* (1874/1922). It moves from a large *tutti* to solo bass, the overall trajectory being a large-scale *instrumental alteration* from *tutti* to bass (Example 2.32). The orchestration reduces the number of instruments in an almost stepwise motion of going lower in the orchestral register.

2.4 SUMMARY

These basic principles and proposed taxonomy account for many new identified subtleties in the art of orchestration and should now permit researchers to systematically and adequately describe changes in orchestral passages. Heretofore, the terminology to describe successive passages in orchestration has been lacking in a capacity to objectively provide insight into instrumental and registral—and therefore timbral—changes over time. In many orchestration treatises and texts regarding orchestration, there is often the use of florid vocabulary or other descriptive words to supplement the narrative; although perhaps beautiful in prose, these descriptions unfortunately are often simply subjective opinion and do not provide insight into the actual scoring methodologies employed by great composers and orchestrators of the past.

The above examples have all been local or phrase-based orchestrational transformations, i.e., the content of the examples do not exhibit large spans of musical time between the changes identified. Chapter 6 explores orchestration-based form, and the notion that orchestrational transformations can be related across large spans of musical time, i.e., connected and goal-oriented even though separated by considerable spans of time.

But first, to connect these large-scale orchestrational transformations, we need to understand the basic principles of timbral relationships and auditory grouping effects, as the score-based principles are enacted in physical and musical time. We need to understand the sound-colour used in a composition and its relationship to other statements of similar sound-colour in a musical context.

SECTION 2: PERCEPTION-BASED PRINCIPLES IN ORCHESTRATION

3 BASIC PRINCIPLES OF TIMBRAL RELATIONSHIPS AND CLASSIFICATIONS

3.1 INTRODUCTION

The previous chapter focused on combinations of orchestral register and combinations of instrumentation and their respective transformations over time. Each of these categories impacts the perception of timbre: as a fundamental concept in orchestration research, timbre (sound-colour that covaries with pitch and dynamics) is the primary element composers are working with along with rhythm. Therefore, there is a need for a taxonomic categorization of timbre, not only to understand the creative ways that timbre is used in a musical setting, but to clarify the way we talk about and conceive of timbral relationships—colour relationships—and classify timbre both perceptually and as a constant in the temporal works of art we call music.

3.2 TIMBRE: DEFINITIONS

By the quality of a tone [*Klangfarbe*] we mean that peculiarity which distinguishes the musical tone of a violin from that of a flute or that of a clarinet or that of the human voice, when all these instruments produce the same note at the same pitch. (von Helmholtz, 1885/1954, p. 10)

Timbre is defined as a structured set of auditory attributes—other than pitch, duration, loudness, and spatial position—that characterizes many qualities of sound events and contributes collectively to sound source identity (Hajda, Kendall, & Carterette, 1997; Handel, 1995; McAdams, 1999). The attributes that contribute to the perception of timbre are attack quality, various aspects of sound such as brightness, richness, and hollowness, other textural aspects such as roughness, inharmonicity, spectral fluctuations, and more. Many of these attributes vary with both pitch—depending on both where the pitch is located in 1) the orchestral register and 2) what part of the instrumental register the pitch lies in—and dynamics within a particular source of sound—and certain attributes can be tied to temporal, spectral, and spectrotemporal acoustic parameters:

The number and comparative strength of the harmonics making up a tone give it its individual tone color, or timbre, enabling us to distinguish the sound of a clarinet from that of a 'cello playing the same note. (Piston 1969, p. 29–30)

With so many attributes contributing to timbre, how do we define—for compositional, pedagogical, or research-based reasons—an overarching *timbre of an instrument*—this encompassing quality that unifies and also identifies a particular sound as belonging to a particular instrument?

Sevsay (2013) defines timbre as tone quality or a sound colour. However, he insists that it not be confused with changes in timbre when the instrument plays in different registers: “This term [timbre] designates the tone quality or sound color that allows us to distinguish between, for example, an oboe and a clarinet. Timbre should not be confused with registral color. Each instrument has a certain timbre and can also have various registral colors (this is especially noticeable among the wind instruments” (p. 71). This is problematic, for Sevsay goes on to say that the “overtones [that are] present in the sound of an instrument play a major role in determining the instrument’s timbre” (p. 71), without clarifying why the change of instrumental register and registral colour, where instrumental overtones will be greatly affected, should be an isolated from the concept of “timbre.” He does bring up the important point that there are registral colours, however, the timbre of an instrumental sound is undoubtedly affected by registral differences, which also causes confusion in the perception of timbral identity (McAdams, 2013).

Some instruments have a wide variety of timbres available, so much so that they “[...] vary in timbre so much in different parts of their compass that they almost seem different instruments. This is particularly true of the clarinet and bassoon” (Jacob, 1976, p. 190). This assertion implies that along with the wide colour palette there are also multiple tone-colour attributes in just one instrument, and indeed McAdams and Goodchild (2017) elucidate the fact that any given instrument possesses, in fact, hundreds of individual timbres. Here is a clarinet-specific case:

[T]he timbre of the clarinet, for instance [...], a specific clarinet played with a given fingering (pitch) at a given playing effort (dynamic) with a particular articulation and embouchure configuration produces a note that has a distinct timbre. Change any of these parameters and the timbre will change. Therefore, in our conception of timbre, an instrument such as a clarinet does not have “a timbre,” it has a constrained

universe of timbres that covary with the musical parameters listed above to a greater or lesser extent depending on the instrument and the parameter(s) being varied. (p. 129)

Such a distinction highlights the importance of the need for a taxonomy not only of timbre, but of timbral relationships as well. After all, composers don't just work with "the clarinet timbre," but rather with hundreds if not thousands of interrelated clarinet timbres. And this fact alone influences a composer/orchestrator's choices in creating specific combinations and contrasts. It is also one of the reasons that most orchestration textbooks focus on detailed knowledge of instrumentation, as there is a vast amount of instrument specific knowledge that must be gained to understand the art of orchestrating these elements.

A student of the art of orchestration, it would seem, must learn by memory all the "thousands" of timbres of an instrument: "[...] then [they] should not only study the scores of the great masters, but above all ask instrumentalists of all kinds to familiarize [them] with the exact technique of their instruments and with the *timbre of their registers* [emphasis added]. [They] should, so to speak, try to find out the secrets of the orchestra tuning-room" (Strauss, in foreword to Berlioz 1948, p. I). And not only should the thousands of timbres belonging to these instruments be understood and heard in the internal ear, but also the student must "store up in [their] memory as many of these mixed timbres as [they] can by hearing orchestras, with knowledge of the scores." (Piston 1969 p. 421); the student must learn and memorize hybrid and composite timbres—the result of orchestrational combinations—as instruments of the orchestra unto themselves. Prout (1902) emphasizes two important facets in the student of orchestration's learning process: the memorization of the collection of timbres of both single instruments and their respective combinations, and that timbres similar enough to other timbres do not add anything when coupled—except weight:

Foremost among these is quickness of ear. By this is meant the power of recognising the tone of every instrument in the orchestra, whether heard singly or in combination. When [they hear] a melody in the orchestra, [they] ought to be able to tell at once by what instrument or combination of instruments it is being played. This, it should be added, is not always entirely possible; because the parts are frequently doubled without anything being perceptibly added to the general effect. (p. 9)

3.2.1 CLASSIFICATIONS OF TIMBRES

A current taxonomic conundrum exists in the use of the same word, *timbre*, to describe both our conception of an instrument's collection of tone colours as well as each of those tone colours' individual or separate colours. This has led several composers, orchestrators, and academics to propose theories and further classifications of timbre. For example, two fairly recent publications address this issue: Alfred Blatter (1997) lists instrument substitutions, either by single instrument or in combination, based on similar timbres; and Henry Brant (2009) presents a theory in which timbres from many different instruments can be abstracted and grouped according to an archetypical instrument (e.g., flute or oboe).

Such theories support/reinforce the need for taxonomies based purely on listening-based perspectives on timbre and not solely on families or sound production methods. This presents us with two research problems: 1) that—orchestratorially and perceptually—instrumental classifications are not adequate to convey enough information about the tone colour of an instrument and 2) that therefore “timbre” on its own as both a meta and a specific classifying term is insufficient; and 3) that a taxonomic categorization or creation of new terms exemplifying and clarifying these distinctions is needed. The relationship among timbres needs to be identified, and relational term(s) defined, in order to facilitate both the teaching and analysis of music and of orchestral (or sound-colour-based) composition with regards to timbre and its implementation and relational and structural capabilities.

3.3 THEORIES OF TIMBRAL RELATIONSHIPS AND CLOSELY RELATED TIMBRES

3.3.1 GROUPING OF INSTRUMENTS

From the perspectives of learning about instrumentation and applying such learning to general and specific knowledge about orchestration, many ways of grouping instruments have been proposed and enacted over the years. However, the focus has been primarily on the materials and their performative qualities and not upon the “nuances of tone quality; no language existed for describing the actual experience and effect of tones” (Dolan, 2013, p. 14).

The Hornbostel–Sachs system (1914) classified instruments based on sound production mode: Idiophones; membranophones; chordophones; and aerophones. This scheme provides insight for composers in order to understand how the sound is being created and propagated.

Most orchestration treatises organize instruments into the following categories based on a combination of instrumental families, the physical materials from which they are made, and how sound is produced: woodwinds, brass, strings, and percussion. Berlioz (1882; 1948) subdivides even further:

Strings are apportioned into:

- Bowed
- Plucked
- With keyboard

Wind instruments:

- With reeds
- Without reeds
- With keyboard
- Brass instrument with mouthpiece
- Wooden instruments with mouthpiece
- Voices of humans

And percussion is divided into:

- Those with definite pitch
- Those with indefinite pitch

Rimsky-Korsakov (1912) classifies instruments similarly to Berlioz, but further introduces the concept of *instruments of sustained resonance* and *instruments with little sustained power* (p. 33) in order to differentiate instruments that can hold and modify a tone versus instruments whose tones begin to decay immediately after the attack. Rimsky-Korsakov suggests that the foremost fabric of music arises by using instruments of sustained resonance, and that the other instruments are simply employed for ornamentation, colour, and rhythmical functions (p. 35).

In hierarchical order, the following instrumental classification lists coloristic and expressive qualities, so that by the bottom of the inventory, according to Rimsky-Korsakov, there is no expressive quality, just coloristic attributes:

- a. Stringed instruments
- b. Wind instruments
 - i. Woodwind

- ii. Brass
- c. Instruments of little sustained power
 - (i) Plucked strings
 - 1. Pizzicato
 - 2. Harp
 - (ii) Percussion instruments (determinate sound / pitched)
 - (iii) Percussion instruments (indefinite sound / non-pitched)

What is interesting in such a classification is that string pizzicatos no longer belong to a subclass of the stringed instruments but are placed together with the harp in a group called “plucked strings.” This illustration can be thought of as an early stage of a classification system based upon timbre. Dunn (1925) further expounds upon this concept:

The pizzicato transforms a bowed instrument into one of the harp type, or into a percussion instrument pure and simple. The sound loses practically all its sustaining power and becomes the embodiment of staccatissimo tone-production, while retaining all the tonal precision of the bowed note. (p. 20)

To further subdivide Rimsky-Korsakov’s labelling, examples c(i) and c(ii) are pitch-based groups, whereas c(iii) are a “noise-based” group.

Instruments can also be classified by their distribution on the orchestral score. The standard “score order” (Blatter, 1997, p. 2) based on instrument family is:

- Woodwinds
- Brass
- Percussion
- Other Instruments
- Strings

These are then obviously subdivided into sections of similar instruments; i.e., the flute section, the clarinet section, the trumpet section, etc. The score order within families is also organized from top to bottom on the basis of orchestral register: those instruments that are the highest and lowest pitched.

Another influential categorization of instruments is found in the stage arrangement or seating plan. This has been standardized over time, and a few, but noticeable, variations are also

possible particularly among string sections. The position of each instrument gives rise to a crucial influence on how timbre is perceived in the hall, and at what point certain instruments may or may not be recognisable. This has resulted in a standardization of how audiences come to hear timbres in a concert hall. Orchestral seating plans therefore will have an important impact on how a composer scores a work.

The classification modes discussed above have had an enormous influence on how instruments are combined in musical works; such standardization might arguably even be the cause of neglect with regard to other less obvious instrumental combinations, as the common combinations become part of a composer or orchestrator's skillsets and reflexes in allocating or distributing instruments over time. There is, one must admit, standardization with regard to timbral roles, and of timbral relations and scored attributes, a regularization that is necessary both from a practical and performative point of view, however limiting such standardization may be.

3.4 GROUPING ACCORDING TO TIMBRE

There currently exists a paradigm of timbral structure solely within the classification of instrumental families, but not one that is a clear parallel system for their connectivity and difference. The following two sections contain my discussion of recent theories by Brant (2009) and Blatter (1997), which attempt to remedy this situation.

3.4.1 PROTOTYPE TIMBRES: HENRY BRANT

Various instrumental classification systems have already been proposed with respect to instrument family, to playing technique, or to sound production method. Brant's *Textures and Timbres*, released posthumously in 2009, proposes a specific taxonomy with timbre as its basis. He proposes a classification based on instrumental tone-qualities¹³ and links these to archetypes of orchestral instruments. Brant creates 13 groups of closely related timbres: Wind timbre 1–4, Percussion timbre 1–4, Piano, String timbre 1–4. Within each of these groups there exist certain specific ranges and dynamics from various instruments that then correspond to a given

¹³ Brant uses the term “tone-colour” interchangeably with “timbre”

instrumental archetype, or what he calls a *prototype timbre*. For example, Brant proposes that what we think of as an “oboe” timbre can encompass compatible tone-qualities—within specific ranges and dynamic thresholds—from the muted trumpet and trombone, horn (hand-stopped or metal mute), all double reeds, clarinet family (bottom fifth only), pipe organ (reed stops only), or accordion, among others (p. 4). Brant provides detailed score-based examples of dynamics and instrumental registers to support and explain his theories.¹⁴

Another example is “Wind-timbre group I,” which lists the flute as its prototype timbre, with the features of “thin, open,” and lists many available “tone-qualities” as possible similar timbres. Table 3.1 shows the ranges and volume limitations for each instrument of Wind-Group I: from left to right, the columns list the prototype timbre name, character (timbre), “tone qualities” (instruments), modification to the timbre (mutes or playing technique needed), low- and high-register limitations, and volume limitations associated with the specific range.

Table 3.1 — Brant’s Wind Group 1 “Flute” timbre, p. 56.

Closely Related Timbre #	Prototype Timbre	Character	Instrument/Available tone qualities	Modification to Timbre	Register limitations, low	Register limitations, high	Volume limitations, low	Volume limitations, high
1	flute	thin, open	piccolo		D 5	C# 6	<i>pp</i>	<i>mp</i>
2	flute	thin, open	piccolo		D 6	G# 6	<i>pp</i>	<i>mf</i>
3	flute	thin, open	piccolo		A 6	C# 7	<i>mf</i>	<i>ff</i>
4	flute	thin, open	piccolo		D 7	Bb 7	<i>f</i>	<i>ff</i>
5	flute	thin, open	piccolo		B 7	C 8	<i>ff</i>	<i>ff</i>
6	flute	thin, open	flute		C 4	Db 5	<i>pp</i>	<i>mp</i>
7	flute	thin, open	flute		D 5	Bb 5	<i>p</i>	<i>mf</i>
8	flute	thin, open	flute		B 5	G# 6	<i>p</i>	<i>f</i>
9	flute	thin, open	flute		A 6	C 7	<i>f</i>	<i>ff</i>
10	flute	thin, open	flute		C# 7	D 7	<i>ff</i>	<i>ff</i>
11	flute	thin, open	alto flute		G 3	Ab 4	<i>pp</i>	<i>mp</i>
12	flute	thin, open	alto flute		A 4	G 5	<i>p</i>	<i>mf</i>
13	flute	thin, open	bass flute		C 3	E 3	<i>pp</i>	<i>mp</i>
14	flute	thin, open	bass flute		F 3	Db 4	<i>pp</i>	<i>mp</i>
15	flute	thin, open	bass flute		D 4	A 4	<i>p</i>	<i>mf</i>
16	flute	thin, open	bassoon		Bb 3	Bb 4	<i>pp</i>	<i>mp</i>
17	flute	thin, open	horn	fiber mute	G 3	C 4	<i>pp</i>	<i>mp</i>
18	flute	thin, open	clarinet Eb		G 3	D 4	<i>pp</i>	<i>mp</i>
19	flute	thin, open	clarinet Eb		Eb 4	Db 5	<i>pp</i>	<i>mf</i>
20	flute	thin, open	clarinet Eb		D 5	Eb 6	<i>p</i>	<i>f</i>
21	flute	thin, open	clarinet Eb		E 6	Bb 6	<i>mf</i>	<i>ff</i>
22	flute	thin, open	clarinet Bb		D 3	A 3	<i>pp</i>	<i>mp</i>
23	flute	thin, open	clarinet Bb		Bb 3	Ab 4	<i>pp</i>	<i>mf</i>
24	flute	thin, open	clarinet Bb		A 4	Bb 5	<i>p</i>	<i>f</i>
25	flute	thin, open	clarinet Bb		B 5	F 6	<i>mf</i>	<i>ff</i>
26	flute	thin, open	bass clarinet Bb		Bb 1	F 2	<i>pp</i>	<i>mp</i>

¹⁴ Given that his treatise is posthumous, Brant did not have the chance to go into depth with respect to all groups.

Closely Related Timbre #	Prototype Timbre	Character	Instrument/Available tone qualities	Modification to Timbre	Register limitations, low	Register limitations, high	Volume limitations, low	Volume limitations, high
27	flute	thin, open	bass clarinet Bb		Gb 2	G 3	<i>p</i>	<i>ff</i>
28	flute	thin, open	contrabass clarinet Bb		Bb 0	F 1	<i>pp</i>	<i>mp</i>
29	flute	thin, open	contrabass clarinet Bb		Gb 1	G 2	<i>p</i>	<i>ff</i>
30	flute	thin, open	violin	natural or artificial harmonics	G 3	B 7	<i>pp</i>	<i>mp</i>
31	flute	thin, open	viola	natural or artificial harmonics	C 3	C# 7	<i>pp</i>	<i>mp</i>
32	flute	thin, open	cello	natural harmonics	C 2	E 6	<i>pp</i>	<i>mp</i>
33	flute	thin, open	bass		C 1	G 5	<i>pp</i>	<i>mp</i>

In row 25 above, Brant postulates that the clarinet can play any note between B5 and F6 at any dynamic between *mf* and *ff*, and that a composer, orchestrator, or listener—depending on context and intent—will perceptually group these collections of timbres into an archetype of—a collection of—flute-like timbres, therefore qualifying these timbres as belonging to the “Flute” prototype timbre. A vital compositional insight that Brant’s theory gives us here is the prospect of an enlarged instrumentarium: the concept that an instrument’s timbre radiates beyond itself, linking its identity to other similar timbres and collections of timbres.

When orchestrating—if the composer does not want to create a strong change of orchestral colour, or needs connections between successive sections of music, or wants to slowly add a part to the texture—such timbral similarities or relationships may help in shaping a musical discourse.

An issue arising with Brant’s theory is the fact that in the creation of timbral archetypes it limits itself to orchestral instruments; one can imagine prototype timbres that exist beyond the thirteen prototypes he proposes, and beyond solely instrumental prototypes, into environmental and noise-based sounds.

3.4.2 INSTRUMENT SUBSTITUTIONS: ALFRED BLATTER

Similar to Brant’s prototype timbre classifications, Alfred Blatter’s (1997) instrument substitutions present us with another list of related timbres. The redacted list in Table 3.2 gives an original instrument followed by a possible instrumental substitution, either by a single instrument or a combination thereof. According to Blatter, the timbre associated with a specific

instrument and range (column A) can be substituted by one of the instruments in column B, and/or a group of instruments from column C.

Table 3.2 – Excerpt from Blatter’s list of instrument substitutions that shows substitution by instrument or combinations of instruments (1997, pp. 385–387)

(A) Instrument	(B) Replaced with ensuing instrument(s)	(C) Replaced by one of these combinations of instruments
English horn (low)	viola	clarinet with bassoon and muted horn
Bass clarinet (throat)	Flute breath tones; stopped horn; string bass harmonics	bassoon with muted horn
Bass clarinet (low)	cup-muted trombone; cello	muted horn with oboe; clarinet with soprano saxophone
Contra bassoon (high)	viola or cello <i>ponticello</i>	trombone with string bass
Alto saxophone (high)	violin	violin with oboe; clarinet with flute
Bass saxophone (low)	electric bass	tuba with string bass
Horn (low)	bassoon	cello with bassoon; (bass) clarinet with trombone
Muted horn (low)	string bass (<i>sul tasto</i>)	cello with clarinet
Cornet (high)	trumpet (into stand); flugelhorn	clarinet with oboe and flute
Cornet (low)	trumpet (into stand); flugelhorn	flute(s) with muted horn
Straight-muted trumpet (high)	oboe	soprano saxophone with flute
Trombone (high)	horn(s); muted horn(s)	clarinet with oboe, flute, and violin
Straight-muted trombone (high)	viola (<i>ponticello</i>)	clarinet with English horn and flute
Tuba (high)	euphonium	trombone with horn

The limitation of Blatter’s list—he admits it is non-exhaustive and encourages students to find their own substitutions—centres upon him not specifying actual pitch names in the instrumental registers on the part of the original instrument or of the substitute (instead using “high” or “low”). Brant’s theory, in contrast, does state these specifics. In terms of combining instruments, Blatter does not specify dynamics or the type of registral couplings the combinations should use; he does indicate instrumental couplings, but one cannot know if he intends unison, or octave, etc., for the registral couplings.

3.5 NEW TERMINOLOGY

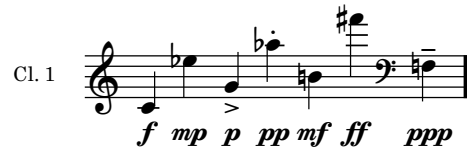
From a taxonomic perspective, as discussed above, it is a difficult task to organize the diverse range of timbral qualities of orchestral instruments. The use of the word “timbre” itself seems insufficient to categorize both the macro archetype of the instrument as well as the micro variations of sound colour, since “timbre” describes multiple perceptual qualities (McAdams, 1989). In my view, Brant’s prototypes and Blatter’s substitutions cannot reach far enough in creating comprehensive taxonomies of timbre and timbral relationships for the limitations stated above. Therefore, I propose two new terms (for taxonomic purposes) in relation to an expanded notion of conceiving timbre and timbral relationships: *metatimbre*, *paratimbre* (with its respective subcategory of *paratimbral relationships*).

3.5.1 METATIMBRE

I propose the term *metatimbre* as any collection of related timbres—instead of using the word timbre to describe a collection of timbres. There are three types of metatimbres: a metatimbre can 1) represent the macro archetype of the instrument *or* 2) a chunking of a group of closely related timbres across many instruments (i.e., Brant’s prototype timbres) *or* 3) the chunking of hybrid timbres (i.e. Blatter’s combinations of instrument timbres that can replace a single instrument timbre) as these are all *collections of related timbres*. By musical and creative necessity, metatimbre is polysemous; therefore it can be defined as either:

- Metatimbre Type 1: the sum-total of individual timbres belonging to one instrument (Sandell, 1998); the conglomerate of timbres that we group into the understanding of an instrument; the “set of timbres” that the listener experiences from the same instrument (Handel & Erickson, 2004, p. 588). Thus, the metatimbre of the clarinet, for example,

would be the perceived timbre, or the collection of timbres, that we associate with the sound of the clarinet: regardless of register, dynamic, attack, duration, etc. (see Example 3.1),.



Example 3.1: Collection of timbres belonging to the metatimbre of the clarinet

- Metatimbre Type 2: timbres that are grouped together independent of family or sound-production method, but purely based on relationships between said timbres. As discussed above, Brant and Blatter propose that the timbres of certain instruments are equivalent because they either 1) belong to an associated prototype or archetype timbre, or 2) can be substituted by similar timbres in those other instruments (see examples Example 3.2, Example 3.3)

Example 3.2: Collection of timbres from different instruments belonging to the metatimbre, or “prototype” timbre (Brant, 2009) of the flute. (Score in C)

B. Cl.

Bsn 1

Hn 1

Tbn 1

Vc.

mp

Example 3.4: Instrument substitution combinations (Blatter, 1997, p. 386) of the low register of the horn

Fl. 1

Ob. 1

Cl. 1

A. Sax.

Vln I

mp

Example 3.5: Instrument substitution combinations (Blatter, 1997, p. 386) of the low register of the alto sax

Example 3.6: Instrument substitution combinations (Blatter, 1997, p. 386) of the low register of the tenor sax

Instruments belonging to the same *metatimbre* have the same perceptual function and can be exchanged orchestrationally or in an orchestration-based context without altering their salient timbral characteristics; the timbres are interchangeable (as in Blatter’s substitution chart). What connects a complex and possible multi-instrument group of *timbres* into a *metatimbre* is their *paratimbral* relationship.

3.5.2 PARATIMBRE

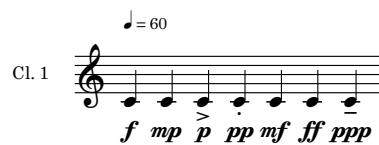
I propose the term *paratimbre*¹⁵ to represent the relationship between closely related timbres: a timbre that only slightly differs from another. The same instrument playing the same pitch multiple ways, with slightly different dynamic or attack, would create a paratimbre. Or another instrument with a very similar timbre creates a paratimbre.

Consequently, one timbre can be associated with (or grouped to) different metatimbres at the same time depending on what paratimbral relationships are apparent. For example, the

¹⁵ The basis for my neologism points to the use of the prefix *para* from the term *paraphony*, which Riemann (1896) defined as: “Paraphony (Gk.). Later antiquity described the fifth, fourth, twelfth, and eleventh as paraphonic (“near-sounding”) intervals; on the other hand, the term antiphonic (“countersound”) was applied to the octave and double-octave” (Riemann, 1896, p. 574). For example: “the vocal part held a note, and the accompaniment struck a paraphonic interval (fifth, fourth) after the unison or octave” (Riemann, 1892, p. 20).

“thousands of clarinet” timbres (cf. McAdams and Goodchild, 2017) some of which can be linked together into a mental construct of a clarinet—the *metatimbre* of the clarinet—or, each one of these timbres can be individually linked to other timbres, either from the clarinet or from another instrument or even electronic sounds.

The similar-sounding quality of the timbres, and the relationship that one timbre displays with another closely related timbre, creates what can be referred to as a *paratimbral relationship*. Schnittke (2002, 2006) offers various perspectives of paratimbral relationships, using his own terms to reflect the connectivity between instrumental timbres, for example the “subtle timbral gradation, the range of recolorations of timbre” that an individual instrument and performer are capable of (2006, p. 170). Each of these gradations can also be referred to as paratimbres. A simplified version of close paratimbral relationship can be seen in Example 3.7, where the orchestral register and instrumental register remains constant (in contrast to Example 3.1 above where the orchestral and instrumental registers change), but the change of attack or dynamics changes the timbres.

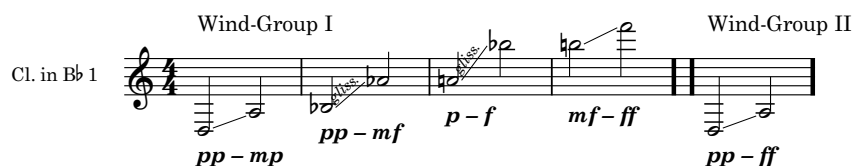


Example 3.7: Paratimbres of one pitch in the clarinet.

He suggests that we might view certain timbres as analogous even across families, such as “[t]hirteen timbral variations on every possible variety of staccato and pizzicato, along with analogous timbres in the percussion” (A. Schnittke, 2002, p. 207). He further remarks that “thanks to the polysemy of the timbral affinities, each individual timbre becomes multifunctional, simultaneously a link in several timbral scales, a point of intersection, and thus the potential center of the whole system” (p. 214). Schnittke hypothesizes that the same timbre can belong to two collections of timbres—i.e., different metatimbres, or prototype timbres—at the same time. For example, in Example 3.8, the timbres of the clarinet in Bb from D3 to A3 between the dynamics of *pp* and *mp* are classified by Brant (2009) as belonging to both Wind group I and II prototype timbres. The paratimbral relationships of these particular pitches at these specific dynamics happen to intersect where the metatimbres overlap; in certain registers, the

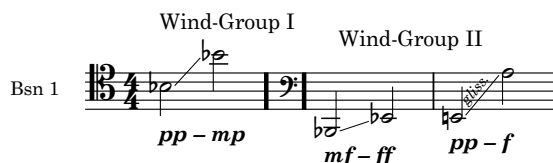
timbre of one instrument is similar to another, the paratimbral relationship is close “[i]n medium register the trombone is closest to the horn in timbre, but with a little more solidity, even hardness, comparatively speaking” (Piston, 1969, p. 276).

The clarinet seems to have many intersections of paratimbres: “While the Oboe can be mistaken for no other instrument, the Clarinet can, without attracting notice, take the place of a Second Flute, or of a Second Horn, or even of a Bassoon, its full, rich quality of tone possessing an unrivalled power of blending with that of any other instrument” (Widor, 1906, p. 31).



Example 3.8: Clarinet timbres belonging to two prototype timbres, from Brant (2009, p. 92)

Example 3.9 shows how the bassoon as an instrument can be grouped with Wind-Group I in its upper register, but with Wind-Group II in its lower register, with A3 and Bb3 as their respective dividing pitches. This exemplifies *metatimbre*’s definitions of types #1 and #2, as all the timbres of the bassoon—obviously—belong to the macro archetype of the bassoon; however, the timbres of various registers have related timbres—*paratimbres*—that connect them to an archetype, a collection of timbres of another instrument.



Example 3.9: Bassoon timbres belonging to two prototype timbres, from Brant (2009, p. 93)

Schnittke also presents the idea of timbral “consonance,” a term which he uses to describe situations where instruments with *paratimbral* relationships combine easily. But his usage of the word “consonance” is not necessarily apt in regard to timbre, given that it embraces wide-ranging semantic and historical significance in connection to pitch. What he views as a timbral consonance covers essentially a sonority created out of near-sounding tone-colours, which therefore have a *paratimbral* relationship and yet are part of two or more *metatimbres*:

“Timbral consonance is a combination of related timbres that create a blended sonority difficult for the ear to analyze, in which the individual characteristics of instruments are fused into a single total color” (Alfred Schnittke, 2006, p. 163). As a blended timbre represents in itself a new timbre, this newly created hybrid timbre can belong to a collection of timbres in the same way as any other timbre regardless of its instrumental or synthetic origin. Blatter’s substitution list implies that there is something in an instrument’s timbre that is related to the timbre of another instrument or in the combination of other instruments.

Forsyth discusses the timbral similarities between low flute and quiet trumpet, where the timbres of these instruments in a specific instrumental register and at a particular dynamic have *paratimbral* relationships, and possibly create a timbral archetype, also known as a *metatimbre*:

Considerable differences of opinion have been expressed as to the reasons for the Flute’s ‘breathe-y’ quality in its bottom octave. On the one hand, this has been positively attributed to the paucity of ‘harmonics’ or ‘overtones’ present in these notes. This perhaps explains the fact, familiar to all Flautists, that persons, judging solely by ear and not by any knowledge of the Flute technique, often suppose them to be playing an octave lower than their actual pitch. On the other hand, precisely opposite and equally positive statements have been made as to the wealth of these lower notes in Harmonics. On the whole, the former opinion seems to be the more satisfactory. One may add that all practical musicians have noticed the curious likeness between these notes and the sounds of the Trumpet when played piano. (Forsyth 1914, p. 184)

Rimsky-Korsakov speaks of harmonics changing the timbre of a stringed instrument: “Harmonics, frequently used to day, alter the timbre of a stringed instrument to a very appreciable extent” (1912, p. 10). The timbre of these harmonics is unique enough—as Brant also implies—as to be *paratimbrally* related to certain timbres of the flute.

Rimsky-Korsakov also explains certain registers or techniques where the *paratimbral* relationship is close enough that the timbres of one instrument could be linked to the *metatimbral* concept of another instrument i.e., “prototype”, Rimsky-Korsakov speaks of points of contact in timbral relationships:

The relationship which exists between string harmonics and the flute or piccolo constitutes a link between the two groups in the upper range of the orchestra. Moreover, the timbre of the viola may be vaguely compared to the middle register of the bassoon and the lowest compass of the clarinet; hence, in the medium orchestral range, a point of contact is established between the quartet of strings and the wood-

wind. The bassoon and horn provide the connection between woodwind and brass, these two instruments being somewhat analogous in character when played piano or mezzo-forte; the flute also, in its lowest register, recalls the pianissimo trumpet tone. Stopped and muted notes in horns and trumpets are similar in quality to the oboe and Eng. horn, and blend tolerably well with the latter instrument. (Rimsky-Korsakov 1912, pp. 34-35).

Widor explains how some timbres resemble each other; these hybrid timbres are *paratimbres* of one of the trombone's timbres: "When blended with the Celli and Double-basses, the Horn acquires a singularly penetrating quality of tone, which one might fancy to be that of a soft Trombone." (Widor, 1906, p. 68)

Berlioz alludes to *paratimbral* qualities, in the "mingling" of the timbres of these instruments: "Of all known qualities of tone, it is singular that the timbre of horns, trombones, and brass instruments generally, mingles best with [the harps]." (Berlioz, 1882, p. 65)

3.6 COMBINING TIMBRES

What Blatter briefly introduced in his substitution model can be, in my view, considered as the concept of new groups of *metatimbres* created in the combining of these closely related tone qualities. For example, when the variegated quality of a cello line is doubled at pitch with a clarinet and bassoon (as in the second half of the Verdi example in Example 5.8), this new metatimbre can be thought of as an enriched or "augmented cello" (McAdams & Goodchild, 2017), and wherein we retain a mental model of this new "instrument" through the fusion or hybridization of the cello's timbre with other tone colours, creating a new collection of timbres.

Indeed, the use of the *metatimbre* of such augmented instruments like an "augmented violin" is prevalent throughout the Classical and Romantic repertoire, as both an expressive and weighting device. Consider Haydn's Symphony no. 100, ii, measure 1. Its main theme—played in a unison registral coupling and duo-chroma coupling of the flute 1 and violins I and II—returns regularly enough as a combined colour. Thus, we can understand that Haydn employs this hybrid colour as a *metatimbre*. Mozart does something similar in the overture to *The Magic Flute*, where the bassoon is regularly combined with the cello and bass (Example 1.37 and Example 1.40).

As with any timbre in the hands of a good composer, the contrast between tone colour of the various types of closely related "augmented instrument" metatimbres can be clearly used to

create parametrical boundaries or to recall the idea of earlier-heard motifs or timbres, where the new iteration is only slightly changed.

3.7 CLASSIFYING METATIMBRES OR COMPOSITION-BASED TIMBRAL

ARCHETYPES

By its definition, Brant's (2009) idea of a prototype timbre harkens back to an organology, and a hierarchy, in which timbres must always align to an orchestral instrument. While being very insightful as a model, the prototype nonetheless presents a problem in the age of new music and electronic music because it limits the aural imagination to Western classical orchestral instruments. The concept of metatimbre, on the other hand, attempts to open up the grouping of timbres to the imagination, and can be—by way of structuring, ornamenting, delineating, etc.—both a construct serving a composer as well as one serving a listener.

Accordingly, metatimbre can be represented by an instrumental, electronic, or descriptive archetype, for instance:

- Instrumental archetype:
 - “flute” sound
 - “oboe” sound
 - “guitar” sound
 - And other instruments
- Combined instrument archetype:
 - “augmented” violin
 - “floboe” flute and oboe hybrid
 - And other created names for combined instruments
- Electronic/Synthetic archetype
- Non-instrumental archetype (e.g., from the natural world) (Chion, 1983; Schaeffer, 2017):
 - wind sound
 - water sound
 - sounds and tone-colours, *ad infinitum*, from the natural world

3.7.1 INFLUENCING FACTORS

A small parametric change in any one of these influencing factors will create a new timbre that is a *paratimbre* of the original timbre. Factors that can influence change of timbre on one instrument include:

- Register—Instrumental and orchestral register
- Dynamic
- Articulation
- Playing technique (e.g., vibrato/non vibrato, sul ponticello/sul tasto, etc.)
- Hall acoustics
- Recording technique

It is important to acknowledge that the metatimbre classification, as a listening-based analysis, functions in (and relates to) the normal acoustic situation of a concert hall or of a recording. Consequently, there exists a performative or interpretive and perceptual side to metatimbre and paratimbral relationships: the relationships must be heard to be effective. A composer will create collections of timbres to create unity among timbral materials and to contrast with other collections of timbres. But in a listening-based approach, the paratimbral relationships among the timbres must clearly relate to the timbral archetype if they are to be compositionally, and therefore structurally, effective.

3.8 SUMMARY

The timbre of an instrument is so vast that taxonomic terms of qualification, of relation, and of identification were posited in order to define and clarify categories. The concept of *metatimbre*—as a composition-based and/or listener-based construct—attempts to differentiate between one specific micro-variation of sound colour (*timbre*) and the amalgam of the totality of one instrument's timbral possibilities or of grouping related timbres across instruments and combined instruments with identifiable characteristics (*metatimbre*). *Paratimbre* represents closely related timbres: two timbres that only slightly differ from one another, thus possessing a close *paratimbral relationship*. The necessity of these neologisms lies in the fact that they are powerful compositional and listener-oriented attributes of music: the natural grouping of sound colours into archetypes, qualities, and interrelationships.

Instrumental timbres can be grouped within an instrument, or across instruments, or within and across instrument families, creating a wide range of associations. Such grouping units

can then be manipulated by the composer or orchestrator, and creatively adjusted by altering timbres or adding timbres that either differ vastly or closely resemble those of the group unit (having a close paratimbral relationship). Composers may create stark contrast, or slowly change a colour palette, thus fashioning an evolution of timbral identities, which then foster connections between successive sections of music.

From a compositional perspective, composers also rely on this confusion—it must be said—between closely related timbres (especially if the composer does not want to create a large parametric change) where a listener is not really sure what instrument is playing. Such an outcome enters into what Fabien Lévy (2016) calls a deliberate misleading of the listener.

Finally, this concept of the perception of instrumental identities and combining instruments with the goal of changing the orchestration across the duration of a work, leads us right into the discussion in Chapter 4.

4 BASIC PRINCIPLES OF THE TAXONOMY OF ORCHESTRAL GROUPING EFFECTS

This chapter presents an overview of the in-preparation article “A Taxonomy of Perceptual Effects of Orchestration Related to Auditory Grouping Principles” by McAdams, Goodchild, and Soden. The chapter presents orchestration-based Fundamental Examples of this taxonomy and is designed as a pedagogical tool to show the orchestrational basic principles that are used in the creation of these grouping effects.

4.1 INTRODUCTION

Now that we have explored the taxonomic categories of the basic principles of orchestrational combinations and transformations in Chapters 1 and 2 and timbral relationships in chapter 3, let us turn to the relationships between score-based orchestration theory and a listening-based theory, specifically the composer’s implicit employment of auditory grouping processes in the creation of music, specifically in orchestral works. A new taxonomy—the Taxonomy of Orchestration Grouping Effects (TOGE)—has recently been developed and applied at McGill University.

The TOGE elucidates four principal qualities or questions: 1. What is the perceptual effect of combining instruments? 2. What happens when independent musical lines are scored simultaneously? 3. What different effects are created in contrasting instrumentation? 4. How does an event change or stay stable, and what is the effect?

Recent research into auditory grouping principles gives insight into these facets of orchestration— heretofore largely implicit—by explaining how timbre is created, how instrumental timbres can fuse with one another, how musical “streams” guide our ears through the musical experience, how contrapuntal “streams” and “strata” in music are formed, and how these local elements are combined, contrasted, segmented, and transformed.

By providing insight into the perception-based organization of musical materials, this perception-based taxonomic system creates insight into the construction and form-bearing attributes that timbre creates in music.

4.1.1 BACKGROUND

Composers and authors of orchestration treatises have historically employed perception-based terminology without explicitly defining a method towards understanding this realm. For example, Prout (1902) speaks of perceived clarity of parts and texture (p. 54–55); Rimsky-Korsakov remarks on perceiving the vertical distance of instruments scored closely together vertically depending upon the orchestral register in which they find themselves (1912, p. 74); and Read speaks about perceptible differences in the timbre of an overtone depending on which violin string is played (1953, p. 280). Recent advances in timbre studies and auditory perception have given us the opportunity to take such ideas further and to clarify and categorize orchestration from new vantage points.

When commentators speak of effects such as a blending of timbres created by the combination of specific instruments, or when they speak of contrast in timbre and tone quality, they are speaking about perception; however, no taxonomy existed until recently that clarifies and structures this discourse of perception-based references. As important as it is to label and classify basic principles of orchestration, creating a taxonomy in order to understand what we are hearing and how we are hearing it—and in turn applying it back onto score-based analysis—proves to be very important.

In traditional orchestration treatises, the primary perceptual effect explored in detail is blend—the art of combining instrumental timbres, using specific techniques, with specific compositional or orchestrational aims. Nevertheless, treatises have lacked an organized and systematic approach to both how instruments are combined (as explored in Chapter 1) and what the effects of these respective combinations are.

4.1.2 ORCHESTRATION RESEARCH

Since no complete theory of orchestration has emerged from previously published treatises—let alone one based on listening practices and perceptual qualities that can be exemplified in a score—a large-scale project funded by the *Social Sciences and Humanities Research Council* (SSHRC) and the *Fonds de recherche du Québec – Société et culture* (FRQSC) was initiated at McGill University’s Music Perception and Cognition Lab (MPCL) directed by Professor Stephen McAdams and Dr. Meghan Goodchild. The Orchestration and Perception Project—as it was first called—worked in collaboration with the Haute école de

musique de Genève/Neuchâtel (HEM) and the Institut de recherche et coordination acoustique/musique (IRCAM), with the goal of establishing a theory of orchestration endowed with a detailed taxonomic categorization founded on the psychological domains of timbre perception and auditory scene analysis, and to be ultimately exploited as a pedagogical tool when teaching orchestration or composition. This partnership expanded into what is now the Analysis, Creation, and Teaching of Orchestration (ACTOR) Project, involving over 100 researchers at thirteen different academic institutions and eight private-sector partners in North America and Europe. One division of its research is dedicated to understanding and correlating various taxonomies of orchestration and timbre.

A by-product of this research, especially when used in concert with traditional methods of teaching orchestration, the Taxonomy of Orchestration Grouping Effects (TOGE) can provide both the student and researcher with new tools for analysis.

The following section provides a summary of the development of the taxonomy and the methodology involved in the process.

4.1.3 DEVELOPMENT OF THE TAXONOMY OF ORCHESTRAL GROUPING EFFECTS

In the winter of 2014, eight graduate students were employed as research assistants to locate within orchestration treatises and scores exemplifications of implicit use of auditory grouping principles. Implicit refers to the sense that aspects of orchestration practice appear to be based on rules and conventions followed intuitively by orchestrators without ever being formalized explicitly. A second phase began in winter 2015, with four research assistants—two new and two from the original team. The orchestral works selected for analysis covered a wide range of stylistic periods. A high-quality scan of the score was created or located online, and various recordings were auditioned. Since many variables in a recording can affect perceived timbre (such as recording equipment, performance space acoustics, and the interpretations of conductor and musicians), selecting a specific recording often proved challenging, and to this day the selection procedure continues to be a topic for discussion and future research.

The analysis of the examples involved both individual and group collaboration. As individuals, annotators analyzed selected pieces by first listening through the orchestral work and marking the location of specific perceptually salient timbral effects: audible, prominent,

attention-capturing, and orchestrational effects. Each scanned score (pdf) was then annotated with colour-coded boxes—specific to each effect—in Mac OSX’s Preview software, and each box was labelled with the taxonomic category as well as its temporal location. If the instruments involved in a specific effect changed, arrows were added to show connections across musical staves. Keeping personal journals was encouraged so that an annotator could reflect upon the aural effect and make personal remarks about their annotation strategy.

In groups of two, the annotators compared individual analyses, debated concepts and conclusions, and created a joint analysis. Each pair of annotators then manually entered a final annotated analysis of effects into a spreadsheet (phase 1) or Google Form¹⁶ (phase 2), which contained all the necessary information—work name, composer, year of composition, publisher, recording name and publisher—and grouping effect information—pdf page start and end number, score start and end page number, effect measure start and end, time location of the start and end of the reference recording, list of the instruments involved, notes describing the effects, techniques, and a strength rating of 1–5 based on the saliency and strength of the annotated effect.

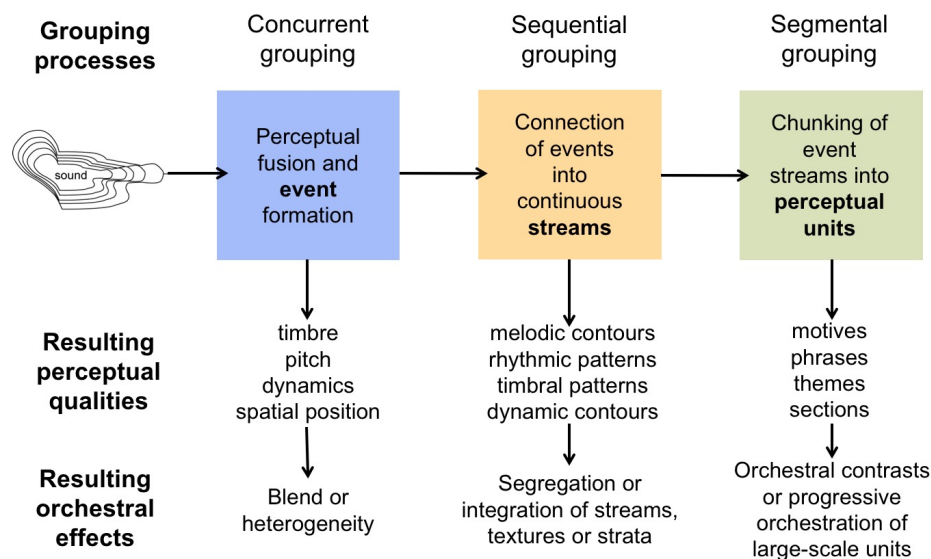
In total, 65 full movements from orchestral works written between 1793 and 1943 were analyzed, and over 4000 individual annotations of the orchestral grouping effects were identified. All results from each analysis pair were then discussed in large team meetings where each group shared their analyses, posed questions, presented their disagreements, and discussed issues. The findings were then documented and shared so that during the project all teams could view them for future reference.

All analyses were imported into a custom-designed database: the Orchestration Analysis and Research Database (OrchARD at <https://orchard.actor-project.org/search/>). In this database, one can browse or query the analyses by composer, piece, movement, instrumentation, strength rating, and/or grouping effect. Each annotation has a custom page with all of this information, as well as the score and audio excerpt.

¹⁶ This was one of the factors that inspired the creation of OrchView (see Future Projects, below)

4.2 AUDITORY GROUPING PROCESSES

The TOGE is based on auditory grouping processes that are experienced and that in turn can be analyzed and exemplified using the orchestral repertoire. These perceptual processes include: *concurrent grouping*—perceptual fusion and event formation; *sequential grouping*—connecting events into continuous streams; and *segmental grouping*—chunking of event streams into perceived units (Goodchild & McAdams, 2018; McAdams, Goodchild, and Soden, in preparation). As shown in Example 4.1, the resulting perceptual qualities of *concurrent grouping* are timbre, pitch, dynamics, and spatial position which create the resulting grouping effects of blend or heterogeneity; the resulting perceptual qualities of *sequential grouping* are melodic contour, rhythmic patterns, timbral patterns, and dynamic contours which create resulting grouping effects of integrated or segregated streams, textures, or strata of music; the resulting perceptual qualities of *segmental grouping* are motives, phrases, themes, sections which create resulting grouping effects of timbral contrasts or timbral progressions and large-scale units.



Example 4.1: Auditory grouping processes and the resulting perceptual qualities and orchestral effects. [Reproduced with permission from Goodchild & McAdams (2018)]

In order to integrate the psychological aspect of sound with the current approaches to orchestration, some of the terms used in the TOGE have been borrowed from perceptual and cognitive fields and have been redefined for use in the context of analyzing orchestral scores. This taxonomy is particularly useful because it categorizes orchestrational devices by how we

hear them and by how we group them perceptually, transferring a listening-based analysis to score-based analysis.

Another important aspect of the TOGE approach concerns its perspective on the temporal qualities of orchestration. As mentioned in the above chapters, sparse literature exists about successive—contrastive—relationships with respect to timbre and orchestration and their impacts on musical analysis. McKay (1963) presciently speculates that “[c]ontrast of any kind will be increasingly recognized as a central orchestral resource [...]” and “since timbre contrast is of such importance to the art of orchestration, perhaps the future will bring psychological clarification and a more positive terminology” (p. 90).

I speculate that perhaps little discussion arises within treatises on how to orchestrate over time because most writers feel that this is part of the “art of orchestration” and is not teachable (Rimsky Korsakov, 1912, p. 2). Gardner Read repeats this mantra as recently as 2004 in *The Art and Science of Orchestral Combinations*: “Every aspect, every facet, of orchestration is a part of creation and so defies the academic approach” (p. xii). Unfortunately, statements like these contribute to a major gap in the knowledge base of orchestration pedagogy, since each successive generation of students hears this kind of quote from the great composers and orchestrators. One might even take these statements further to mean that *great composition cannot be taught*. But proper orchestration, like proper counterpoint, harmony, etc., can be taught, but it simply requires the right tools and resources.

The teaching of “traditional” orchestration focuses primarily on short examples from the repertoire that highlight the use of small units of instrumental combinations, contrapuntal sections, and orchestral layers. As mentioned in Chapter 2, such teaching lacks the notion of *time-based orchestration relationships*, i.e., *orchestrational transformations*. There is some mention of contrasts, of dovetailing lines (dovetailing here used in the horizontal sense rather than the vertical as by Jacob, 1982) and, with regard to orchestral crescendos, the additions and reductions of instruments are mentioned. But again, no unified approach emerges and no terminology is developed relating to orchestrating progressively over time. Here approaches that draw upon perceptual psychology make an impact on our labelling and organization of temporal processes. The somewhat rudimentary term of *chunking*, implying the grouping of sound events based on temporal, timbral, pitch, and dynamic attributes, allows us to talk about how various

timbres, through changes in instrumentation, function over time in order to create an *orchestration-based form* that can contrast with or complement musical form. Orchestration-based form does not operate on a one-to-one basis with musical form. Still, this is no reason for a lack of a theoretical methodology concerning such an important facet of music: timbral organization and timbral relationships. More on this topic appears in Chapter 5.

4.2.1 THE PERCEPTION ORCHESTRATIONAL COMBINATIONS

Although not a new concept to composers—as many have written about hybrid and reinforced timbres (Berlioz, 1882/1948; Rimsky-Korsakov, 1912; Piston, 1969)—Sandell (1995) brings insight into two types of fusion (concurrent grouping) by explicitly defining them from a psychological perspective: *timbral emergence* and *timbral augmentation*, as well as the lack of fusion: *timbral heterogeneity*. More on this in section 4.4.

As discussed in Chapter 1, orchestrational combinations are founded in pitch and instrumental couplings and—if the combination temporally coincides with a melodic line—rhythmic unison. Accordingly, the perceptual effect of the couplings of registers and instruments can result in a fusion of two or more sounds. As Piston (1969) explains:

Unison doubling involves the creation of mixed timbres. This was of less importance in dealing with strings, which are far more alike in tone color than are the woodwind instruments. Furthermore, the greater disparity in the different registers of each woodwind instrument renders the matter of their combination more complex. Two instruments playing in unison reinforce each other, but at the same time each tends to cancel some of the intensity of the other's tone. The unison of two instruments of the same kind possesses somewhat less than twice the tone-weight and carrying power of one. Also, the subtle fluctuations of expressive playing are bound to be in large part destroyed when two play in unison. (p. 421)

In Table 4.1, Piston lists these common—albeit simplified—combinations that, as he states above, create “new” tone colours. However, these tone-colours are not new *per se*, since a listener is familiar with them from at least the time of Haydn onwards. They are familiar metatimbres—collections of fused combinations of instrument timbres (see Chapter 3)—that function as basic orchestral colour as much as individual instrument timbres do in the orchestral repertoire.

Table 4.1: List of standard doublings to create mixed timbres (Piston, 1969, p. 421)

	POSSIBLE DOUBLING #1	POSSIBLE DOUBLING #2	POSSIBLE DOUBLING #3	POSSIBLE DOUBLING #4
PICCOLO +	Flute	Oboe	Clarinet	[vacant]
FLUTE	Oboe	English horn	Clarinet	Bass Clarinet
OBOE	English horn	Clarinet	Bass Clarinet	Bassoon
ENGLISH HORN	Clarinet	Bass clarinet	Bassoon	[vacant]
CLARINET	Bass clarinet	Bassoon	[vacant]	[vacant]
BASS CLARINET	Bassoon	Contrabassoon	[vacant]	[vacant]
BASSOON	Contrabassoon	[vacant]	[vacant]	[vacant]

Piston is not the only composer to write about orchestrational combinations in this way; Rimsky-Korsakov describes ways to create different types of augmented blend, where either woodwinds or strings dominate:

One department of strings added to the wood-wind in unison produces a sweet coherent quality, the wood-wind timbre still predominating; but the addition of one wind instrument to all or part of the strings in unison, only thickens the resonance of the latter, the wood-wind timbre being lost in the process. (Rimsky-Korsakov, 1908, p 34)

Rimsky-Korsakov also comments further on combining timbres and the influence of the metatimbres of families of instruments—i.e., the woodwind timbre is a collection of timbres associated with the combined timbres of the woodwinds—on other instrumental families:

The influence of the timbre of one group on another is noticeable when the groups are doubled; for instance, when the wood-wind timbre is closely allied to the strings on the one hand, and to the brass on the other. Re-enforcing both, the wind thickens the strings and softens the brass. The strings do not blend so well with the brass, and when the two groups are placed side by side, each is heard too distinctly. The

combination of the three different timbres in unison produces a rich, mellow and coherent tone. (Rimsky-Korsakov, 1908, p 34)

Another instrument whose timbres can create bridges between other instruments and helps with combinations is the horn, as it has paratimbral relationships with many of the instruments of the orchestra:

As the viola is to the strings, so is the horn to the woodwind; in fact, it blends most deliciously with all instruments, and can be employed equally well in breathing forth charming melodies of an appropriate character, in sustaining important notes of the harmony, or even in reinforcing the repeated notes of an accompaniment, though that is not what may be called a legitimate use of the horns. (Vincent 1897, p. 17)

And similarly, the brass section of orchestra has similar timbres to a chorus of tenor voices:

[...] we see full harmony for the whole mass of brass instruments accompanying the tenor chorus. This is one of the commonest methods of employing the trombones; their rich and sonorous tone blends admirably with that of the horns and trumpets. (Prout 1898, p. 227–228)

Read speaks of the qualities of the string sections when playing pizzicato and this timbre's prototypical connection to the harp's plucking, and how this leads to a hybrid timbre: "Although these string instruments can normally produce a strong and resonant pizzicato, here their contribution is delicate and restrained, blending smoothly with the more assertive harp timbre." (2004, p. 12) speaking of excerpt from Debussy's *Danses sacrées et profanes*.

4.3 TAXONOMY OF ORCHESTRAL GROUPING EFFECTS

An overview of the Taxonomy of Orchestral Grouping Effects is presented in the following sections, organized under the three grouping principles, concurrent, sequential, and segmental. Within each of these, they are further categorized into effect type (e.g., blend) and subtype (e.g., Timbral Augmentation), and whether the instrumentation remains the same throughout the effect (e.g., stable) or changes (i.e., transforming). Concurrent grouping is even further classified based on duration: whether the effect is sustained over time or occurs as a marked punctuation. As in Chapters 1 and 2, each section begins with a definition and is followed by a Fundamental Example, and further commentary and then links to exemplifications. Each level of the hierarchy is also further explained by adding a prelude to the taxonomic hierarchy; a perceptual descriptor (i.e., I perceive a... manifesting itself as a...) as proposed by Baril and Bouliane (private document, OrchView OrchEffects definitions, 2019).

4.4 AUDITORY GROUPING PROCESSES: CONCURRENT GROUPING

Concurrent grouping is based on onset synchrony, harmonicity, and spatial distribution (Bregman 1990; McAdams 1984; McAdams and Bregman 1979), and “[...] concerns the integration or separation of simultaneously present acoustic information from multiple sound sources. This process is responsible for auditory event formation. In orchestration, an ‘event’ can therefore be formed from several grouped sound sources.” (McAdams et al, in preparation)

Auditory fusion occurs in the organization of an acoustic surface into musical events that can be perceived as a blend of instrument timbres; a combination of instrument timbres that creates the illusion that the sound originated from a single instrumental source.

Although scored simultaneously, in the performative interpretation of the music each attack of each one of the instruments concerned must occur relatively simultaneously/synchronously, within a small enough window of time (roughly 30–50 milliseconds) where a listener would not hear (perceive) two separate attacks, but rather one.

Harmonicity “[...] applies to any registral coupling that increases the coincidence of harmonics of the constituent sounds” (McAdams, private correspondence 2020). For example, in a unison registral coupling of flute and oboe, harmonicity concerns how much each of the instruments’ harmonic spectra line up or contrast with each other.

Concurrent grouping is affected by spatial distribution, given that the instruments placed in their stage positioning and the acoustic qualities of the performance hall (i.e., early reflections, reverb time, etc.), and the radiation pattern of the instruments performing all affect whether sounds fuse or not.

4.4.1 BLEND

Definition: “The fusion of different sources of acoustic information into a more or less unified auditory event. It primarily depends on onset synchrony, harmonicity, and the degree of overlap of constituent sound spectra. It is reinforced over time by parallel or similar motion in pitch and dynamics.” (McAdams et al, in prep.)

Further commentary: Although sounds can be fused with one another, there are varying degrees to which they blend together. Either there exists a complete fusion, or there remains one

instrument in the combination whose timbres dominate, or there is no blend at all between the sound sources.

4.4.1.1 Blend: Timbral Augmentation

Definition: “One sound source is identifiable and dominates the timbral result and is embellished, highlighted or reinforced by one or more other sound sources.” (McAdams et al, in prep.)

Perceptual description: *I perceive a blend, manifesting itself as a timbral augmentation.*¹⁷

Further commentary: As the fusion of one or more instruments, timbral augmentation occurs as the combined result of rhythmic doubling and/or registral and instrumental couplings. One or more instruments’ timbres dominate the orchestrational combination and are embellished by the other instruments’ timbres. One refers to the dominating instrument as being augmented, e.g., an “augmented trumpet.”

An example of an embellishing instrument is the clarinet. Widor (1906) speaks of the ease of the amalgamation of the clarinet’s various timbres in its middle instrumental register. These timbres are paratimbres of many other instruments of the orchestra in the same orchestral register, so it functions well as a blending instrument: “Another characteristic of the Clarinet is its neutral tone-color in the medium register, which allows of its blending with almost every group in the orchestra” (p. 31). Riemann (1890) speaks of the “[..] tone of the clarinet blend[ing] equally well with that of the other woodwind instruments, or with that of the horns” (p. 47).

In larger ensembles, certain instrumental timbres facilitate the blending with other instruments. Fiddler (1921) speaks of the paratimbral relationship of the horn and how “[t]he middle register resembles and blends well with the Bassoon, so it serves as a transitional instrument between Wood and Brass” (p. 93).

¹⁷ (Perceptual Descriptors are extracted from the in-preparation OrchView software documentation by Félix Baril, Denys Bouliane, and Stephen McAdams)

4.4.1.1.1 *Stable Timbral Augmentation, Sustained*

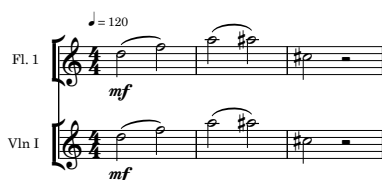
Definition 1: “A sustained sonority over one or more events in which one sound source dominates and is identifiable.” (McAdams et al, in prep.)

Definition 2: “A given sound source dominates throughout the duration of the passage.” (McAdams et al, in prep.)

Perceptual description: *I perceive a blend, manifesting itself as a timbral augmentation. The event involved is sustained, and the instruments involved are stable.*

Further commentary: In a timbral augmentation that is sustained—happening for a duration longer than the equivalent of an attack and release—and where the instrumentation stays stable throughout the passage, the blend stays the same. The registral and instrumental couplings remain the same, and one instrument’s timbres will dominate, timbrally augmented by the embellishing instrument’s (or instruments’) timbres.

In Fundamental Example 4.2¹⁸, flute 1 and violin 1 play in a duo-chroma unison coupling. The phrasing and dynamic are the same. As the violin 1 represents an orchestral section, and because of the middle instrumental register of both instruments, the violin 1 is the dominating timbre of this excerpt, and the flute’s timbre embellishes and augments it.



Example 4.2: Fundamental Example — Stable Timbral Augmentation, Sustained

¹⁸ As the Fundamental Examples for the Taxonomy of Orchestral Grouping Effects required passages that would stand up to a listening-based analysis, I used the first four notes from Bach’s *Musical Offering*, transposed up a major second, and—for the ease of reading—with accidentals reflecting pitch relationships rather than harmonic (the A# is not written as a Bb). All FE’s in this chapter keep the same pitch classes; the registers change and the rhythmic values change as needed per FE.

Exemplifications: For each taxonomic category, exemplifications are linked to: Example 4.23

4.4.1.1.2 Transforming Timbral Augmentation, Sustained

Definition: “The dominating sound source or the embellishing sound source(s) change progressively over the duration of the passage” (McAdams et al, in prep.)

Perceptual description: *I perceive a blend, manifesting itself as a timbral augmentation. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: A transforming timbral augmentation always displays at least one consistent instrument throughout its scoring, and additional instruments may be added or removed throughout the passage: the instrumental couplings change in the course of the musical passage, with an orchestrational transformation—addition, reduction. Sometimes this occurs in concert with an expansion or contraction of the orchestral register. If the change in instrumentation changes the quality of the augmentation enough, then the excerpt can be labelled as two separate blends.

Fundamental Example 4.3 begins like Fundamental Example 4.2. The embellishing instrument changes from flute 1 to clarinet 1, dovetailed so that the clarinet is added just before the flute is removed.

Example 4.3: Fundamental Example — Transforming Timbral Augmentation, Sustained

Exemplifications: Example 4.24, Example 4.25, Example 4.26

4.4.1.1.3 Punctuation Blend

Definition: “A sonority of fairly short duration in which one sound source dominates.” (McAdams et al, in prep.)

Perceptual description: *I perceive a blend, manifesting itself as a timbral augmentation. The event involved is punctuated.*

Further commentary: Short, punctuated chordal iterations tend to blend in unique ways. The noisiness of the attacks, paired with the short temporal duration, create timbral fusions that might be different if they were of longer duration, and there was a longer opportunity to discern timbral identities.

In Fundamental Example 4.4, flute 1, oboe 1, and violin 1 are coupled in unison on D5, clarinet 1 and horn 1 on D4, and bassoon 1 and trombone 1 and cello on D3. This compound multi-unison multi-octave poly-chroma coupling plays on each downbeat of the melody. The string timbre dominates. However, as timbre changes with register, the timbre of each chord iteration is slightly different. The augmented timbre of the overall chord remains fairly similar because of the stable instrumentation, so the augmented timbres of each chord have close paratimbral relationships.

♩ = 120

Fl. 1
mf

Ob. 1
mf

Cl. 1
mf

Bsn 1
mf

Hn 1
mf

Tbn 1
mf

Vln I
mf

Vc.
mf

Example 4.4: Fundamental Example — Stable Punctuated Timbral Augmentation

Exemplifications: The chords composed by Sibelius; see next chapter

4.4.1.2 Blend: Timbral Emergence

Definition: “Timbral emergence is defined as the synthesis of a new timbre, where one cannot identify any of the constituent timbres.” (McAdams et al, in prep.)

Perceptual description: *I perceive a blend, manifesting itself as a timbral emergence.*

4.4.1.2.1 Stable Timbral Emergence, Sustained

Definition: “A sustained sonority over one or more events in which sound sources are not easily identifiable.” (McAdams et al, in prep.)

Perceptual description: *I perceive a blend, manifesting itself as a timbral emergence. The event involved is sustained, and the instruments involved are stable.*

Further commentary: Throughout the musical passage, the instruments’ timbres fuse together, creating what is perceived as a new timbre.

Fundamental Example 4.5 shows the tetra-chroma multi-unison octave coupling of flute 1 and oboe in unison on the upper registral voice, and clarinet 1 and bassoon 1 on the lower registral voice. The melody is played in parallel motion, and all phrasing and dynamics are the same. All instruments are in their upper-mid registers, except the clarinet, in mid-register. The timbres merge to create a new hybrid timbre.

Fl. 1
Ob. 1
Cl. 1
Bsn 1

mf

Example 4.5: Fundamental Example — Stable Timbral Emergence, Sustained

Alfred Blatter (1997) identifies specific procedures for combining instrumental timbres, in the context of scoring prominent musical lines. His “procedure 6” (p. 334) is a recipe to recreate the organ’s mutation stops by pitch-coupling at the octave as well as intervals other than the octave. His example, shown here in Example 4.6, displays parallel intervallic pitch-coupling

at the perfect 12th (compound perfect 5th) and major 17th (compound major 3rd). Although tuning is difficult, once achieved, a merging of the timbres—an *emergence*—will result in a new timbre. If this emergent timbre is used again in the work, with any slight variation in registral or instrumental quality, its timbre would have slightly changed, yet the recognition of this emergent timbre now—as similar yet different than the last iteration—as its own collection of timbres, creates a new metatimbre.

Example 4.6: Blatter, Procedure 6 (1997, p. 334), Synthesizing new timbres

This technique, familiar to any scholar of orchestration, resembles Ravel’s famous orchestrational combination at m. 149 of *Bolero* (as seen in Example 1.41 in Chapter 1), where a synthetic timbre using similar registral couplings creates a unique moment in the listening experience since it sounds quite different from the other “normative” (Rea, 2009) orchestrations, i.e., unison or octave registral couplings.

This synthesis of collections of new timbres is common practice for contemporary composers, as they look for new orchestral colour and ways to shape each unique work.

Exemplifications: Example 4.27, Example 4.28

4.4.1.2.2 Transforming Timbral Emergence, Sustained

Definition: “The instrumentation changes progressively over the duration of the passage.”

(McAdams et al, in prep.)

Perceptual description: *I perceive a blend, manifesting itself as a timbral emergence. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: Transforming timbral emergence occurs with the addition or reduction of an instrument in a musical passage where the timbres have fused. This represents a delicate balance orchestrationally, depending on how much the timbre changes, or if there is a new identifiable quality to the passage. The consistent element here is the presence of the new emergent timbre.

Fundamental Example 4.7 shows the bass clarinet added in unison to the lower registral coupling of the clarinet 1 and bassoon 1.

Example 4.7: Fundamental Example — Transforming Timbral Emergence, Sustained

4.4.1.3 No-Blend: Timbral Heterogeneity

Definition: “Limited to cases in which onset synchrony, harmonicity, and (for continuous cases) parallel motion in pitch and dynamics are present, but the timbres of the sound sources or groups of blended sound sources remain independent due to their timbral dissimilarity.” (McAdams et al, in prep.)

Perceptual description: *I perceive no blend, manifesting itself as a timbral heterogeneity. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: In an excerpt where all the score-based conditions for creating a blend are met, no-blend can occur due to the fact that the unique timbre of the instruments, the orchestral or instrumental register differences or the technique applied, make it so that the instruments do not fuse. Each instrument is heard distinctly.

4.4.1.3.1 *Stable Timbral Heterogeneity, Sustained*

Definition: “A sustained sonority over one or more events in which different sound sources or groups of sound sources are easily distinguished.” (McAdams et al, in prep.)

Perceptual description: *I perceive no blend, manifesting itself as a timbral heterogeneity. The event involved is sustained, and the instruments involved are stable.*

Further commentary: A passage of music where one can clearly distinguish the individual timbres of the registral voices, Timbral Heterogeneity is defined as the simultaneous scoring of two instruments that do not blend with a unison or octave registral coupling. From an orchestrational perspective, blend or fusion is not always the end goal of orchestrational combinations; the composer or orchestrator may specifically combine two or more instruments that do not blend for the sake of the heterogeneity of their timbres.

Fundamental Example 4.8 shows the piccolo flute and bassoon playing in parallel, two octaves apart. This registral separation, in concert with the difference in timbres, makes for a clear perception of these individual registral voices.



Example 4.8: Fundamental Example — Stable Sustained Timbral Heterogeneity

Treatises speak of examples where the student orchestrator should avoid certain combinations, if they seek blend or balance. Timbral Heterogeneity is not to be considered solely as a defect or an error in orchestration, as it is the aim of many orchestrators to bring out registral voices without fusing them into one. Indeed, pop music production often relies on production techniques that bring about or promote timbral heterogeneity.

Jacob (1982) warns us of the unison registral coupling of the oboe and horn since they “[...] are not satisfactory in unison—they blend insufficiently” (p. 35). As well, he points out that octave registral coupling of “[t]he violins and horn do not form a very good octave combination as they fail to blend. If both are muted, however, a strange and attractive tone-

colour is produced in the pianissimo, but this is only suitable, naturally, for very special effects. The sound is better, perhaps, when the horn is an octave lower than the violins than vice versa” (p. 51). Thus, the change of dynamics can affect the blending capacity of certain instruments:

The tuba, when blown softly, combines well with the horns, and might be looked upon as a possible deep ‘5th horn’. It must be emphasized, however, that this amalgamation is only possible in p and pp. The harder they are blown the more will the horns and tuba part company, until in ff there is an almost complete lack of blend.” (Jacob 1982, p. 60)

Throughout history not all instruments were considered ideal for the orchestra. Some were excluded for practical reasons, but also for how well they did or did not blend with the other orchestral instruments. Casella and Mortari (1950) speak unfavourably of the timbre of the accordion and of the reasons it is not utilized as an orchestral instrument: “Today the principal obstacle that impedes [the accordion’s] use in the orchestra is without doubt the ugliness of its sound that does not blend with any other instrument or group of instruments in the orchestra” (p. 135).

Fiddler (1921) claims that “[m]uted Strings do not blend well with anything” (p. 43), but modern composers would disagree with her. The lack of perceived blending quality was the reason for the saxophone’s early rejection from the symphony orchestra: “It is said that Adolf Sax tried to persuade Wagner to include [saxophones] in his orchestral apparatus but Wagner perceived that they would not blend well with either woodwind or brass (still less, strings) and never used them” (Jacob 1982, p 63).

Adler speaks of the incompatibility of the woodwinds in general, and this would seem to contradict Piston’s advice (above), but Adler speaks here more of performative nuances:

Composed of largely heterogeneous instruments, the woodwind choir is perhaps the most quarrelsome of all the families within the orchestra. It is difficult for wind instruments to time with one another, and only the finest players can accomplish any kind of balance or blend of their colorful and diverse timbres. (Adler 2002 p. 164)

4.4.1.3.2 Transforming Timbral Heterogeneity, Sustained

Definition: “The instrumentation changes progressively over the duration of the passage, maintaining separation.” (McAdams et al, in prep.)

Perceptual description: *I perceive no blend, manifesting itself as a timbral heterogeneity. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: Although the instrumentation changes, each registral voice in the passage remains timbrally heterogeneous.

Fundamental Example 4.9 begins similarly to the examples for stable timbral heterogeneity, but the celesta enters in measure 2 (both are notated an octave below sounding pitch) and then the piccolo drops out.



Example 4.9: Fundamental Example — Transforming Sustained Timbral Heterogeneity

4.4.2 INSTRUMENTAL REGISTER COMBINATIONS AND BLEND

The choice of combination of instruments in complementary or contrasting instrumental registers greatly affects perceived timbral fusion. Depending on how the instruments have been scored on a vertical basis in the chord or line, blend may occur in one or all of the voices, for example in a multi-octave coupling with multi-unison registral couplings in each of the voices. An example of this type may be heard in the main theme from Tchaikovsky's *Pas de Deux* (Chapter 1, Example 1.6), where there is fusion—within voices—of the unison registral couplings, but one does not perceive a complete blend of the entire excerpt, which comprises the multi-octave registral couplings.

When in the vertical structuring of a chord, the goal is a fusion of the component instrumental colours, Piston (1969) describes the experimental process that one must go through to find balance and blend in a chord. The various couplings must be experimented with:

The student should experiment with the arrangement of chords, applying the devices of unison doubling, overlapping, superposition, interlocking, and enclosing, and try

to judge their effect. A general statement as to the relative value of these devices in achieving an even blend of timbres cannot and should not be made. (p. 448)

4.5 AUDITORY GROUPING PROCESSES: SEQUENTIAL GROUPING

Definition: “Sequential grouping involves the perceptual connecting of a succession of similar events and the separation of events with different perceptual qualities into distinct groups.”

(McAdams et al, in prep.)

Further commentary: Sequential grouping creates the perception of various musical textures, whether it be a single line of music, contrapuntal lines, layers, or complex textures. The single line of music is an integrated stream, “[c]onsistent timbre across a sequence of notes helps them to be connected perceptually into an auditory stream” (McAdams *et al*, in preparation). When the streams integrate into a texture where individual parts are hard to follow due to their integration into the musical surface, and one still perceives the multiplicity rather than a single stream, it is categorized as *textural integration* or *surface texture*. McAdams and Goodchild (2014) further describe its attributes:

- Sounds from the same source tend to be similar in timbre
- Sounds with different timbres tend to come from different sources
- Perceptual organization connects similar sounds into auditory streams

A difference in timbres plays an important role in following a specific musical voice in contrapuntal textures (McAdams & Bregman, 1979). Brant (2009) emphasizes that to keep the voicing very clear in contrapuntal situations where the “counterpoint consists of *contrasted* linear elements, *each linear-rhythmic unit should retain its own timbre*, irrespective of whether this results in juxtaposition, interlocking or enclosure.” (p. 12) [Italics mine] When independent voices or auditory streams are perceived over time, we call this *sequential grouping*.

If the various music streams are heard as co-equal, then a *segregation* of the musical stream has occurred. If individual elements of the streams are heard as hierarchical, i.e., separating into a foreground or background of musical material, this taxonomic classification is called a *stratification*.

4.5.1 INTEGRATION

Definition: “The grouping over time of events into streams or surface texture”.

Perceptual description: *I perceive an integration.*

Further commentary: The musical events are linked over time, whether as in an integrated stream of music or as an integrated surface texture.

4.5.1.1 Stream Integration

Definition: “A sequence of events produced by a single sound source or groups of blended sound sources is perceived as connected and forms a unitary musical pattern.”

Perceptual description: *I perceive an integration, manifesting itself as a stream.*

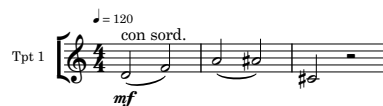
4.5.1.1.1 Stable Stream Integration

Definition: “A stream of events played by the same sound source or group of blended sound sources.” (McAdams et al.)

Perceptual description: *I perceive an integration, manifesting itself as a stream. The event involved is sustained, and the instruments involved are stable.*

Further commentary: These sequences of events get grouped into one stream. The key thing is that the stream is from the same sound source or instrument, or groups of blended instruments. Any of the blend examples represent an integrated stream.

Fundamental Example 4.10 shows the trumpet playing the excerpt. The timbres of each of these notes are similar enough and come from the same source, so it creates a stream of events. They are heard as connected and form a cohesive musical pattern that the listener identifies as a musical stream.



Example 4.10: Fundamental Example — Musical Stream

Exemplifications: Example 4.23, Example 4.28, Example 4.27

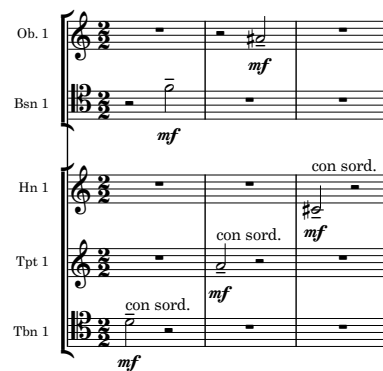
4.5.1.1.2 Transforming Stream Integration

Definition: “A stream of events in which the sound source or group of blended sound sources changes over the passage (e.g., Klangfarbenmelodie)” (McAdams et al.).

Perceptual description: *I perceive an integration, manifesting itself as a stream. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: The same stream of events, but with changing instrumentation. Depending on the level of contrast the composer wants to create in the stream; i.e., if there is too much contrast, one loses the sense of the musically connected auditory stream.

This Fundamental Example is orchestrated similar to Webern’s orchestration of Bach’s *Musical Offering*. Example 4.11 is scored with a different instrument on each note of the melody. However, the choice of instrument and instrumental technique keeps the timbres connected (into a metatimbre or prototype timbre) which keeps the stream connected.



Example 4.11: Fundamental Example — Transforming Stream (Score in C)

Exemplifications: Example 4.26, Example 4.29, Example 4.30

4.5.1.2 Textural Integration

Definition: “Overlapping sequences of notes by two or more sound sources, often with distinct rhythmic patterns but in similar registers, which do not form a single stream but are difficult to separately follow through time, and thus form a looser grouping into a surface texture. The term ‘texture’ is used here in its meaning of ‘the consistency of a surface.’”

Perceptual description: *I perceive an integration, manifesting itself as a surface texture. The event involved is sustained, and the instruments involved are stable.*

Further commentary: Two or more instruments playing two or more independent lines, oftentimes in the same orchestral register, create a musical texture where it is hard—if not impossible—to hear the component elements. As Piston (1969) explains:

Another kind of complex texture is not the product of a synthesis of other textures, but is an ensemble of many elements, none of which emerges as a primary element. The ear is attracted momentarily to various details, and almost at once diverted to others. This effect of a woven musical fabric has aptly been called a ‘tapestry of sound.’ (p. 410–411)

4.5.1.2.1 Stable Textural Integration

Definition: “The sound sources forming the surface texture remain constant over the duration of the passage.” (McAdams et al.)

Perceptual description: *I perceive an integration, manifesting itself as a surface texture. The event involved is sustained, and the instruments involved are stable.*

Further commentary: Fundamental Example 4.12 shows a blended, tri-chroma unison coupling of the flute, clarinet and violin 2. In the same orchestral register, playing the same pitches but at double the rhythmic value are a blended duo-chroma unison coupling of the clarinet and violin 1. Although elements of each stream can be heard, overall they form a texture on the musical surface.

Example 4.12: Fundamental Example — Textural Integration

Exemplifications: Example 4.31

4.5.1.2.2 Transforming Textural Integration

Definition: “The sound sources forming the surface texture change over the duration, maintaining the textural integration” (McAdams et al.)

Perceptual description: *I perceive an integration, manifesting itself as a surface texture. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: Similar to stable textural integration, but with instrumental changes. Most often relatively seamless, by addition or reduction on the same registral voice and creating a change in the instrumental coupling.

Fundamental Example 4.13 exhibits a similar excerpt to the previous. Clarinet 1 in unison is added to flute 1, oboe 1, and violin 2. The other stream starts off as oboe 2, clarinet 2, and violin 1, but the oboe 2 drops out.



Example 4.13: Fundamental Example — Transforming Textural Integration

4.5.2 SEGREGATION

Definition: “Sequences of events that separate into two or more independent streams or strata (orchestral layers).” (McAdams et al.)

Perceptual description: *I perceive a segregation.*

Further commentary: Two or more musical lines are scored, either as co-equal voices or as a layering of musical material and with some layers having more perceptual prominence than the others.

4.5.2.1 Streams

Definition: “Multiple independent auditory streams with equivalent prominence. Note that each stream is integrated but segregated from other streams.” (McAdams et al.)

Perceptual description: *I perceive a segregation, manifesting itself as independent auditory streams.*

Further commentary: In this category, two or more co-equal lines of music are scored.

4.5.2.1.1 Stable Stream Segregation

Definition: “The sound sources forming the separate streams remain constant over the duration of the passage.”

Perceptual description: *I perceive a segregation, manifesting itself as independent auditory streams. The event involved is sustained, and the instruments involved are stable.*

Further commentary: As to be expected, sounds from the same (instrumental) source tend to be similar in timbre, whereas sounds with different timbres tend to come from different (instrumental) sources. Our perceptual organization of these timbres connects similar sounds into auditory streams. If auditory streams are determined to be clearly distinguishable voices with nearly equivalent prominence or salience, we then perceive *stream segregation*. The different instrumental parts must be coequal, and as such are often scored as contrapuntal melodic lines with rhythmic independence.

In Fundamental Example 4.14, the stream in the upper voice scored with flute 1 and oboe 1 create a blend that forms an integrated stream. The stream in the lower voice with violin 1 plays the same pitch class but with rhythmic independence, and there is a difference in orchestral register of an octave. Had the violin been scored in the same orchestral register, something closer to a textural integration might have been perceived, or quite possibly the timbre and rhythm differences would still be enough to create a stream segregation. The registral independence,

creates a key difference in each stream, enough as to be able to track each one of these separately. These streams are *juxtaposed* in orchestral register, rather than *interlocked*.

Fl. 1
Ob. 1
Vln I

$\text{♩} = 120$

mf

mf

mf

Example 4.14: Fundamental Example — Streams

Exemplifications: Example 4.32, Example 4.33

4.5.2.1.2 Transforming Stream Segregation

Definition: “The sound sources forming each separate stream change over the duration of the passage.” (McAdams et al.)

Perceptual description: *I perceive a segregation, manifesting itself as independent auditory streams. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: A change in instrumentation occurs in either one of the streams, usually a dovetailing of sort—the addition of one instrument and the reduction of another—that keeps a continuity within each stream. Fundamental Example 4.15 features the addition of parts to each stream.

Fl. 1
Ob. 1
Hn 1
Tpt 1
Vln I
Vc.

$\text{♩} = 120$

mf

mf

mf

mf

mf

mf

Example 4.15: Fundamental Example — Transforming Stream Segregation (Score in C)

4.5.2.2 *Stratification*

Definition: “Orchestral stratification involves looser groupings of events into strata of different prominence (e.g., foreground, middleground, background). A stratum may contain one or more streams, a surface texture, or more loosely grouped collections of instruments that are still distinct from other layers.” (McAdams et al.)

Perceptual description: *I perceive a segregation, manifesting itself as a stratification.*

Further commentary: We can also perceive an orchestral passage in terms of *stratification*, where two or more layers of musical material are separated into more or less prominent strands; and the most prominent being the foreground, followed by a middleground, and then the background. Oftentimes this coincides with melody and accompaniment, and the registral placement of the layers where “[...] we find the melody sometimes above, sometimes below, but always clearly separated from its accompaniment, either in register or by contrast of tone-color” (Mason, 1909, p. 93). As Joseph Wagner explains further:

“The painter achieves a two-dimensional effect of foreground and background by means of color contrasts and composition. The orchestrator must accomplish the same illusion by means of contrasting timbres, along with the right balancing of these sonorities. Occasionally these two elements, foreground and background, merge with such subtle craftsmanship that only the trained eye and ear can detect the points of contact.” (J. Wagner, 1959, p. 14)

Rimsky Korsakov also comments on the creation of orchestral strata, aided by the orchestrational combinations chosen:

Whether it be long or short, a simple theme or a melodic phrase, melody should always stand out in relief from the accompaniment. This may be done by artificial or natural means; artificially, when the question of tone quality does not come into consideration, and the melody is detached by means of strongly accentuated dynamic shades; naturally, by selection and contrast of timbres, strengthening of resonance by doubling, tripling, etc., or crossing of parts (violoncellos above the violas and violins, clarinets or oboes above the flutes, bassoons above the clarinets etc.). (1908, p. 36)

4.5.2.2.1 *Stable Stratification*

Definition: “The sound sources grouped into the various strata remain constant over the duration of the passage.” (McAdams et al.)

Perceptual description: *I perceive a segregation, manifesting itself as a stratification. The event involved is sustained, and the instruments involved are stable.*

Further commentary: Fundamental Example 4.16 features three independent rhythmic qualities, three orchestral registers being used, and three different dynamics in play. Each one of these factors influences where these musical lines are perceptually placed in the orchestral strata: Flute 1 and oboe 1 (an integrated stream) in a duo-chroma octave coupling are the highest and loudest, and therefore in the *foreground*. The clarinet and bassoon are in the middle register, with *mp* dynamics, rhythms diminished to eighth notes, creating a *middleground*. The cello and contrabass in the lowest register, with the rhythmic durations that are the most augmented, are in the *background*.

Example 4.16: Fundamental Example — Stable Stratification

Exemplification: Example 4.34

4.5.2.2.2 Transforming Stratification

Definition: “The sound sources grouped into the various strata change over the duration of the passage.” (McAdams et al.)

Perceptual description: *I perceive a segregation, manifesting itself as a stratification. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: In the category of transforming stratification, any or all of the strata can be perceived as transforming. In Fundamental Example 4.17, the foreground transforms with the

addition of violin 1 in unison with oboe 1. The middleground also transforms at the same time with the addition of viola at the unison to the clarinet 1 and bassoon 1 line. The background stays stable.

Example 4.17: Fundamental Example — Transforming Stratification

Exemplifications: Example 4.25

4.6 AUDITORY GROUPING PROCESSES: SEGMENTAL GROUPING

Definition: “Segmentation into perceptual units occurs when discrete changes are involved in one or more musical parameters, in particular here, changes in instrumentation or electroacoustic sound creating orchestral contrasts.” (McAdams et al.)

Further commentary: Changes in instrumentation will cause auditory segmentation, the “chunking” (a psychological term meaning segmenting) of event streams into musical units of various sizes, from several seconds to a couple of minutes. Such changes are usually discrete in nature, since they occur at a clear (musical) moment in time where instrumentation changes. The change can be repeated or may occur just once, but it is enough to cause a segmenting or a chunking of the musical events concerned.

A musical composition is the result of a process by which complete structures are built from smaller units. On an obvious level, a symphony is typically organized in

several discrete units called movements. The organization of smaller pieces without such obvious divisions is the result of the same process. The understanding of a complex musical entity, therefore, depends upon the understanding of relationships between smaller units within that entity. Such an understanding is dependent upon locating those points at which the larger structure is divided into smaller sections. (Spencer & Temko, 1988, p. 1)

We can mobilize the categories of *orchestrational transformations*—by examining what is changing in an orchestration *compared to* a previous orchestration—to understand the mechanism behind the TOGE’s classification of Timbral Contrasts and Timbral Progressions. Timbral Contrasts occur where a listener hears local changes, contrasts such as timbral shifts, timbral echoes, general contrasts, antiphonal contrasts of call and response, and boundary creation. Timbral Progressions are where there are large-scale gradual changes with internal coherence without discontinuity (unless discontinuity is integrated purposefully into these large timespans) involving many aspects of concurrent, sequential, and segmental grouping; such as changing blend, changing strata, changing of colours of a melody, colours changing streams, larger-scale orchestral gestures.

4.6.1 TIMBRAL CONTRASTS

Definition: “Timbral contrasts form segments as small as melodic-rhythmic patterns and as large as sections of a piece. Contrasts of lesser strength may just highlight changes in other musical parameters and stronger contrasts can create boundaries between adjacent musical materials.” (McAdams et al.)

Perceptual description: *I perceive a timbral contrast.*

Further commentary: What kinds of timbral contrast do we hear? We hear ones clearly related to orchestrational transformations, where either the pitch or rhythmic material remain constant and it is solely the timbral change that creates the segmental grouping, or we hear timbral contrasts that work in concert with changes of pitch and rhythm.

4.6.1.1 Timbral shifts

Definition: “A kind of orchestral hot potato in which a musical pattern is reiterated with varying orchestrations of similar prominence presented in discrete timbral steps.” (McAdams et al.)

Perceptual description: *I perceive a timbral contrast, manifesting itself as a timbral shift. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: Timbral shifts are discrete changes in timbre—the basic orchestrational transformation of alteration is what creates it—usually with a short motive that is repeated by one or more other instruments with varying orchestrations (i.e., a repeated phrase is “passed around” the orchestra).

Fundamental Example 4.18 shows the rhythmically diminished version of the motif scored with a different instrument on each iteration. In this case, the orchestral register stays the same.

The musical score for Fundamental Example 4.18 is written for four instruments: Fl. 1, Ob. 1, Hn 1, and Vln I. The tempo is marked as 120 bpm. The key signature is one flat (B-flat major or D minor). The motif is a four-note phrase (D4, E4, F#4, G4) in 4/4 time, marked *mf*. The motif is passed around the orchestra: Fl. 1 plays it in the second measure, Ob. 1 in the first, Hn 1 in the third, and Vln I in the fourth.

Example 4.18: Fundamental Example — Timbral Shifts (Score in C)

Exemplifications: Example 4.35, Example 4.36, Example 4.37

4.6.1.2 Timbral echo

Definition: “Repetition of a musical pattern by a different sound source or combination of sound sources with timbres that mimic being more distant than the original presentation. At times achieved with off-stage instruments.” (McAdams et al.)

Perceptual description: *I perceive a timbral contrast, manifesting itself as a timbral echo. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: By definition, this timbral contrast implies the use of a different timbre in the repeated passage. Usually, it is the direct imitation of a previous motive that has been changed timbrally in order to display an echo-like quality, by way of instrumental alteration

or by changing the timbre of the original instrument. When a musical phrase or idea is repeated—almost exactly in pitch and rhythm—with different orchestrations by harnessing specific orchestrational transformations that create a distancing-like effect, the repeated phrase or idea is called a timbral echo.

Consider, say, a horn making a “call” and then responding with a muted pianissimo “echo.” Rimsky-Korsakov (1912) described this specific effect perfectly as an “imitation entailing not only decrease in volume of tone but also an effect of distance.” (p. 110). Contrary to an antiphonal example (see section 0 below), this type of repetition does not function as an antecedent or consequent phrase (Caplin, 1998), but rather consists of the same material as the original. Sometimes this effect is reversed or retrograded – we hear the quiet/distant effect first, and the second iteration is louder/closer.

Fundamental Example 4.19 shows the muted trumpet playing the same motif as the violin, but at *pp*. The combination of the change of instrument along with the dynamic and the mute, creates the illusion of a distancing effect, an “echo.”

The musical score is for two staves: Tpt 1 (Trumpet 1) and Vln I (Violin I). The tempo is marked as quarter note = 120. The key signature has one sharp (F#) and the time signature is 4/4. The Violin I part (bottom staff) plays a motif starting with a half note D4, followed by quarter notes E4, F#4, and G4, then a half note A4. The dynamics are marked *mf* (mezzo-forte). The Trumpet 1 part (top staff) is silent for the first four measures. In the fifth measure, it enters with the same motif as the violin, but with a half note D4, followed by quarter notes E4, F#4, and G4, then a half note A4. The dynamics are marked *pp* (pianissimo) and it is marked "con sord." (con sordina), indicating it is muted.

Example 4.19: Fundamental Example — Timbral Echo

Exemplifications: Example 4.38, Example 4.40

4.6.1.3 General contrasts

Definition: “Musical patterns that are of similar perceptual prominence are set against one another sequentially with different instrumentations.” (McAdams et al.)

Perceptual description: *I perceive a timbral contrast, manifesting itself as a general contrast. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: This comprehensive term, general contrasts, describes any occasion where a timbral contrast, and change in instrumentation, produces some type of perceived boundary.

These kinds of contrasts are discussed in orchestration treatises, and they include timbral differences, instrumental contrasts, instrumental choirs, alternation of voices, timbral roles, and so on.

Fundamental Example 4.20 shows the same excerpt from the *Musical Offering*, this time every two notes the orchestration changes. It begins with a quinta-chroma compound multi-unison multi-octave coupling, in the mid and low orchestral register at *p*. It is contrasted timbrally (via instrument and register change to the pitch classes) with a poly-chroma multi-unison multi-octave coupling of all different instruments from the previous two notes, and these in the mid and high-mid orchestral register at *ff*.

♩ = 120

Fl. 1

Fl. 2

Ob. 1

Ob. 2

Cl. 1

Cl. 2

Bsn 1

Bsn 2

Hn 1

Hn 2

Tpt 1

Tpt 2

Tbn 1

Tbn 2

Tbn 3

Vln I

Vln II

Vla

Vc.

Cb.

ff

p

p sub.

Example 4.20: Fundamental Example — General Contrasts (Score in C)

4.6.1.4 Antiphonal contrasts

Definition: “Timbral contrasts underscoring an alternating call-and-response pattern.”

(McAdams et al.)

Perceptual description: *I perceive a timbral contrast, manifesting itself as an antiphonal contrast. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: Antiphonal contrasts require both a phrase structure that effectuates a call/response quality as well as timbral differentiation of the orchestral “answer.”

Fundamental Example 4.21 shows a call and response between two types of rhythmic patterns. The change from call to response is scored with the change of amount of instruments and the reduction of orchestral register. This is contrasted again with the return of the original call.

♩ = 120

Fl. 1 *mf*

Fl. 2 *mf*

Ob. 1 *p*

Ob. 2 *mf*

Cl. 1 *mf*

Cl. 2 *mf*

Cl. 3 *mf*

Bsn 1 *mf*

Bsn 2 *mf*

Hn 1 *mf*

Hn 2 *mf*

Tpt 1 *mf*

Tpt 2 *mf*

Tbn 1 *mf*

Tbn 2 *mf*

Tbn 3 *mf*

Vln I *mf*

Vln II *p*

Vla *mf*

Vc. *mf*

Cb. *mf*

Example 4.21: Fundamental Example — Antiphonal Contrasts (Score in C)

Exemplifications: Example 4.42, Example 4.43

4.6.1.5 Sectional Boundaries

Definition: “Creation of boundaries of larger-scale sections with strong contrasts in register, texture, and instrumentation.” (McAdams et al.)

Perceptual description: *I perceive a timbral contrast, manifesting itself as a sectional boundary. The event involved is sustained, and the instruments involved are transforming.*

Further commentary: Sectional Contrast are essentially timbral markers or signals that delineate some sort of formal boundary. They are the perceived beginning or ending of a segment (chunk) at the beginning or ending of musical events, identified by a timbral difference. Please recall that, as seen in Example 54 (chapter 4), Haydn composes the oboe phrase between two repeats signifying or marking a boundary between two sections in his Symphony no. 99, third movement (1793).

Music is often structured in such a way that some of its aspects (parameters) maintain similar configurations of values for some time. At certain points some of these parameters may change more radically, eventually arriving at a new, comparatively stable configuration of patterns or values. These changes may be large or small, depending on what has been established as “normal” in a particular context. These points of multiparametric change are what I shall call “sectional boundaries.” Like any other kind of boundaries, they may be sharp or not. (Snyder, 2000, p. 193)

Fundamental Example 4.22 is similar to the FE of *Antiphonal Contrasts*, but here the change is not repeated, so the change in parameters (instrument and register and dynamics) represents a sectional boundary. The timbral and registral change influence the boundary creation.

The musical score is for a full orchestra, arranged in a standard symphonic format. It consists of 18 staves, each representing a different instrument or section. The instruments are: Flute 1, Flute 2, Oboe 1, Oboe 2, Clarinet 1, Clarinet 2, Bassoon 1, Bassoon 2, Horn 1, Horn 2, Trumpet 1, Trumpet 2, Timpani, Violin I, Violin II, Viola, Violoncello, and Contrabass. The score is written in 4/4 time. The key signature is C major. The music is divided into two main sections by a sectional boundary. The first section, from the beginning to the boundary, is marked with a mezzo-forte (mf) dynamic. The second section, starting after the boundary, is marked with a piano (p) dynamic. The boundary occurs at the end of the eighth measure of the first system. The woodwinds and strings play a similar melodic line in the first section, while the brass and woodwinds play a more complex, rhythmic pattern in the second section.

Example 4.22: Fundamental Example — Sectional Boundary (Score in C)

4.6.2 TIMBRAL PROGRESSIONS

Definition: “Timbral progressions over longer timespans can be used to create coherence and dramatic shape within larger-scale formal units. There is only one subcategory (orchestral gestures) for the moment, leaving open the possibility to add others later.” (McAdams et al.)

4.6.2.1 *Orchestral Gestures*

Definition: “Large-scale, goal-directed timbral shaping that coordinates various musical elements in order to create a sense of agency and emotional force. Defined in terms of rate of change in instrumentation (gradual vs. sudden) and the direction of change (additive vs. reductive).” (McAdams et al.)

Further commentary: Orchestral gestures are goal-oriented, large-scale additions or reductions of orchestral forces (Goodchild, Wild & McAdams, 2012). They can involve the entire orchestra or only certain layers within the orchestra. A few different general types of gesture exist: *sudden gestures* are climactic moments occurring at the goal of a section or movement, whereas *gradual gestures* can emerge over several minutes. Large-scale changes in instrumentation and orchestral register signify a formal function in the musical discourse such as gradual addition, gradual reduction, sudden addition, and sudden reduction. Gradual addition of instruments is generally referred to as build-up, accumulation, gradual crescendo, or entering one by one, etc. Gradual reduction is described as thinning out, dwindling down, orchestrating a diminuendo, etc. Sudden addition designates a sudden orchestrational transformation, i.e., an addition of instruments and an expansion of orchestral register. Sudden reduction refers to the opposite transformation process, i.e., a sudden contraction of the orchestral register and reduction in number of instruments scored.

4.7 EXEMPLIFICATIONS AND SCORE EXCERPTS

Now that we have explored the taxonomy, the following sections contain the exemplifications referred to in the above sections. These score excerpts demonstrate the concepts of the TOGE using the orchestral repertoire.

4.7.1 *TIMBRAL AUGMENTATION*

In Example 4.23, Ravel’s 1922 orchestration of Mussorgsky’s (1874) *Pictures at Exhibition*, (the “Samuel Goldenberg und Schmuyl” movement) represents an example where the woodwinds embellish the strings in what is categorized as a *Timbral Augmentation*, and can additionally be referred to as belonging to a collection of familiar timbres in the orchestral repertoire, the metatimbre of *Augmented Strings*. It is a two-octave compound registral coupling, and a poly-chroma coupling: a multi-unison scoring of the English horn, clarinets 1 and 2, violin

I and II (and sometimes viola) on the upper octave (tri or tetra-chroma); and the bass clarinet, bassoon 1 and 2, cello and bass (and sometimes viola) on the lower octave (tetra-chroma or poly-chroma).

This metatimbre of Augmented Strings relies upon the dominant timbres of the entire string section, but the embellishing timbres can be different. Although in this case (as Ravel was a master of orchestration), the embellishing timbres happen to be strong in the alto and tenor orchestral register, instrumental registers that speak well here and yet contribute to the overall hybrid augmented string metatimbre.

Andante

The musical score is for the piece "Samuel Goldenberg und Schmuÿl" from Mussorgsky's *Pictures at an Exhibition*. It is marked "Andante" and shows measures 1 through 5. The score is written for a woodwind section and a string section. The woodwind section includes English Horn (Eng. Hn), Clarinet in A (Cl. in A 1), Clarinet in Bb (Cl. in A 2), Bass Clarinet in A (B. Cl. in A), Bassoon 1 (Bsn 1), and Bassoon 2 (Bsn 2). The string section includes Violin I (Vln I), Violin II (Vln II), Viola (Vla), Cello (Vc.), and Double Bass (Cb.). The woodwinds play a melodic line with triplets and slurs, while the strings provide a rhythmic accompaniment with triplets and slurs. The score is in C major and 3/4 time. Dynamics include "f" (forte) and "Div." (divisi).

Example 4.23: Mussorgsky, *Pictures at an Exhibition*, “Samuel Goldenberg und Schmuÿl,” mm.

1–5. (Score in C)

4.7.2 TRANSFORMING TIMBRAL AUGMENTATION

In *Roméo et Juliette* (1839), at the *Largo* shown in Example 4.24, Berlioz scores a unison registral coupling and tri-chroma coupling of the English horn, bassoons 1–4, horn, and—with an addition for the crescendo at the end of the phrase—viola. It is described here by Piston as a mixture of tone colours, but with a quality of the English horn that remains:

An extraordinary effect of mixed tone colors is created by Berlioz with the unison of four high bassoons, English horn, and horn. In the concert hall one is impressed by the fact that the English horn, far from being lost in this combination, is distinctly heard as an ingredient in the composite timbre. (Piston 1969, p. 200)

Largo (♩ = 132)

The score is for a *Largo* movement (♩ = 132). It is in C major and 12/8 time. The instruments involved are C. A. (Cello/Double Bass), Bsn 1, Bsn 2, Bsn 3, Bsn 4, Hn in E 1, and Vla. The music starts with a half rest in the first measure. The melody is played by the C. A., Bsn 1, Bsn 2, Bsn 3, Bsn 4, and Hn in E 1. The dynamic is *mf espressivo* for the first four measures. In the fifth measure, a crescendo begins, leading to a fortissimo (<sf>) dynamic in the sixth measure. The viola enters in the fifth measure with a lower octave version of the melody. The score shows the registral coupling and tri-chroma coupling of these instruments.

Example 4.24: Berlioz, *Roméo et Juliette* (Score in C)

4.7.3 TRANSFORMING TIMBRAL AUGMENTATION AND STRATIFICATION

In this example (Example 4.25) from Haydn's Symphony no. 100, flute 1 and violin 1 are coupled in unison throughout the theme, with the violin's timbres dominating. Violin 2 enters at unison in m. 3, and the violas briefly join in parallel intervallic and octave coupling only in measure 5.



Example 4.25: Haydn, Symphony no. 100 in G major, mov. ii.

4.7.4 TRANSFORMING TIMBRAL AUGMENTATION, TRANSFORMING STREAM

In Example 4.26 from Beethoven's *Egmont Overture*, violin 1 is first coupled at the unison by clarinet 1, then at the octave by flute 1. This is followed by a three-octave registral coupling with bassoon 1 below, and flute 1 above violin 1. A *reduction* and a *contraction* in the following measure returns to the duo-chroma coupling as well as the octave registral coupling of the violin and flute. Finally, there is a change to oboe and violin. The final measure, with the new instrumental coupling and new intervallic harmonic registral coupling of the oboe and clarinets, is a timbral modulation of the phrase, or as the TOGE would classify it, a timbrally *transformed stream* of the original phrase.

Example 4.26: Beethoven, Egmont Overture, mm. 15–22. (Score in C)

4.7.5 TIMBRAL EMERGENCE

Emergence does not always need complex registral couplings to occur. Sometimes simple unison with the instrument scored in complementary instrumental registers can create the conditions to fuse completely. This unison registral coupling of the viola with the English horn,

creates a *timbral emergence* (Example 4.27). As McKay (1963) explains, “[a]nother striking instance of subtle blend is found in Tchaikovsky’s *Romeo and Juliet* Overture, where viola and cor anglais are doubled in the famous melody. The blend of the mellowness of the viola tone with the “bite” and brooding “graininess” of the cor anglais tone, creates a sound of moving and memorable richness” (p. 122).

Example 4.27: Tchaikovsky, *Romeo and Juliet*, mm. 183–190. (Score in C)

4.7.6 TIMBRAL EMERGENCE, TRANSFORMING STRATIFICATION

Example 4.28 from Debussy’s *La mer* exhibits an example of an emergent blend, with the English horn and muted trumpet in parallel in an octave registral coupling, a common technique to create a blend: “Two or more different instruments playing a line in different octaves is another effective way to synthesize new timbres.” (Blatter 1997, p. 333). This example contains a stratification as well, with the stable instrumentation of the foreground emergent blend, contrasting with the transforming background of strings. *Addition* just before *reduction*—known to orchestrators as dovetailing—matches the descent in orchestral register.

alteration), the unison and octave coupling of the violin passes the line off at its apex to the unison coupling of flute 1 and clarinet 1, who hand it back to the violins and violas. They join in unison with violin 1 to end the first part of the phrase.

In Example 4.30, an excerpt from the “Gnomus” movement in Ravel’s orchestration of Modest Mussorgsky’s *Pictures at an Exhibition*, a continuous stream of music is heard even though the instrumental colouring is changing, creating a *transforming stream integration*. The orchestrational transformations used/perceived are *alteration*, *addition*, and *reduction*. There is a fluid transition between each element (unison registral coupling of bass clarinet and contrabass), and the cello takes over the ascending line, slightly changing the duo-chroma coupling. The contrabass is then coupled with the bassoon in unison, and the cello takes over at the descending motive.

82 poco accel.....

B. Cl. *pp* *mf* *tr*

Bsn 1 *mf* *tr*

Vc. *gliss.* *p* *mf* *simile*

Cb. *pp* *tr*

Example 4.30: Mussorgsky, orchestrated by Ravel (1922), *Pictures at an Exhibition*, “Gnomus.”

4.7.8 TEXTURAL INTEGRATION

Example 4.31 from Smetana’s *Die Moldau* displays a good example where the flutes and clarinets are each scored within their own musical stream (in rhythmic unison and a harmonic-based registral and mono-chroma couplings), but because of the overlapping of the orchestral register within which they are scored and the quiet dynamic, they are perceived as a textural integration.

Example 4.31: Smetana, *Die Moldau*, mm. 187–194. (Score in C)

4.7.9 *STREAM SEGREGATION*

The following excerpt from Brahms' Symphony no. 4, mov. iv, (Example 4.32) is an example of auditory stream segregation, where the compound multi-unison octave coupling of the flutes and oboes is co-equal to the octave-coupling of the clarinets and bassoons. It functions as an interesting example because of the rhythmic unison of the quarter notes that is broken up by the different phrasing, and the harmonic and timbral differentiation of the two voices. These musical lines are separated into four registral voices and the registers of each are juxtaposed vertically at the beginning of the line and then interlocked.

Allegro ♩ = 120

19

Flute 1 *mp* *cresc.*

Flute 2 *mp* *cresc.*

Oboe 1 *mp* *cresc.*

Oboe 2 *mp* *cresc.*

Clarinet 1 in A *mp* *cresc.*

Clarinet 2 in A *mp* *cresc.*

Bassoon 1 *mp* *cresc.*

Bassoon 2 *mp* *cresc.*

Example 4.32: Brahms, Symphony no. 4, mov. iv, mm. 19–25 (Score in C)

4.7.10 STREAM SEGREGATION, STRATIFICATION

Another example of segregation in Example 4.33, is taken from *The Lark Ascending* by Ralph Vaughan Williams, displaying two separate musical lines. As with many of the examples from the TOGE—as they are derived from the orchestral repertoire—there is more than one grouping effect happening at the same time: the separate voices are oboe and solo violin in foreground, with the string section in the background (see section 4.5.2.2). Although the solo violin retains its prominence in this section because of its overall presence in the composition as soloist, this moment is still considered an example of segregation with two co-equal voices in this passage.

Example 4.33: Vaughan Williams, *The Lark Ascending*, mm. 88–94

4.7.11 STRATIFICATION

Sometimes it is unclear whether the perceptual result is segregation or stratification, and if it is stratification, whether or not it contains foreground and background layers alone, or also a middleground layer. Take, for example, an excerpt from Bizet's *Carmen* (Example 4.34). At first listen, it seems to be a clear case of stratification with augmentation of the strings by the woodwinds in the foreground, with the rest of the orchestra in the background. Although the triangle's distinct timbre pulls it out of the background, and the repeated onset causes it to be an important part of the overall timbre; it could be classified as middleground—as its own layer—but it also fits in much better with the background because of its rhythmic unity within the brass and percussion section, as the triangle is in rhythmic unison with the rest of the background layer. However, in this case, this musical passage is still perceived as having two different layers wherein one has a blended stream perceived as foreground and the other has timbral heterogeneity in the background.

1 Allegro giocoso $\text{♩} = 116$

Fl. 1
Picc.
Ob. 1, 2
Cl. in A 1
Cl. in A 2
Bsn. 1, 2
Hn. in A 1
Hn. in A 2
Hn. in E 3
Hn. in E 4
Tpt. in A 1
Tpt. in A 2
Tbn. 1
Tbn. 2
Timp.
Tri.
Cr. Cym. 1
B. Dr. 1
Vln. I
Vln. II
Vla.
Vc.
Cb.

Example 4.34: Bizet, *Carmen*, Overture, mm. 1–9. (Score in C)

4.7.12 TIMBRAL SHIFT, TRANSFORMING STRATIFICATION

In Example 4.35, showing the famous motif from Beethoven's Symphony no. 5, a listener perceives the timbre shifting in each measure—alteration and transposition—since it is scored with different instruments or combinations of instruments.¹⁹

125 Allegro con brio (♩ = 108)

CL in Bb 1 *ff* *p*

CL in Bb 2 *ff* *p*

Bsn 1 *ff* *p*

Bsn 2 *ff* *p*

Hn in Eb 1 *ff*

Hn in Eb 2 *ff*

Vln I *ff* *p*

Vln II *ff* *p*

Vla *ff* *p*

Vc. *ff* *p*

Cb. *ff*

Example 4.35: Beethoven, Symphony No. 5, mov. I, mm. 125–137. (Score in C)

Rimsky-Korsakov's *Overture on Three Russian Themes* (1879–80) repeats the opening motif of the theme in three different instruments, and each ascends an octave (Example 4.36). Some stratification is created when the horn holds the F#—a pedal-like effect—when the oboe comes in.

¹⁹ From unison and duo-chroma, to compound unison and three-octave tetra-chroma coupling, to single part (vln II), to unison mono-chroma, etc.

A Andante ♩ = 69

Fl. 1

Ob. 1

Hn in F 1

p *pp* *p*

Example 4.36: Rimsky-Korsakov, *Overture on Three Russian Themes*, mm. 3–10 (Score in C)

4.7.13 TIMBRAL SHIFT, GENERAL CONTRAST, TRANSFORMING STRATIFICATION

In Example 4.37 from Mendelssohn's Symphony no. 3 (1829–42), we see a compound example of orchestral grouping effect inside a *general contrast*: in the first four measures, the *timbral shift* of a motive from the flutes and oboes to bassoons and then to horns, which are at the same time the *foreground* layer of a *transforming stratification*.

A Vivace non troppo (♩ = 126)

Fl. 1
Fl. 2
Ob. 1
Ob. 2
Bsn 1
Bsn 2
Hn in C 1
Hn in C 2
Hn in F 3
Hn in F 4
Tpt in D 1
Tpt in D 2
Vln I
Vln II
Vla

pp
cresc.
dim.

Example 4.37: Mendelssohn, Symphony No. 3 in A minor. (Score in C)

4.7.14 TIMBRAL ECHO

From the opening measures of Mahler's Symphony no. 1, an example of *timbral echo* includes the four-octave registral coupling of piccolo, oboe 1, and clarinets 1 and 2 (Example 4.38). In measure 5, the motive has been timbrally altered (all new instruments), transposed to a lower orchestral register, and contracted from four to three octaves; the registral and instrumental change creates a “darkening” or a low-pass-like filtering that signals distance. These orchestrational transformations are part of the reason this music is heard as timbral echo, even though the dynamics of *pp* stay the same.

3 Langsam. Schleppend

Example 4.38: Mahler, Symphony no. 1 in D major, mov. I, mm. 3–9. (Score in C)

In Example 4.39, Rimsky-Korsakov exemplifies the echo effect, with oboe 1 and 2 each echoed at pitch by the offstage trumpets.

264 Allegro non troppo $\text{♩} = 112$

Example 4.39: Rimsky-Korsakov, *Sadko*, rehearsal 264. (Score in C)

4.7.15 TIMBRAL ECHO, TEXTURAL INTEGRATION, TRANSFORMING STRATIFICATION

In a work by Vincent d'Indy, *Chorale Varié*, the foreground theme is played by horns 1 and 2 in unison, which is then repeated by these same instruments but with mutes. It is heard as a

timbral echo. (Example 4.40). In mm. 134–136, the background is a *textural integration* of the flutes and clarinets. The stratification changes to three layers in m. 137.

Example 4.40: d'Indy, *Choral varié*, mm. 134–141. (Score in C)

4.7.16 GENERAL CONTRASTS, TRANSFORMING STRATIFICATION

An example of a general contrast appears in Example 4.41 from Bizet's *Carmen*. It shows a unison registral coupling of clarinet 1, bassoon 1, and cello contrasted with the octave coupling of the horns, timpani, harp, and contrabass; the orchestrational transformation is alteration and transposition of orchestral register. This Timbral Contrast is in the foreground of a stratification with the tremolo strings in the background.

F

123 Andante moderato $\text{♩} = 58$

Cl. in A 1

Bsn 1

Hn in A 1

Hn in A 2

Tpt in A 1

Timp.

Hp

Vln I

Vln II

Vla

Vc.

Cb.

Example 4.41: Bizet (1875), *Carmen*, Overture, mm. 123–126. (Score in C)

4.7.17 ANTIPHONAL CONTRASTS

An example of antiphonal call/response is found in Mozart's *Don Giovanni*, shown here in Example 4.42. There is timbral contrast in each measure between the *tutti* and violins 1 and 2. The contraction at the end of m. 56 and expansion at m. 58 of the orchestral register are accentuated by the addition and reduction (subtraction) of instruments.

56 Molto Allegro

The musical score for measures 56-61 of Mozart's *Don Giovanni* Overture is presented in a standard orchestral format. The tempo is marked 'Molto Allegro'. The score includes parts for the following instruments: Fl. 1, Fl. 2, Ob. 1, Ob. 2, Cl. in A 1, Cl. in A 2, Bsn 1, Bsn 2, Hn in D 1, Hn in D 2, Tpt in D 1, Tpt in D 2, Timp., Vln I, Vln II, Vla, Vc., and Cb. The key signature is one sharp (F#), indicating C major. The time signature is 2/4. The music is characterized by strong antiphonal contrasts, with instruments often playing the same rhythmic and melodic motifs in alternation. Dynamics range from forte (f) to piano (p).

Example 4.42: Mozart, *Don Giovanni*, Overture, mm. 56–61. (Score in C)

4.7.18 ANTIPHONAL CONTRASTS, TRANSFORMING STRATIFICATION

In this example from Haydn (Example 4.43), the rhythm and the contour of the motive stays the same, so it is the change of instrumentation, the change of timbre, that strengthens and delineates this antiphonal contrast.

61 Allegretto

Fl. 1
Ob. 1
Ob. 2
Cl. in Bb 1
Cl. in Bb 2
Bsn 1
Bsn 2
Vln I
Vln II
Vla
Vc.
Cb.

Example 4.43: Haydn, Symphony no. 100 (Military), ii

4.8 CONCLUSION

This chapter illustrates the connection between perceptual grouping principles and orchestration theory by showing the basic principles involved in the orchestration. In future research, one of the next steps is to show what techniques were used to create these blends and how various orchestrational goals can change what grouping effects will arise.

By examining scores from the repertoire and by showing the orchestrational combinations and orchestrational transformations that form the basis of the Taxonomy of Orchestral Grouping Effects (TOGE), we begin to bridge the gap between 1) novel psychology-based as well as listening-based analyses and 2) traditional scored-based orchestration analysis.

SECTION 3: FORM-BASED PRINCIPLES IN ORCHESTRATION

5 BASIC PRINCIPLES OF ORCHESTRATION-BASED FORM

5.1 INTRODUCTION

This chapter proposes and reviews various approaches employed by composers to structure and shape the orchestration of their compositions, from local orchestrational combinations and transformations to those patterns and changes occurring across the duration of a work.

A present-day essay defines form as a “way in which the various elements in a piece of music—its pitches, rhythms, dynamics, timbres—are organized in order to make it coherent to a listener” (Denis *et al.*, 2017). While this view does feature timbre, the elements of pitch and rhythm usually—if not always—take a place of privilege in defining form, hence the impetus for studying more methodically the role of timbre—manifesting as orchestration—in form. It can be argued that, for a piece of ensemble music wherein form meets orchestration (or vice-versa), instrumental colours ought to be cogently organized. However, the deployment of an orchestration-based form need not follow, nor inevitably be congruent with, traditional form on a one-to-one basis; it may be as Berlioz noted, *sui generis* (Berlioz, 1882, p. 233).

Orchestrations are built from many layers of parametric change: change in the number of instruments, the orchestral registers, the instrument register, playing techniques, and articulations and rhythmic qualities, among others.

Spencer and Temko (1988) explain how structural phenomena in a composition operate as perceived cues, and how the relational qualities of musical elements or parameters—such as cadence, tonality, tempo, meter, rhythm, dynamics, density, timbre, register, texture, and motive—help with the segmentation of these perceived structural qualities. Toch (1948) makes a further distinction between “forms” and “FORM [*sic*]”: the former contains musical forms with which we are familiar (sonata, rondo, variation, etc.), whereas the latter points to “the balance between tension and relaxation” (p. 157), a relationship certainly useful in the study and deployment of timbral and orchestrational transformations.

Sevsay (2013), explains how orchestration-based form might differ from an analysis of a pitch- or harmony-based form:

There is a strong relationship between form and orchestration. For that reason we have to keep the following in mind: Orchestration helps to emphasize the form of a composition. For example, as we see in the music of the Romantic period, every new idea or every repetition of an existing idea almost always receives a new instrumentation. However, the analysis of a form with regard to instrumentation and/or orchestration can differ from the analysis of form used by music theorists and musicologists. These differences can be important, especially in the analysis of the subdivisions of a composition. For example, two sections that may count as two different subdivisions in formal analysis may have the same instrumentation throughout and therefore count as one whole section for us. On the other hand, one complete section with no subdivisions in formal analysis may have three different instrumentation sections, thus counting as three separate parts for us. These differences, however, are not always present, and they tend to disappear as the analyzed forms get larger. (Sevsay, 2013, pp. 261–262)

One way in which composers structure their orchestration, and thereby the form, of their music, concerns the practice of the return of, the accumulation of, or the liquidation of timbral qualities in the construction of main themes and motifs; this is achieved by using orchestrational transformations—in the form of instrumental or registral change—to develop and expand important thematic material. Local changes in the orchestration are musically connected to previous iterations or statements of similar orchestrations, so that on a larger scale, there are formal implications created by the interrelationships in the differences in instrumentation and orchestral register.

Relations are thus quite important components of musical material. Much psychological research on musical recognition memory has shown the importance of relations as building blocks of patterns. These relations would include pitch levels, timbre vectors and duration proportions. Our ability to recognize transposed or accelerated musical patterns testifies to the psychological reality of relational encoding. (McAdams 1989, p. 185)

The change of instruments and change of orchestral register—and thus the change of timbre—acts as an identifiable and salient change in musical structure; these changes are as important to musical form as are pitch and rhythmic features, as it can be argued that “[o]rchestral color is much more perceptible than the abstract aspects of form” (Sevsay, 2013, p. xv). It is my belief that the use of instrumental colour, and the use of orchestral registers in

creating orchestrational combinations and transformations, acts as an important parameter in the establishment of musical form.

5.2 SIMULTANEOUS AND SUCCESSIVE RELATIONSHIPS IN ORCHESTRATION

In most orchestration treatises and textbooks, and in respect to orchestration-based form, priority is given to the technical knowledge of instruments, with a focus on vertical, or *simultaneous*, relationships—combinations and textures—while horizontal, or *successive*, relationships and their temporal interactions are overlooked. With regard to instrumental choice, there may be much talk of harmonic balance being effected by instrumental choice and vertical placement (see Chapter 1), but not much discussion of tone-colour-based motivic relationships, or of the reoccurrences of instrumental colour and how the properties of such sound colours within a musical work may be associated with each other hierarchically.

From a perceptual perspective, orchestrations occur either at the same moment in time (simultaneous) or at different moments in time (successive). In a small enough unit of time, such as a single beat or measure of music, we may see on the score as well as hear that something has been designed either to be *combined* or *contrasted* vertically, these being the two categories of simultaneous orchestrations. When we enlarge the span of time, and see and hear musical differences, we understand that there has been a change over time, creating successive contrasts in the music. A most important category—and the least talked about in treatises—in understanding orchestration from temporal perspectives, and in gaining insight into orchestration-based form, concerns the notion of *successive orchestrational changes*, similar to those successive relationships of pitch and harmony studied in traditional music theory.

Examples from this category epitomize orchestrations that are segmented into units by the listener, segments that are perceived as either discrete change (timbral contrasts) or continuous change (transformations of blends, or streams, or changes of orchestral strata). Composers exploit such perceptions of discrete and continuous changes to their advantage in order to paint a picture, as it were, of their musical and timbral ideas over time.

That which naturally occurs to our mind is the opportunity of differentiating the repetitions of a musical idea by variety of tone-colour. Out of this arises the sound principle: Never orchestrate a passage twice running in identically the same way, unless when mere iteration is intended. Or, in other words, when the repetition of an

idea denotes a new phase in the course of the work—a lull, a climax, or a reinforcement—the tone-colour, volume, or power of the orchestration should be modified in keeping with the situation. (Dunn, 1925, p. 89)

In each new composition, a composer must first determine the basic elements of the instrumentation, that is, the timbres used in the composition and their relationships to the other timbres. And the design of the collections and relationships of these timbres—the meta- and paratimbres of the composition—is an endeavour in orchestral music not unlike the outlining of other musical parameters such as specific chord progressions or harmonic syntax or melodic profiles. The temporal relationship of one element to another may foster continuity or it may stimulate discontinuity, which then causes the music to segment (Deliège, 1989). Such compositional determinations build hierarchical relationships within various levels of the music, from phrase to section to movement to the entire composition.

Hierarchy aids this process insofar as it is a type of structure that allows us to break the recall task up into units of manageable size. We can recall one chunk of a maximum of five to nine elements, use one of those elements as a retrieval cue for another chunk of five to nine elements, and so on, and so forth. In this way, we can reconstruct some remarkably complex materials from memory, provided they can be structured in the form of a hierarchy of chunks. (Snyder, 2000, p. 202)

5.3 BACKGROUND: MUSICAL FORM AND STRUCTURE

Riemann (1895) describes form as the impression of movement created in the music by the continuous changes of pitch and/or strength (as in dynamics or instrumental weightings). Hanslick (1854) defines the form of a musical work—a symphony, an overture, a sonata, an aria, a chorus, etc.—as the “architectonic combination of the units and groups of units of which a composition is made up” (p. 169). Important to note here is the assertion that such structures and related hierarchies are created *within each musical work*. Gehrkens (1914) also compares musical form to an architectural plan:

A *form* in music is a specific arrangement of the various parts of a composition resulting in a structure so characteristic that it is easily recognized by the ear [...] The word *form* is therefore seen to be somewhat synonymous with the word *plan* as used in architecture; it is the structure or design underlying music [...] Speaking broadly we may say that *form* in any art consists in the placing together of certain parts in such relations of proportion and symmetry as to make a unified whole. In music this implies unity of tonality and of general rhythmic effect, as well as unity in the grouping of the various parts of the work (phrases, periods, movements) so as to

weld them into one whole, giving the impression of completeness to the hearer. (Gehrken, 1914, p. 62)

Toch (1977) elaborates on the architectural metaphor and the idea of reiteration, modulation, and combination, etc. These qualities are much like orchestrational transformation in how they build off of elements and unfold over time:

Schopenhauer calls architecture ‘frozen music’. This is not merely an aesthetic comparison; the analogy goes into the very substance of both arts. By the same token one could call music ‘sounding architecture’. The ‘measure’ is essential for both to such an extent that music borrows the very term for its metrical units. Architecture in turn uses the ‘motif’, another kind of unit, as a germ-cell for building purposes—just as music does—by reiteration, modification, combination, grouping and regrouping. Perfect FORM crowns the masterpiece of architecture as well as the masterpiece of music. Yet, while architecture unfolds itself in the medium of *space*, the medium in which music unfolds itself is *time*. (p. 155)

Caplin’s *Classical Form* (1998) provides a framework for analyzing the formal functions in the music of Haydn, Mozart, and Beethoven by subdividing and analyzing musical materials—in this case, pitch, rhythm, and harmony—and demonstrates how each part contributes to various hierarchical structures. As regards the musical fabric, this taxonomy of formal functions categorizes what we hear into a hierarchy consisting of: 1. *basic ideas*—and the repetition of a contrasted form of this basic idea, usually in the same rhythmic profile but in contrasting harmonic variants, and 2. *contrasting ideas*—usually with different rhythmic profiles as well as contrasting harmony. His theory “emphasizes the role of local harmonic progression as a determinant of form” (Caplin, 1998, p. 4). Motives that make up basic ideas and contrasting musical ideas then create, along with harmonic progressions, the foundation of musical *sentences* or *periods*, which in turn are used as a foundation for larger form. This *Formenlehre* furnishes a visualization of the basic building blocks of musical form in the works of the great composers.

5.4 BASIC AND CONTRASTING ORCHESTRATIONAL IDEAS

Just as there exists these building blocks of rhythmic, harmonic, and motivic development in a musical work, timbre—as we’ve seen—also develops through the changing of instruments over time and/or the modification of an instrument’s timbre through performative nuances or registral changes. Lerdahl (1987) proposed various ideas about timbral prolongation, timbral consonance and dissonance, an anchoring timbre, distances between timbres, and the possibility of moving in “musically meaningful patterns” (Lerdahl, 1987, pp. 148–149). His theory of timbral hierarchies remains only an insightful attempt, as unfortunately the author did not methodically follow it up with clear examples from the repertoire.

Analysis of orchestral repertoire reveals a systematic manner in which a melody or a main theme gets orchestrated across the duration of a work, as well as how local texture and instrumentation behave, and how accompaniment phrases evolve. We know that composers systematically combine instruments—using *simultaneous combinations*—in order to create themes and orchestral chords, which they then transform—through the relationship between *successive contrasts*—or keep the same for reasons of continuity across the duration of a work. These orchestrational transformations, I maintain, are akin to developing *basic ideas* and *contrasting ideas*, being transposed not only by pitch but also by sound-colour. Therefore, I propose that a taxonomy to categorize them is needed: *Basic Orchestrational Ideas* and *Contrasting Orchestrational Ideas*.

Music theory textbooks display many examples of prolongational methods, of modulations or sequences—why not similar techniques in orchestration textbooks? Temporal relations of tone-colour are arguably as important as harmonic relations.²⁰ Here I reimagine a definitional claim by Caplin (1998), replacing the word “harmony” with either the word “timbre” or “orchestration”:

An *orchestrational* prolongation is created when a single *timbral* entity is perceived in the listener's imagination to be sustained through time, despite the presence of an intervening *timbre* (or *timbres*) of different *orchestrational* meaning. The *prolonged*

²⁰ Imagine the impact of the recapitulation of Mozart’s K440 first movement orchestrated with trombone and horn or flute and oboe upon the return of the main theme, rather than with the violins.

orchestration thus “remains in effect without being literally represented at every moment” throughout the progression.²¹

Broadly speaking, by substituting the concept of harmony in this claim with the concept of sound-colour, I propose that if musical prolongations do indeed exist, they are *not restricted to harmony*. The timbral qualities of a composition do not appear as isolated occurrences: just like harmony, they may emerge as something stable, they can be used as contrasting musical material, and may also exhibit interdependence.

The act of orchestration implies the creation of tone-colour relationships, shaped by the choice of instrumentation—that is, based on the *de facto* instrumentation of the orchestra, which could be said to function like a *home key*—*home timbres* per se—meaning that such tone-colours will have a specific reference function in a piece of music. Crane (1960) explains that the “[u]se of color may act to relate material, or to provide contrast. It can help to distinguish phrase structure; different colors in different voices of a polyphonic work can help to distinguish them, while similar colors in different voices give a special unity to them” (p. 18). Moreover, as there exists a hierarchical and archetypical function in the perception of timbres; our minds naturally want to group similar sound colours—collections of timbres—into one identifiable unit (a *metatimbre*) as well as into structural or form-bearing units. Such units are not “fixed”; they can be manipulated in their various orchestrational combinations or transformations by altering timbres or adding timbres that closely resemble those of the unit (*paratimbres*) or by using timbres that contrast each other. The stretching, connecting, correlating, and contrasting of timbres remains one of many manipulations that composers exploit to create their orchestration-based form.

²¹ The original text: “A harmonic prolongation is created when a single harmonic entity is perceived in the listener's imagination to be sustained through time, despite the presence of an intervening chord (or chords) of different harmonic meaning. The *prolonged harmony* thus “remains in effect without being literally represented at every moment” throughout the progression.” (Caplin 1998, p. 25)

In the art of orchestration, transformations happen on many levels, from the practical level of changes of instrument and register, to the perceptual level of changes of timbre or balance. Transformations imply the passage of time, implying the shaping of form. There is an inexhaustible variety of ways to create contrasts in one's orchestration, both instrumentally as well as registrally. Let's now look at some exemplars of creating *basic ideas* and *contrasting ideas* with orchestral colour—*basic orchestrational idea* (BOI) and *contrasting orchestrational idea* (COI)—where the pitch class, pitch relationship (melodic structure) and rhythmic parameters all stay the same, but where that which changes solely concerns instrumentation and/or orchestral register.²² Fundamental Example 5.1 at A shows the BOI, whereas examples B and C show two instances of COI: from the flute 1 in example A, then to example B with an *addition* of the clarinet at the unison. In example C, in relation to example B, the flute 1 is removed (*reduction*) and the oboe 1 is added at the octave (*expansion*). This represents a fairly standard summary of the types of changes of orchestrations that composers use on thematic material. Although the pitch contour and rhythm are the same in examples A and C, the last *contrasting orchestrational idea* is quite different than the original: two different instruments, now with two registral voices one octave apart.

Example 5.1: Fundamental Example — Basic Orchestrational Idea (A) and Contrasting Orchestrational Idea (B and C). (Score in C)

²² The concept of BOI and COI can be applied to genres of music outside of classical and romantic-era music under investigation in this dissertation: in pop music, certain timbres play key roles in establishing song structure; hip hop music often uses a drumbeat and a riff or a sample as the BOI in a repetitive framework, with COI's inserted at key structural moments; in contemporary new music, timbre plays a central role, and several timbral/orchestrational “main themes” are established and contrasted.

In the orchestral repertoire, examples of such transformations do not always occur right after one another, but can occur, in the case of main or subordinate themes, across large spans of musical time. In Fundamental Example 5.2, a BOI appears widely separated from the same two versions of COI by many measures of music (what is shown as the tacet measures in this FE would indeed be filled by music and other themes.)

The musical score for Fundamental Example 5.2 is written for three instruments: Fl. 1, Ob. 1, and Cl. in Bb 1. The score is divided into three sections labeled A, B, and C. Section A (measures 44-83) shows Fl. 1 and Ob. 1 playing a melody in 4/4 time, while Cl. in Bb 1 is silent. Section B (measures 83-122) shows Cl. in Bb 1 playing the melody in 4/4 time, while Fl. 1 and Ob. 1 are silent. Section C (measures 122-161) shows all three instruments playing the melody in 4/4 time. The score includes dynamic markings of *mf* and rests for the instruments that are silent in each section.

Example 5.2: Fundamental Example — a BOI and two COIs separated by musical time. (Score in C)

Erickson (1975) emphasizes that the musicality of the uses of sound-colours lies in how they change over time yet still remain identifiable.

The most musically significant thing about sounds, timbral objects, is not that they are recognizable, identifiable, nor that they are multidimensional wholes, individual and various: it is that they exist in time, have a shape in time, exhibit changes during their time course, and still retain their identity. (p. 58)

One might argue that a musical composition results from a process by which large-scale structures are built up from smaller units. The understanding of a complex musical entity, consequently, depends upon an understanding of the relationships between smaller units within that entity. It follows then that such an understanding is dependent upon locating those points at which the larger structure is divided into smaller sections (Spencer & Temko, 1988, p. 1).

Music, and thereby orchestration, is a hierarchy of “chunks” (Snyder, 2000). The temporal relationship of these chunks of specific orchestrations and their transformations to one another may encourage the perception of continuity, or may create discontinuity, which can then elicit segmentation in the music (Deliège, 1989) to various degrees—large or small. And this

segmentation can build hierarchical relationships within various levels of the music, from phrase to section to movement to the composition itself. McAdams argues that:

It is not only desirable that listeners be able to recognize transformed material as being similar or related, but that they appreciate the nature of the transformation as well. This can contribute to a sense of direction in the musical development. The recognition and comparison of a more or less similar pattern after some kind of transformation at a later point in a piece, implies the existence of a mental representation of the original pattern that maintains certain structural properties during transformation. (McAdams 1989, p. 194)

Musical form and orchestration-based form unfold along different time scales; some composers, for example, prompt forward the orchestration-based form at a faster rate than musical form, while others make it evolve at a slower rate (Dolan, 2013, p. 98). I argue that as much as the ear is drawn to a theme's melodic contour, harmonic context, and changes to its syntactical function, the ear is also drawn to changes in timbre—whether it be due to dynamic change, articulation change, instrumental change or registral change—and therefore is drawn to the fundamental principles in the creation of musical structures regardless of the span in temporal separation within a work.

5.5 EXEMPLIFICATIONS

The following exemplifications represent and demonstrate orchestrational changes that arise in local contexts or that are not separated by large spans of musical time. Different approaches to the analyses are taken throughout the examples, as orchestration is so complex that there are many ways to analyze and use the various taxonomic categories.

5.5.1 LOCAL ORCHESTRATION-BASED FORMS

5.5.1.1 Tchaikovsky, *Symphony no. 6, mov. iv*

Example 2.30 displayed the orchestrational transformations of *addition*, *expansion*, *reduction*, and *contraction* in the opening phrase of the Finale of Tchaikovsky's 6th Symphony (and Example 1.47 displayed the harmonic coupling of the foreground string material). These changes in timbre are representative of an orchestration-based arch form, typically expressed as an ABCBA. However, in this excerpt, with its consistent timbres of the flute and bassoon blending throughout the passage, a more appropriate reading would be A-a/A-b/A-c/A-b/A-a, where "A" is the flute and bassoon orchestrational combination: A-a is the *basic orchestrational*

idea (BOI), A-b is the first *contrasting orchestrational idea* (COI), and A-c the second COI. The (temporal) reduction, displaying just the first note of each orchestrational change, in Example 5.3 clearly shows this arch form: the flutes and bassoons enter in unison at m. 2 (A-a); the addition of the clarinets and expansion of the orchestral register at m. 8 functions as A-b; the addition of the oboes in m. 11 appears as A-c; the reduction of the oboes back to the orchestrational combination of the octave registral coupling of flutes, clarinets, and bassoons appears as A-b; and the return to the BOI which functions as the *home timbres* at m. 15 (A-a). This example represents a local prolongation of the instrumentation—an *orchestrational prolongation*—by way of the orchestrational combination of the flute and bassoon, and of the emergent timbres of the combined sounds: an accumulation of timbres followed by a liquidation of timbres back to the home timbres. It is a transforming stream / emergent timbre (metatimbre or prototype of the horn,²³ as performed by the combination of flutes and bassoons in unison).

²³ The horn performs this supporting motif later in the movement.

Example 5.3: Temporal reduction of the opening of Tchaikovsky, Symphony no. 6, mov. 4.
(Score in C)

5.5.1.2 Otto Nicolai, *Die lustigen Weiber von Windsor*

Example 5.4, taken from Otto Nicolai's *Die lustigen Weiber von Windsor* (1849), presents the basic rhythmic idea and the BOI of the motif played by horn 3. A contrasting motivic *and* orchestrational idea is presented in the oboes and clarinets, followed by the strings. The primary BOI motif of this example is then transformed in various manners over the next 6 measures of music. Each orchestrational transformation becomes a new COI. The BOI returns in horn 1 in m. 7, then again in horn 3 at m. 8. After these iterations, the contrasted timbres continue, and in mm. 9-10 horn 3 joins the clarinets and bassoons for an intervallic registral coupling.

The local orchestration-based structure of this section—here broken down into smaller units for clarity of analysis—is ABAB, A'B'A'C, ACAC, DC'A''C'A''. The A-based material is played by either the solo horn or an orchestrational combination with the horn as the A prime or A double prime material. B and C are combinations using the strings, and the woodwinds play D.

5.5.1.3 Puccini, *La Bohème*, “Sì, mi chiamano Mimi”

During the climax of Mimi’s aria, “Sì, mi chiamano Mimi,” Puccini gradually adds instruments and *expands* the orchestral register. In Example 5.5, the orchestration changes from unison and octave coupling to doubling Mimi’s line. It begins with a tri-chroma unison coupling of clarinet 1, violin 2, and soprano, with the duo-chroma unison line of the flute 1 and violin 1 an octave above. In the second measure of this example, flute 2, English horn, and clarinet 2 enter with an upward flourish, flute 2 to the upper registral voice, and the English horn and clarinet 2 to the lower group. This poly-chroma multi-unison octave coupling supports Mimi as the music crescendos. At the climatic arrival point, Puccini expands to three registral voices, separated by an octave, adding horn 1 and 3 and cello in the lower registral voice. This creates weight and intensity.

The musical score for Example 5.5 is a page from a score for Puccini's *La Bohème*, specifically the aria "Sì, mi chiamano Mimi". The tempo is marked "Andante Sostenuto Molto". The score includes vocal lines for Mimi and orchestral parts for Flute 1 & 2, Clarinet 1 & 2, English Horn, Violin 1 & 2, Viola, and Cello. The score includes dynamic markings such as *pp*, *p*, *ff*, and *cresc.* (crescendo). It also contains performance instructions like *poco allarg.* (poco allargando), *rall.* (rallentando), and *divisi* (divided). The lyrics are in Italian, and the score includes a "left blank for purpose of exemplification" note for several instruments.

Example 5.5: Puccini, *La Bohème*, “Sì, mi chiamano Mimi” (Score in C)

5.5.1.4 Mozart, *Eine kleine Nachtmusik*

Local registral coupling changes can be activated in various ways to highlight the differences and contrasts between melodic statements; a change in textures, for example, from monophony to homophony, can emphasize different expressive qualities between sections. Adler (2002) provides an example from Mozart’s *Eine kleine Nachtmusik*, first movement, mm. 56-62 (see Example 5.6). Here, a four-octave mono-chroma unison registral coupling in the strings

becomes, in the second section of the phrase (by *contraction* and *reduction*), a mono-chroma parallel intervallic coupling between violin 2 and viola, with the melody of violin 1 in the foreground, and in the background the bassline of cellos and contrabass. “Even though these coupled parts present only a slight change of texture and dynamic, the simple accompaniment in parallel 3rds registers a tremendous emotional contrast to the stark octaves in this Classical style.” (Adler, 2002, p. 125)

Example 5.6: Mozart, *Eine kleine Nachtmusik*, mm. 56-62.

5.5.2 LARGE-SCALE ORCHESTRATION-BASED FORMS

On a larger scale, the structural changes and interrelationships of successive orchestrations have motivic-like qualities and thus have formal implications, functioning as fundamental facets of the building of orchestration-based form. For example, the orchestration of main themes as well as structurally important chords and musical exchanges may operate as pivotal sonic moments where composers’ orchestrational choices imply formal arrival points or goals. Such orchestrational and timbral transformations usually occur on a longer temporal scale than pitch and rhythmic transformations. This transpires of course in conjunction with, but also in contrast to, the form(s) created by other musical parameters (i.e., harmony, rhythm, etc.).

5.5.2.1 Rimsky-Korsakov, *The Tsar’s Bride*

Example 5.7 from the “Overture” to Rimsky-Korsakov’s *The Tsar’s Bride* shows three excerpts of temporally separated recurrences of the theme accumulating orchestrational ideas on each restatement; each recurrence is orchestrated differently. The statement at Rehearsal 1 utilizes violin 1. At Rehearsal 2, we find a duo-chroma unison and octave coupling: flute 1 and violin 2 are added, with violin 1 moving up the octave to join with flute 2 in unison—an *addition*

and *expansion* from the first statement. At Rehearsal 7 is a tetra-chroma multi-unison multi-octave coupling, again an *addition* and *expansion*. These orchestrational changes of the theme contribute to the structure of the Overture.

The image displays three excerpts from the score of Rimsky-Korsakov's *The Tsar's Bride* Overture.
 Rehearsal 1: Labeled '1 Allegro $\text{♩} = 108$ '. It shows Violin I playing a melody starting on a half rest, marked *pp*.
 Rehearsal 2: Labeled '2'. It shows a multi-octave coupling of the theme in parallel octaves. Violin I, Flute I, and Violin II all play the same melody, marked *f*.
 Rehearsal 7: Labeled '7'. It shows a tetra-chroma multi-unison multi-octave coupling. Piccolo, Flute I, Clarinet in Bb, Violin I, and Violin II all play the same melody in unison, marked *ff*.

Example 5.7: Rimsky-Korsakov, *The Tsar's Bride*, “Overture,” rehearsals 1, 2, and 7.

5.5.2.2 Verdi, *La Traviata*, “Prelude”

Example 5.8 shows the two entries of the main theme of the Prelude to Verdi’s *La Traviata* at mm. 18 and 29. The first time the theme is stated, it occurs simultaneously in two parallel octaves with violin I, viola, and cello taking one voice each (a three registral voice, tri-chroma multi-octave coupling). This is the basic orchestrational idea (BOI). At m. 29, in the restatement, Verdi transforms the quality of the theme, setting it in a unison (tri-chroma unison coupling), but in three contrasting instruments—clarinet, bassoon, and cello (a tri-chroma coupling, with augmented cello). The return of the theme is the contrasting orchestrational idea (COI). These two orchestrations are key features of the Prelude: in a piano reduction, the orchestrational transformation at m. 29 would only be heard as a registral change from the two-octave coupling to unison. The timbral change from the blended string metatimbre (important

timbral thematic material since it is the metatimbre that opened the Prelude) to the hybrid timbres of the clarinet, bassoon, and cello represents a crucial structural change in the Prelude.

The image shows a musical score for Verdi's *La Traviata* Overture. It includes staves for Clarinet in C, Bassoon, Violin I, Viola, and Violoncello. The score is divided into two sections: measures 18-19 and measures 29-30. In measures 18-19, the strings (Violin I, Viola, Violoncello) play a melodic line, and the Bassoon has a solo. In measures 29-30, the Clarinet in C and Bassoon play a melodic line, while the strings provide harmonic support. The tempo is marked 'p con espressivo'.

Example 5.8: Verdi, *La Traviata*, Overture, mm. 18-19, mm. 29–30

5.5.2.3 Rimsky-Korsakov, *Scheherazade*, movement i.

Rimsky-Korsakov's 1888 orchestral work, *Scheherazade*, movement I, provides an example of orchestrational transformations of a theme across the duration of a work. The main theme, which opens the 1st movement, "The Sea and Sinbad's Ship," is stated approximately two dozen times, and even more if one counts the fragmenting of the theme. Each contrasting orchestrational idea represents a further dramatic development in the work: the orchestrational transformations are a grounding structure in the perception of the form of the movement.

Its first statement occurs in m. 1 (Example 5.9) in three registral voices and in thirteen parts (clarinet 1 and 2, bassoon 1 and 2, trombone 1, 2 and 3, tuba, and all strings). This excerpt constitutes poly-chroma couplings, within and across families, multi-unison and multi-octave. This is the *basic orchestrational idea* for this theme.

Largo e maestoso $\text{♩} = 48$

Cl. in A 1.2
Bsn 1.2
Tbn 1.2
Tbn 3
Tba
Vln I
Vln II
Vla
Vc.
Cb.

Example 5.9: Rimsky-Korsakov, *Scheherazade*, mov. i, mm. 1–4. (Score in C)

The next statement of the theme occurs in mm. 20–23 (Example 5.10), with the clarinet and violins 1 and 2 in a duo-chroma unison coupling, a *reduction* of parts and *contraction* from three registral voices to one. The violin timbres dominate, creating an “augmented violin” metatimbre. This represents the *contrasting orchestrational idea* for this theme.

20 Allegro non troppo $\text{♩} = 56$

Cl. in A 1
Vln I
Vln II

Example 5.10: Rimsky-Korsakov, *Scheherazade*, mov. i, mm. 20–23. (Score in C)

Throughout the rest of the movement the string and brass metatimbres are transformed and *successively contrasted* against one another. These changes represent a systematic and syntactical orchestrational plan across the movement, moving through the instruments of the orchestra in a systematic method of transformations. “It is [...] possible for musical material to

refer backward across a piece and change the significance of something we have heard earlier. Much of the syntactical connections between different but related patterns in a piece of music are associative.” (Snyder, 2000, p. 202) Overall, the perceived *home timbres* of this movement’s theme is the string timbre; even though it is introduced by a brass fanfare, the final statement of the theme is with the solo violin. This contrast also provides an example of discursive and formal elements found in orchestral writing.

5.5.2.4 Wagner, *The Flying Dutchman*

Although separated by large spans of time (within the overture and then the piece itself—but here we deal with just the overture), the Dutchman’s theme is always recognizable not only for its pitch contour but also for its instrumentation. Example 5.11 shows the reduction of just the first note of each statement of the theme, which coincides with a change in orchestration. The basic orchestrational idea (BOI) is first in the horns—embellished at the unison by the bassoons—and then orchestrationally transformed for each iteration. All orchestrations are either connected by paratimbres (i.e., trombones, tuba) to the horn metatimbre by subtly changing the BOI or are contrasted orchestrationally (COI) with the presentation of contrasting timbres (i.e., pizzicato cello). This timbral consistency—familiar metatimbres evolving through Wagner’s overture—is used to anchor the thematic quality of the Flying Dutchman—a timbral leitmotif—across the duration of the overture, and indeed the entire opera.

Example 5.11: Wagner, *Flying Dutchman*, Overture. (Score in C)

5.5.2.5 Verdi, *Aida*, “Celeste Aida”

In the aria “Celeste Aida,” from Act One of Verdi’s 1871 opera *Aida*, the doubling of the tenor’s melody occurs almost throughout, for 83% of the aria in fact. The transformational significance lies therefore in the changes between coupling instruments. Some of the registral couplings are harmonic, therefore having contrary or oblique motion in their following of the melody. There is a progression of chroma-coupling throughout the aria, from flute I (solo *col canto*) in measure 1 of the aria, to the four-part, two registral voice poly-chroma coupling in m. 16 (Example 5.12) of oboe and tenor in octaves and bassoon and cello in unison. Next comes an eleven-part tetra-chroma coupling in m. 41, in the alto, tenor, baritone, and bass orchestral registers.

Andantino $\text{♩} = 116$

Ob. 1
Bsn 1
Radamès
Vc.

p
sempre dolcissimo
p

Il tuo bel cie - lo vor - rei ri - dat - ti, le dol - ci brez - ze del pa - trio suol;

Example 5.12: Verdi, *Aida*, “Celeste Aida,” mm. 16–19.

5.5.2.6 Puccini, *Tosca*, “Vissi d’arte”

The aria “Vissi d’arte” is found in the second act of Puccini’s 1900 opera, *Tosca*. The aria is 35 measures long, with the soprano, *Tosca*, singing for 33 of those measures, and doubled in 23 of them; this amounts to instrumental rhythmic unison occurring in 70% of the aria. Besides the climax of the aria starting at m. 31, there are only a small number of additional parts in the couplings. The strings double the vocal melody harmonically (see Example 5.13) in the opening section. Following this, the woodwinds and strings accent just parts of phrases, for instance in mm. 19–21: flute, violins, and viola double the melody at pitch, with the cello at one octave below. In contrast, from mm. 31–34, there are 19 parts, with six instrumental parts doubling at pitch, one at the octave above, three in lower octaves, and nine harmonically. This poly-chroma coupling, across-families, covers the soprano to bass orchestral registers.

(51) Andante lento appassionato $\text{♩} = 40$
p dolcissimo con grande sentimento

Tosca
Vln I
Vln II
Vla.

pp con molta dolcezza
pp con molta dolcezza
pp con molta dolcezza

Vis - si d'ar - te, vis - si d'a - mo - re,

Example 5.13 : Puccini, *Tosca*, “Vissi d'arte,” mm. 1–4.

5.5.2.7 Sibelius, *Symphony no. 5*

In this example from Sibelius' *Symphony no. 5*,²⁴ the orchestration of the closing of the symphony has its roots in the orchestration of the final chord of movement 1 (see Example 5.14). As this punctuation blend occurs at the end of a crescendo in movement 1, it does not grab the ear in the same way that the closing chords do. The orchestration is prolonged from this arrival point at the end of movement 1 up to the end of movement 3. It represents a liquidation of orchestral registral voices, and a *contraction* of the orchestral register itself.

In Table 5.1, we can see in the score-based view that the instrumentation remains constant except for the timpani. The register-based view, in Table 5.2 shows how the instrumental parts move through the registral voices, and the consistency of the orchestration when the pitches change (the multi-unisons are mostly consistent). The score, in Example 5.14, shows the consistency of dynamics and short rhythmic iterations. Of note is the use of just one pitch class at the end of movement 1, an Eb. Throughout the cadence there is a liquidation of the registral material, while keeping the same instruments.

²⁴ This was pointed out to me in a private meeting with William Caplin in February 7th, 2019, as a unique orchestration of a cadence, an example that he would be analyzing for his upcoming book on cadences.

Table 5.1: Sibelius Symphony no. 5 — reduction of final chords, score-based view.

	end of mov. I	Cadence of mov. III					
Instruments							
flute 1							
flute 2							
Piccolo							
oboe 1							
oboe 2							
clarinet Bb 1							
clarinet Bb 2							
bassoon 1							
bassoon 2							
horn 1							
horn 2							
horn 3							
horn 4							
trumpet 1							
trumpet 2							
trumpet 3							
trombone 1							
trombone 2							
trombone 3							
timpani							
violin 1							
violin 2							
viola							
cello							
bass							

Table 5.2: Sibelius Symphony no. 5 — reduction of final chords, register-based view.

movements		end of mov. I	Cadence of mov. III				
Note name	Register						
DWb3	7	vb1					
D	7						
CWb3	7						
C	7						
B	6						
AWb3	6		II	II	II	II	II
A	6						
GWb3	6						
G	6		II				
DWb3	6						
F	6						
E	6						
DWb3	6	III, II, ob1, ob2, vb2					II
D	6						
CWb3	6						
C	6						
B	5						
AWb3	5		ob1, cII, vb1	II, cII, vb1	II, cII, vb1	II, cII, vb1	II, ob1, cII, vb1, vb2
A	5						
GWb3	5						
G	5		ob2, vb2				
DWb3	5						
F	5						
E	5						
DWb3	5		vb				II, ob1, cII, vb1, vb2, vb
D	5						
CWb3	5						
C	5						
B	4						
AWb3	4		ba1, ba2, qb1, vb1, vb2	ob1, ba1, ba3, qb1, vb1, vb2, vb	ba1, vb1	ob1, ba1, ba3, qb1, vb1, vb2, vb	cII, ba1, ba3, qb1, vb1, vb2, vb
A	4				ob1, ba3, qb2, vb2, vb		
GWb3	4						
G	4		ba3, qb2				
DWb3	4						
F	4						
E	4						
DWb3	4	ba1, ba3, qb1	ba1, vb1, vb2, vb				ob2, ba1, ba3, ba2, ba4, qb1, qb2, qb3, vb1, vb2, vb
D	4						
CWb3	4		ob2, ba2, qb2, vb2, vb				
C	4						
B	3				ob2, ba2, qb1, vb2, vb		
AWb3	3	ba2, ba4, qb2, ba1, vb	cII, ba4, qb3, ba2, vc	cII, ba1, ba4, qb3, ba1, ba2, vc	cII, ba4, ba1, vc	cII, ba1, ba4, qb3, ba1, ba2, vc	ob2, cII, ba2, ba4, qb2, qb3, ba1, ba2, vb, vc
A	3				ba1, ba2		
GWb3	3						
G	3	qb3	ba3, vb1, vb2, vb				
DWb3	3						
F	3						
E	3						
DWb3	3	cII, cII, ba2, ba3, timp, vb	vc				cII, ba1, ba1, ba2, ba3, timp
D	3						
CWb3	3						
C	3						
B	2						
AWb3	2	ba1, vc	ba1, timp	ba2, ba1, cb	ba2, ba3, cb	ba2, ba3, cb	ba1, ba2, ba3, timp, cb
A	2						
GWb3	2						
G	2		ba2, vc, cb				
DWb3	2						
F	2						
E	2						
DWb3	2	ba2, vc, cb					ba2, vc, cb

Più Presto Un pochettino stretto
Movement 1 Movement 3

The musical score is for Sibelius's Symphony no. 5, specifically the final chords of Movement 1 and Movement 3. The score is written for a full orchestra, including Flute (Fl.), Oboe (Ob.), Clarinet in Bb (Cl. in Bb), Bassoon (Bsn.), Horn in F (Hn in F), Trumpet in Bb (Tpt in Bb), Trombone (Tbn.), Timpani (Timp.), Violin I (Vln I), Violin II (Vln II), Viola (Vla.), Violoncello (Vc.), and Contrabass (Cb. I). The tempo changes from 'Più Presto' to 'Un pochettino stretto'. The score is marked with 'ff' (fortissimo) and includes various musical notations such as 'a 2' and '8va'.

Example 5.14: Sibelius, Symphony no. 5 — final chord of movement 1 and final chords of movement 3 (Score in C).

5.5.2.8 Ravel, *Rapsodie espagnole*, mov. *i*

In 1907 and 1908, Maurice Ravel composed his first major work for symphony orchestra, *Rapsodie espagnole*. From early on in this composer's career, there is evidence to show that a

compendium of prominent features resurface again and again in his instrumental compositions: the use of orchestration as a structuring device.

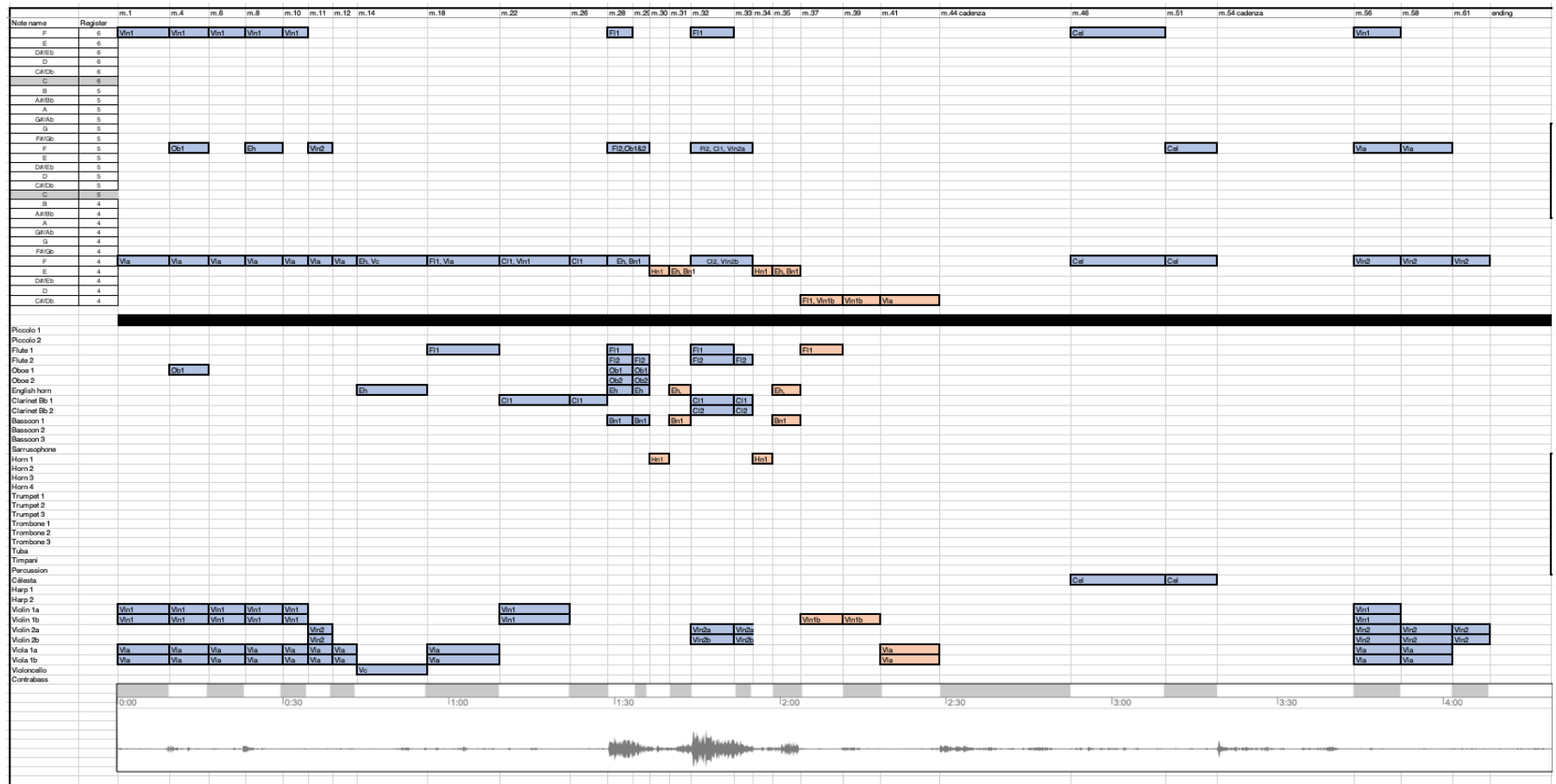
The opening movement of the work presents a basic descending motive (Example 5.15), which is repeated throughout the entire movement (except for a few measures where it is fragmented, or when it pauses during the two cadenzas).



Example 5.15: Ravel, *Rapsodie espagnole*, mov. i, excerpt from the ostinato

What makes this ostinato motif unique in this movement is that its pitch classes remain constant throughout all repetitions: F, E, D, and C#, and during the movement it varies solely through registral and instrumental couplings. The reduction/visualization of this process in the ostinato appears in the example in Table 5.3, where each column represents the measure in which the first pitch class of the motif (mostly F) changes instrumentation or register, aligned with the location on the audio file waveform (at the bottom of the example) where it takes place. The rows represent pitches in the upper half and instruments in the lower half. The blue boxes represent the main motif, and the orange boxes, the diminutions.

Table 5.3 – Temporal reduction of the ostinato material from Ravel, *Rapsodie espagnole*, mov. 1.



Ravel prolongs the string timbre, as the opening and closing of the movement are orchestrated with the string section: this is the *basic orchestrational idea*. Beginning in mm. 14, there is a slow transition to a *contrasting orchestrational idea* of wind timbre at m. 22, where the unison coupling of violin 1 transforms by *reduction* to solo clarinet 1 in m. 26. At least one of the string sections (the strings are always paratimbrally related, so not a strong parametric difference) plays the motif up to this point; therefore, the transition—the transformed stream—represents a moment of structural change. And indeed the alteration to the other woodwinds with the *addition* and *expansion* after this solo moment is a change from one part to a tetra-chroma multi-unison multi-octave coupling. The woodwind timbres blend, creating an emergent timbre. A gradual *reduction* occurs from measure 32 to 43, from *tutti* to viola.

The first cadenza, performed by the clarinets, is followed by another contrasting orchestrational idea in the ostinato, as Ravel scores the celesta to contrast with the melodic material in the foreground. The second cadenza is performed in a contrasting timbre to the first, this time by bassoons 1 and 2. The movement ends with a return to the string timbre, the *basic orchestrational idea*, *reducing* from violin 1 and 2 and viola to just violin 2, and *contracting* from three registral voices in octaves to just one registral voice.

5.5.2.9 Ravel, *Boléro*

In contrast to the early orchestral work of Ravel, this next example analyzes one of his late works, where we observe a similar—but enriched—use of the basic principles of orchestrational combinations and transformations over the course of an entire composition. The temporal and timbral reduction of *Boléro* shown in Table 5.4 provides many insights into the analysis of orchestration of the melody(ies). The upper portion of the table (above the waveform) represents the registral view. The rows show a range from Bb4 to C7, representing the range of the first notes of the entry of each melody. In the portion below the waveform, the instruments are listed in score order. While this reduction displays only melody-related analyses, all of the instruments scored in the work are listed here for context. Columns signify measures; every time a change of instrumentation or registers occurs, which in this case is always at the start of a melody, that change is tracked in each column of the reduction. The colour blue represents theme A, light orange theme B. Throughout *Boléro*, theme A (Example 5.16) and theme B (Example 5.17) are stated twice, an AA and a BB, except at the end where each theme is stated once (with the B section adding a harmonically modulated *coda*). However—and here is where we begin the orchestration analysis—each statement of the theme is orchestrated differently, creating an AA' and a BB'. Each orchestration pair throughout the work is unique, with no instrumental or registral combination repeating, such as AA' / BB' / A''A''' / B''B'''', etc.

Tempo di Bolero moderato assai ♩ = 72

1. solo

pp

9

13

17

1

Example 5.16: Ravel, *Boléro*, mm. 1–21, flute 1 part.



Example 5.17: Ravel, *Boléro*, mm. 41–57, bassoon 1 part.

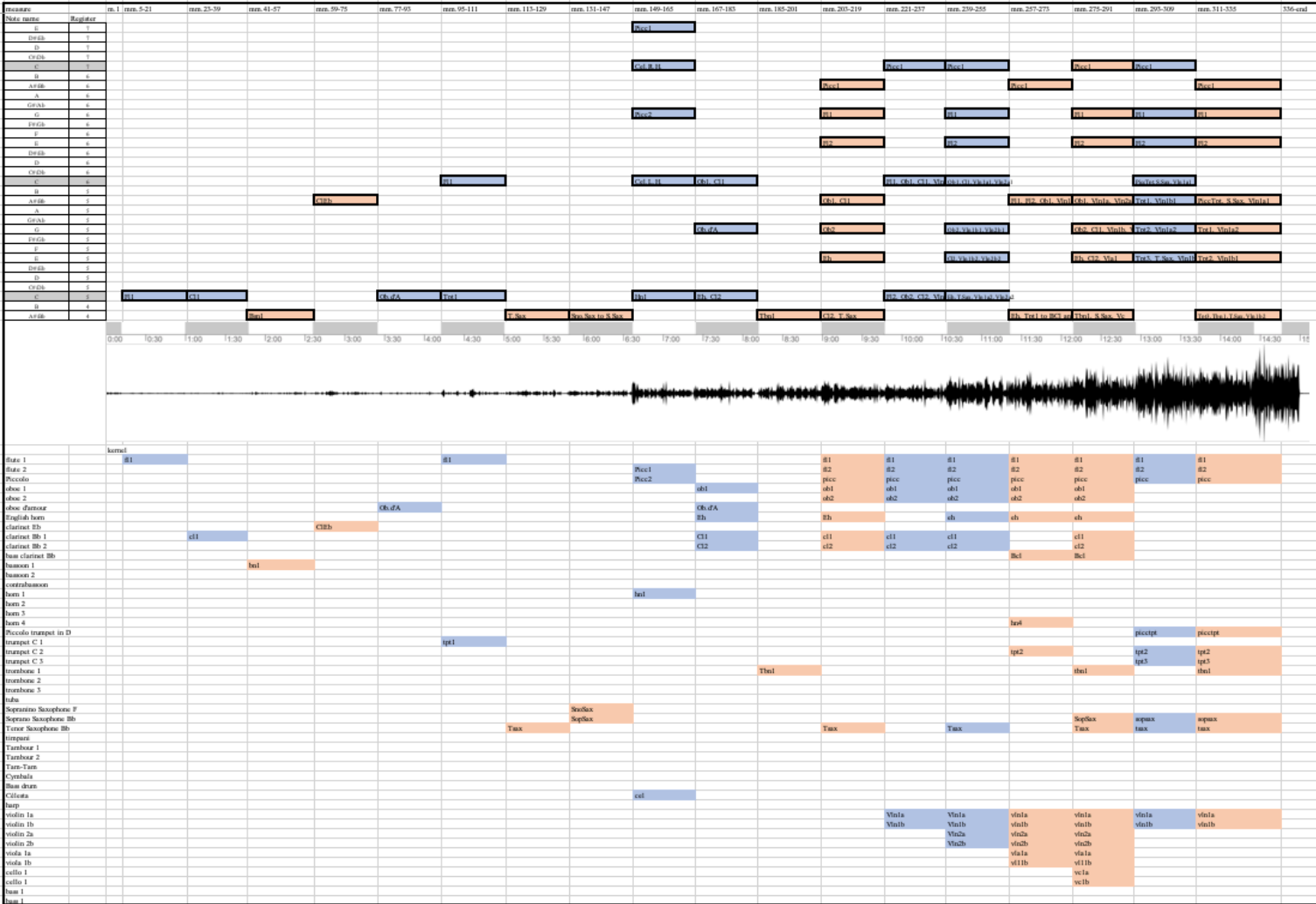
As the piece proceeds with its repeating melody, its rhythmic ostinato and non-modulating harmony, the orchestration-based form can be gleaned from both the registral and instrumental accounts. Following the initial statements of AA' and BB', where A' is an instrumental alteration (a discrete change of instrumentation) of A, and B' is a transposition of B, a form begins to emerge with the theme or across themes: 1) Within the theme: a first statement of each theme is always followed by either a change of instrumentation and/or an accumulation (*addition* and/or *expansion*) in the second statement (except for m. 149, see below). For example, the oboe d'amour in mm. 77–93 contrasted through the *alteration* and *expansion* with the orchestration of the flute 1 and trumpet 1 playing in parallel octaves in mm. 95–111; and 2) Across the themes: following an A or B set of repeats, the first statement of either theme is always an *alteration* and/or *reduction* plus a *contraction* from the previous theme, for example, the alteration, reduction and contraction to tenor saxophone at m. 113.

In mm. 149 and 167, the theme statements of AA' are unique, representing the only time in the composition that a second statement of one theme is a *reduction* and *contraction* rather than an *addition* and *expansion* (or a simple *alteration*). As a successive contrast to the soprano sax ending theme B' in m. 147, the orchestrational transformation at m. 149 gains strength through its stark change of timbres and orchestral register. This becomes evident as the *emergent timbre* mentioned earlier in Chapter 4—it is unique not only for its hybrid timbral nature but also for its use in the composition as it has the widest range of coupled registers in the entire piece. Furthermore, there are no multi-unison registral couplings, only octaves, a fifth, and a third in the

construction of the orchestrational combination. This parallel octave and intervallic registral coupling by Ravel has since been an influential orchestrational approach for generations of composers as it exemplifies the harmonic spectrum-based spacing of intervallic relationships: the registral coupling relationships of partials that occur naturally.

At m. 167, the A' succeeding this moment displays an *alteration* and *contraction*, further contrasted by the change of orchestration to five instruments in three voices, with the multi-unison coupling of oboe 1 and clarinet 1 in the upper octave and English horn and clarinet 2 in the lower octave, the oboe d'amour playing the fifth in between. This collection of double-reed timbres makes for an overall "oboe-like" metatimbre, as proposed in Henry Brant's Wind Group II prototype timbre.

The next three contrasts of BB', AA', BB' (mm. 185–291) adhere to the aforementioned *addition/expansion* (and *thickening*) between the repetition of phrases, and the *reduction/contraction* (and *thinning*) across themes (as well as *thickening* in mm. 239 and 275). In the reduction, such accumulations of engaged orchestral registers and instrumentation (shown by the orchestrational transformations of the instrumental combinations) do behave in accordance with the overall trajectory of an orchestral crescendo that the composition exemplifies. Yet, locally, there are brief accumulations and liquidations, which rather make for a far more complex orchestration than a simple accumulation traversing the entire work would suggest.

Table 5.4 — Temporal reduction of melodic material from Ravel's *Boléro*

5.5.2.10 Tchaikovsky, *Symphony no. 6, mov. 1*

Although Ravel's *Boléro* exemplified orchestrational transformations that were linked temporally, the next case exemplifies a theme with a changing and returning orchestration, one separated by other sections of music. Here, the theme is presented (Example 5.18), and subsequent iterations either timbrally support or contrast the *basic orchestrational idea* of the blended duo-chroma octave coupling of muted violin and cello.

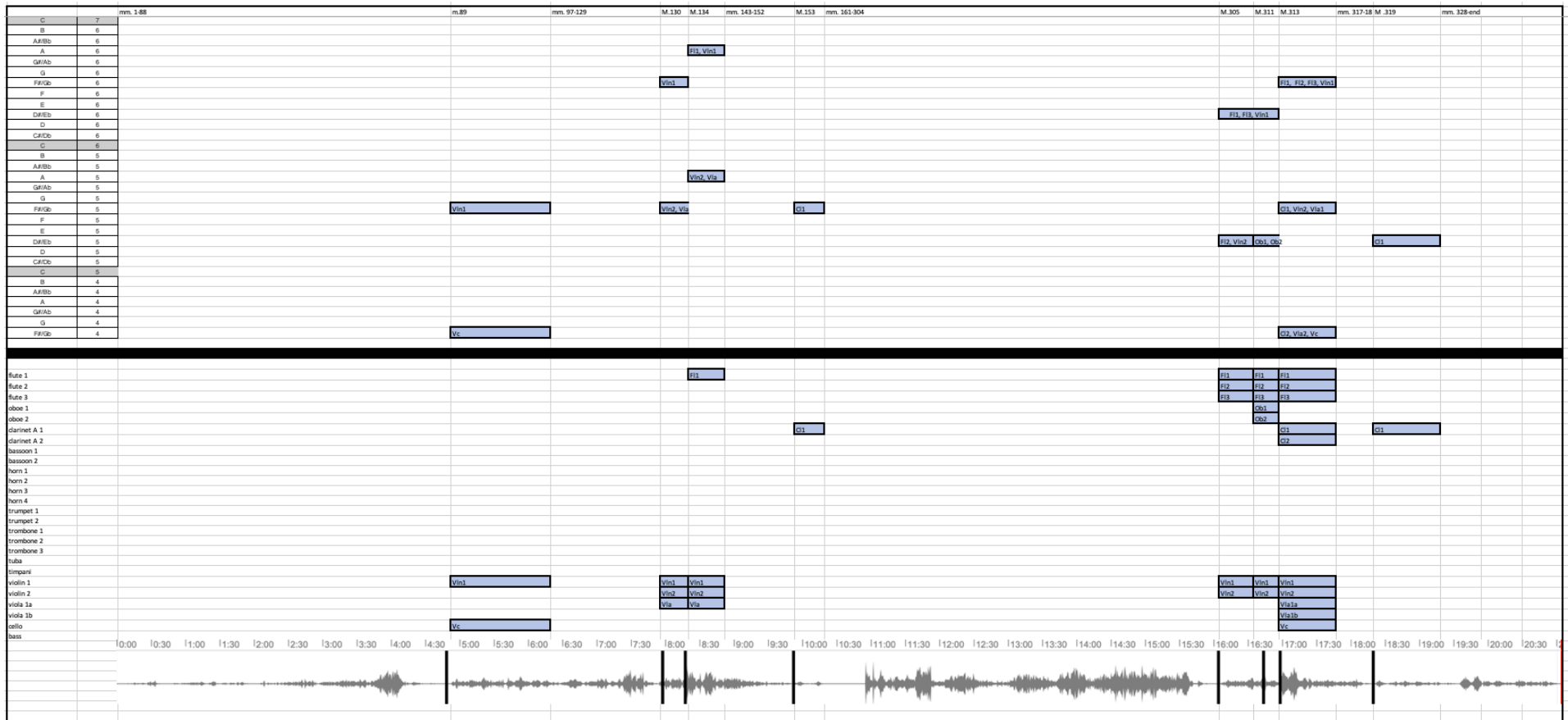
Example 5.18: First statement of theme from Tchaikovsky, *Symphony no. 6, mov. 1*

Table 5.5, below, encloses a temporal reduction of the theme and its use throughout the first movement. Established as *the* sonority, the combined string metatimbre of the perceptual fusion of the violin and cello—the *home timbres*—transforms by transposition (at m. 130, the lower octave is moved to the upper octave), and by the *addition* of violin 2 and viola. The flute joins the upper register at m. 134, producing a multi-unison octave coupling but still a variation on the *basic orchestrational idea* of strings. The third iteration of the theme occurs in a contrasting timbre of the clarinet at m. 153; this is the *contrasting orchestrational idea*.

At mm. 305, in B major rather than the home key of B minor, the multi-unison octave coupling returns, now with different instrumental couplings for each unison: the upper octave displays an instrumental coupling of flutes 1 and 3 and violin 1, the lower octave flute 2 and violin 2 (at m. 311, joined by the two oboes). At the climax of the line, beginning with a rapid orchestral sweep upwards, the oboes drop out while clarinets, viola, and cello enter. This addition of instruments coincides with an *expansion* to a three-octave registral coupling; the unison in each octave emerges now as a duo-chroma instrumental coupling. From the perspective of the Taxonomy of Orchestral Grouping Effects, the second and fourth iteration of the theme are categorized as the *transforming timbral augmentation* of the violins with the change of

instrumentation (not to mention the stratification happening in the other layers). It is interesting to note that the supporting/embellishing instruments in this apex are the clarinets, the instrument family that is part of the *contrasting orchestrational idea*. This repeat of the theme acts accordingly much like a recapitulation: the two contrasting elements have now become one. And instead of the subordinate theme being played in the home *key*, it is the subordinate *timbres* that are played in the *home timbre* (strings).

Table 5.5 – Temporal reduction of a theme from Tchaikovsky, Symphony no. 6, mov. 1



Lastly, one can distinguish a trajectory and directionality to the instrumentation. In the change from the column of m. 89 to the column of m. 313 in Table 5.5, one notices the original two instruments (violin 1 and cello) with the addition of the other instruments (flute 1 & 2 & 3, clarinet 1 & 2, violin 2, and viola), representing a large-scale *accumulation* of instrumentation and register, with local sections of *liquidation*. This orchestration principle was seen in the *Boléro* example (above) as a structuring component, and indeed this kind of orchestrational approach creates a more dynamic and complex quality in the orchestration.

At m. 319 (Example 5.19), with the return of the theme, and now as the *contrasting orchestrational idea*, the clarinet softly closes out the statements of the theme. We also see a *reduction* of instrumental forces involved in this theme—one part—and a *contraction* of the orchestral register to one registral voice.

Example 5.19 is a musical score for Clarinet in A 1 (Cl. in A 1) in 4/4 time. It begins at measure 319. The tempo is marked 'Meno ♩ = 60 con tenerezza'. The dynamics are marked 'Solo', 'ppp', 'p', 'ppp', 'p', 'ppp', 'pp', 'pppp', 'pp', 'pppp'. The tempo markings 'animando' and 'rallentando' are also present.

Example 5.19: Third statement of theme from Tchaikovsky, Symphony no. 6, mov. 1 (score in C)

5.5.2.11 Tchaikovsky, *The Nutcracker*, “Pas de Deux”

We return once more to the “Pas de Deux,” this time examining the orchestrational combinations and transformations that lead up to the combination in m. 44. Each of these excerpts in Example 5.20 represents the first iteration of the melody in a new and distinctive orchestration. Again, there’s the element of *accumulation* overall, but with local elements of *liquidation*.

Example 5.20: Tchaikovsky, *The Nutcracker*, “Pas de Deux,” excerpts. (Score in C)

The excerpt in mm. 4–5 shows the solo cello playing part of the main theme. The theme is orchestrated differently in its next appearance in mm. 14–15: this time with flute 1, flute 2, clarinet 1, and clarinet 2. The following bullet points summarize the differences in standard orchestration terminology, and the types of combinations, transformations, parts and registral voices in each new iteration:

- **Standard terminology:** Octave doubling of melodic line by flutes and clarinets.
- **Orchestration Combination:** duo-chroma multi-unison octave coupling.
- **Orchestration Transformation:** alteration, addition, and expansion from the previous statement.
- **Instrumental Parts:** four (two different instruments).

- **Registral Voices:** two.
 - **Registral Voice 1:** Flute 1 and 2, a mono-chroma unison coupling.
 - **Registral Voice 2:** Clarinet 1 and 2, a mono-chroma unison coupling.
- **Notes:** Each line is unison coupling with same instrument.

The next iteration in mm. 16–17 is with oboe 1, oboe 2, bassoon 1, and bassoon 2:

- **Standard terminology:** Octave doubling of melodic line by oboes and bassoons
- **Orchestration Combination:** duo-chroma, multi-unison octave coupling
- **Orchestration Transformation:** alteration, transposition (addition and reduction)
- **Instrumental Parts:** four (two different instruments).
- **Registral Voices:** two.
 - **Registral Voice 1:** Oboe 1 and 2, a mono-chroma unison coupling
 - **Registral Voice 2:** Bassoon 1 and 2, a mono-chroma unison coupling
- **Notes:** But what is interesting is that each line is unison coupling with same instrument.

Another orchestration of the theme in mm. 18–19: Flute 1, flute 2, English horn, clarinet 1, clarinet 2, violin 1, and cello:

- **Standard terminology:** octave doubling by flutes, English horn, clarinets, 1st violins, cellos
- **Orchestration Combination:** poly-chroma, multi-unison multi-octave coupling
- **Orchestration Transformation:** alteration, addition, expansion
- **Instrumental Parts:** seven (five different instruments).
- **Registral Voices:** two
 - **Registral Voice 1:** Flute 1, flute 2, clarinet 1, violin 1, a tri-chroma unison coupling
 - **Registral Voice 2:** English horn, clarinet 2, cello, a tri-chroma unison coupling

- **Notes:** Continues to be octave coupling, but sounds quite different, as the multi-unisons start to add more complexity, creating new blended timbres, that change the quality of the octave.

The next orchestration is further apart than the previous iterations, shown here in mm. 39–40:

- **Standard terminology:** doubling at the fifth
- **Orchestration Combination:** duo-chroma, multi-unison and intervallic coupling
- **Orchestration Transformation:** alteration, reduction, contraction
- **Instrumental Parts:** four (two different instruments).
- **Registral Voices:** two
 - **Registral Voice 1:** Trumpet 1 and 2, a mono-chroma unison coupling
 - **Registral Voice 2:** Trombone 1 and 2, a mono-chroma unison coupling

Notes: Coupling at the 5th, and the strong dynamic, makes for an interesting blend of brass qualities.

A large arrival point in the accumulating orchestration is shown in mm. 44–45:

- **Standard terminology:** multi-octave doubling with woodwinds and strings
- **Orchestration Combination:** poly-chroma, multi-unison and multi-octave coupling
- **Orchestration Transformation:** alteration, addition, expansion
- **Instrumental Parts:** fourteen (nine different instruments).
- **Registral Voices:** four.
 - **Registral Voice 1:** solo piccolo.
 - **Registral Voice 2:** Flute 1, flute 2, Violin 1, a duo-chroma 3-part unison coupling.
 - **Registral Voice 3:** Oboe 1, oboe 2, clarinet 1, violin 2, a tri-chroma 4-part unison coupling.
 - **Registral Voice 4:** English horn, clarinet 2, bassoon 1, bassoon 2, viola, cello, a poly-chroma 6-part unison coupling

- **Notes:** vast sounding melodic line. The multiple unisons, and the spread of the orchestrational register, and the nine different instruments, create a unique melodic descent.

The last orchestration of the theme is found in mm. 53–54:

- **Standard terminology:** unison / sectional doubling
- **Orchestrational Combination:** mono-chroma, unison coupling
- **Orchestrational Transformation:** alteration, reduction, contraction
- **Instrumental Parts:** two (one instrument).
- **Registral Voices:** one
 - **Registral Voice 1:** Trumpet 1 and 2, a mono-chroma unison coupling
- **Notes:** The trumpets doubling each other create an amplified and intense timbre.

5.6 COMPOSITIONAL EXEMPLIFICATIONS: *OVERTURE*

5.6.1 OVERVIEW

The following section presents an overview of my composition *Overture*—an orchestral overture to a future three-act opera—composed as part of my thesis creation project. In fulfillment of the Andrew Svoboda Prize in orchestral composition awarded to me in 2018, the McGill Symphony Orchestra premiered this *Overture* in February 2020. The instrumentation of *Overture* is 3 3 3 3 - 4 3 3 1, 3 percussion, celesta, 2 harps, strings 12-10-10-8-6,²⁵ and the approximate duration is 14 minutes.

Overture is also meant to be a stand-alone work. Within a long-standing tradition, an operatic overture acts as a microcosm of the larger work, inasmuch as it is a representation of a macrocosm (Moortele, 2017, Chap.1). It sets in place the pattern of the musical discourse—the overture itself as a palimpsest for the forthcoming work.

²⁵ The string section size at the premiere was 10-10-10-7-4, as a scheduling conflict prevented more strings players from attending. However, the piece was composed as noted for a larger string section.

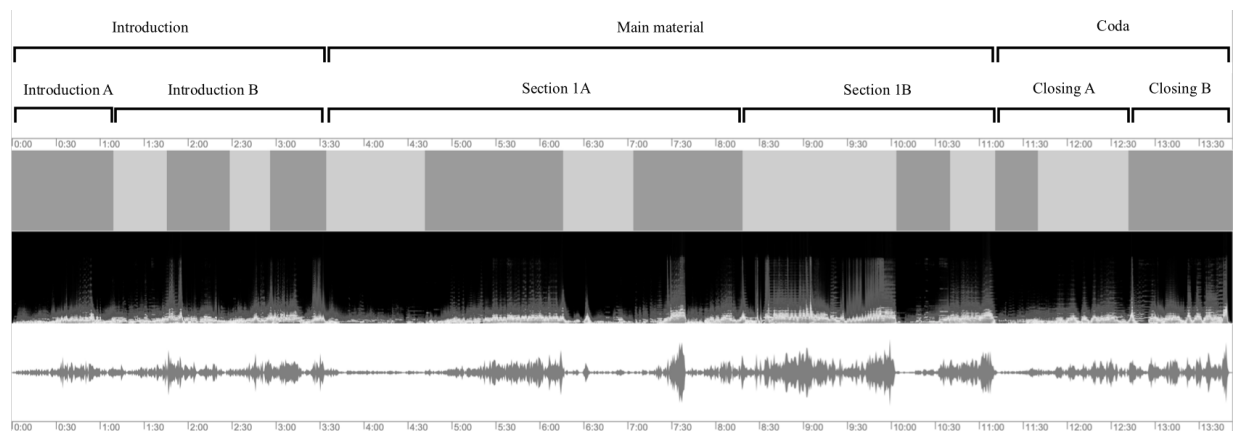
5.6.2 BACKGROUND

In 2016, the FAWN Chamber Creative commissioned me for the creation of a 25-minute chamber opera/*ballet-lyrique* for three voices (soprano, tenor, and baritone), solo ballerina (non-speaking actor), four instruments (bassoon, percussion, piano, and cello) and electronics—with a premiere that took place in Toronto, ON, in May 2019. A professional librettist and writer, David James Brock, and I created the storyline, which takes as a point of departure the Greek myth of Pandora and the novel *The Picture of Dorian Gray* by Oscar Wilde. The chamber opera, whose working title is *Self Portrait of an Artist*, represents the first Act of a future three-act opera for full cast, chorus, and orchestra.

I based the *Overture* on material that I created for the first act, as well as material planned for the unfinished second and third acts.

5.6.3 FORM

The form of the overture is episodic, where many themes are presented and developed. Example 5.21 shows the various subdivision and sections of *Overture* along with the waveform above the timeline, then spectrogram and structural changes (each shade of grey is a section).



Example 5.21: Overview of Soden, *Overture*

The Introduction section is followed by Main material (m. 90) and the Coda (rehearsal 257). Each of these sections is further subdivided by various thematic materials.

- Introduction:

- Introduction A (m. 1) presents the main themes of the opera.
- Introduction B (m. 19) presents the characters and their role in the narrative.
- Main material
 - Section 1A (m. 90) presents the two main themes and their development.
 - Section 1B (m. 177) presents the contrasting themes and their development.
- Coda
 - Closing Section A (m. 257) recapitulates some of the main themes and narratives.
 - Closing Section B (m. 294) is both a dramatic ending to the overture and as well as drive towards, an upbeat of sorts, into the beginning of the opera.

5.6.4 THEMES

There are four principle themes in *Overture*, relating to the main characters of the future opera. Each theme exhibits a metatimbre:

- Theme 1, Basic Orchestral Idea: Cello, low-string metatimbre.
- Theme 2, Basic Orchestral Idea: multiple identities, moving from double reed to strings to flutes.
- Theme 3, Basic Orchestral Idea: trombone and contrabass metatimbres.
- Theme 4, Basic Orchestral Idea: horn and bassoon metatimbre.

The following sections detail the various orchestrational combinations, transformations, perceived grouping effect, and timbral relationship for various statements of each theme.

5.6.4.1 Theme 1

Example 5.22 shows theme 1 in mm. 1–3, although an augmented (stretched out) version of it. Duo-chroma octave coupling between the viola and cello creates a blended low-string metatimbre.



Example 5.22: Soden, *Overture*, mm. 1–3

Example 5.23 shows mm. 7–8 with theme 1. This orchestration is perceived as a transforming stream: the cello plays the theme, and the orchestrational transformation comprises the addition of the flute 1 and oboe 1, and an expansion. The solo cello becomes a tri-chroma multi-octave coupling (from one to three registral voices).

Example 5.23: Soden, *Overture*, mm. 7–8

Example 5.24 shows the arrival point of the introductory section in mm. 12–14, with a repeat of theme 1, now fully orchestrated. It is a poly-chroma, multi-unison and multi-octave registral coupling. Four registral voices and 10 instrumental parts are perceived as an augmented string metatimbre. The Orchestrational Transformation from the last iteration of theme 1 is the addition of instrumental parts and an expansion of orchestral register.

12

Fl. 1 *f* *mp sub.* *mf* *f*

Fl. 2 *f* *mp sub.* *mf* *f*

Ob. 1 *f* *mp sub.* *mf* *f*

Ob. 2 *f* *mp sub.* *mf* *f*

Bsn 1 *p* *mp pp sub.* *mp*

Vln. I *f* *mp sub.* *mf* *f*

Vln. II *f* *mp sub.* *mf* *f*

Vla *f* *mp sub.* *mf* *f*

Vc. *mf mp sub.* *mf* *f*

Cb. *f* *mp sub.* *mf* *f*

Example 5.24: Soden, *Overture*, mm. 12–14

The next major orchestrational change for theme 1, and indeed an arrival point of the overture itself at mm. 158–159 (in the second half of Section 1a), is shown in Example 5.25. It is a four-octave, five-registral voice, 23-part, poly-chroma, multi-unison, multi-octave coupling. The orchestrational transformation from m. 12 consists of an addition and expansion.

Con gran espressione (♩ = 60)

The musical score is for a full orchestra and includes parts for Flute 1 & 2, Flute 3, Oboe 1 & 2, English Horn, Clarinet 1 & 2, Bass Clarinet, Bassoon 1 & 2, Horn 1 & 2, Trombone 1 & 2, Violin I 1a & 1b, Violin II 2a & 2b, Viola 1a & 1b, Violoncello, and Contrabass. The music is in 4/4 time and features a dramatic crescendo from fortissimo (f) to fortissimo (ff) across all instruments. The score includes various musical notations such as slurs, accents, and dynamic markings.

Example 5.25: Soden, *Overture*, mm. 158–159

190

Bsn 1 *ff*

Bsn 2 *ff*

Cbsn *ff*
con sord.

Tpt 1 *mf*

Tbn 1 *ff*

Tbn 2 *ff*

B. Tbn *ff*

Tba *ff*

Pno *ff*
8va

Hp 1 *ff*

Hp 2 *ff*
div.

1a *ff*

Vc. *ff*

1b *ff*

Cb. *ff*

231

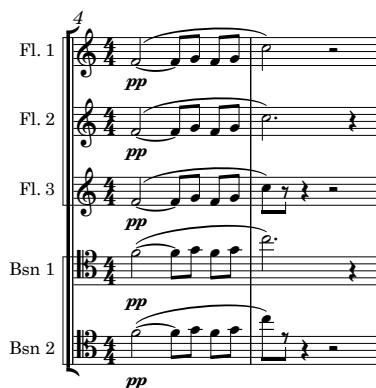
The final example from theme 1 is shown in Example 5.27. The statement of the theme in mm. 295–301 creates the perception of a transforming stream: the coupling of the clarinet 1, trumpet 1, and cellos begins the passage and changes to the coupling of the flutes 1 and 2, piccolo, and oboes 1 and 2. The unison and octave couplings—the clarinet 1 and trumpet 1 in unison, and the cellos an octave above—are folded into and expanded at mm. 296. The oboes appear in unison with clarinet 1 and trumpet 1, the flutes in unison with cellos, and the piccolo one octave above.

Example 5.27: Soden, *Overture*, mm. 295–301

The various transformations of theme 1 in *Overture* show an overall trajectory of orchestrational accumulation, with a reduction and contraction to the final statement of the theme at mm. 295–301. The low-string metatimbre remains an important feature to this theme, even as it is contrasted orchestrationally with the addition of contrasting metatimbres.

5.6.4.2 Theme 2

A fragment of theme 2 is presented in mm. 4–5, shown here in Example 5.28. It is a duo-chroma unison coupling between flutes 1, 2, and 3 and bassoons 1 and 2. If this combination seems familiar, it was intended to be so since it is a “timbral quote” from Tchaikovsky’s orchestration at the opening of Symphony 6, no. iv. The orchestrational combination creates the perception of an emergent blend, a hybrid timbre.



Example 5.28: Soden, *Overture*, mm. 4–5

Example 5.29 shows a transforming stream with two unique blends in mm. 101–103: the melody (stream) contains two different types of instrumental and registral couplings that create the two blends, so that the overall perceived effect points to a timbral modulation from the beginning to the end of the melody. The sustained oboe 1 and clarinet 2 act like a pedal while sustaining the pitches and the timbres throughout the motivic fragment.

Clarinet 2 and bassoon 1 are in unison and oboe 1 an octave above. With the addition of English horn in unison with the bassoon, a new coupling makes its entrance. Although the bassoon is the common instrument, there are unique timbres in each one of these blends; consequently, it is not a transforming timbral augmentation, but rather a transforming stream.

(♩ = 55)

101 ord.

Ob. 1

Eng. Hn.

Cl. 2

Bsn 1

pp *mp* *pp*

pp sub. *mp* *p* *pp*

Example 5.29: Soden, *Overture*, mm. 101–103

Example 5.30 begins the main part of the Section 1a in mm. 110–112, the development of theme 2. Here it is a duo-chroma, multi-octave coupling: three registral voices and three instrumental parts. The timbres of the horn are juxtaposed against the timbres of the violins.

Meno mosso (♩ = 76)

110

Hn 1

Vln. I

Vln. II

p *mf* *p* *mf* *p* *<mf*

mp *mf* *p sub.* *mf* *p* *<mf*

mp *mf* *p sub.* *mf* *p* *<mf*

Example 5.30: Soden, *Overture*, mm. 110–113

Example 5.31, from mm. 114–118, displays a transforming timbral augmentation of the strings. The orchestrational transformation from m. 110 is an addition and expansion; at m. 116, an addition, reduction, and contraction, while at m. 118, an expansion with the addition of the contrabass.

114

Cl. 1

Cl. 2

Bsn 1

Bsn 2

Hn 1

Hn 3

Crot.

Hp 1

Hp 2

Vln. I

Vln. II

Vla

Vc.

medium yarn

p *mf* *f* *ff*

Example 5.31: Soden, *Overture*, mm. 114–118

The following two examples, Example 5.32 and Example 5.33, illustrate the transformation of the Theme 2, first at the *Subito Luminoso* at m. 120 and then later at m. 130. In Example 5.32, there is an expansion at m. 120 from pitch- and pitch-class-based coupling to couplings that use different pitch classes as well: a multi-unison, multi-octave, intervallic registral coupling.

English horn, horns 1 and 2 play the starting pitch, B3, in unison, with violin 1b, one octave

above. Violin 1a and the piano's left-hand appear in unison one octave higher. Flute 2 plays in parallel thirds from the root note, and flute 1 in parallel fifths to the root. The piccolo and the piano's right-hand emerge in unison starting on B6. The orchestrational transformations are transposed to a higher orchestral register overall, occurring with an addition and as well as a reduction of instrumental parts, and expanded to a denser use of the orchestral register.

Example 5.32: Soden, *Overture*, mm. 120–127

Example 5.33 shows the arrival point of the theme 2 section, with the addition of trumpets 1 and 2 in unison with the horns, and the piano's left hand in unison with flutes 1 and 2, and the right hand one octave above. Violins I and II are transposed one octave higher as well.

Dolce ♩ = 60

257

Ob. 1

Vc.

p *mf* *pp* *mp* *p sub. mf*

Example 5.34: Soden, *Overture*, mm. 257–260

In the penultimate measure of *Overture*, theme 2 is heard one last time. It has received an addition and an expansion: a quinta-chroma, multi-unison, and multi-octave coupling. The bassoon appears in the lowest register, whereas cello, viola and violin II play in the middle registral voice, and violin I and flute 1 emerge in the upper registral voice.

molto rall. Subito a tempo ♩ = 100

316

Fl. 1

Bsn 1

Vln. I

Vln. II

Vla

Vc.

fff

Example 5.35: Soden, *Overture*, mm. 316–317

Theme 2 is heard throughout *Overture*, each time with a different orchestration. Although the first and last iterations are orchestrated with flute and bassoon, the theme is most often scored with the upper strings. And the theme's structural qualities embrace changing orchestration, rather than consistent timbral identity.

5.6.4.3 Theme 3

Introduced in m. 8, and as shown in Example 5.36, theme 3 consistently exhibits low-brass metatimbre. In this iteration, horn 1 and trombone are in duo-chroma, octave coupling, and within-family. I have included the trumpet in this example in order to show how in the composition I create resonant strata (a stratification, a layering): the trumpet comes in on the same beat and at the same pitch at the horn 1, but remains on the pitch. There is brief sense of timbral augmentation of the trumpet, but while it holds the note, the pedal-like effect creates a stratified background layer.

8 ♩ = 60

Hn 1

Tpt 1

Tbn 1

f *mp* *ff* *ff* *ff*

Example 5.36: Soden, *Overture*, mm. 8–9

The next iteration of theme 3 (Example 5.37), at the beginning of Section 1b, occurs as a *fff* quinta-chroma, multi-unison, octave coupling of the trombones 1 and 2, and cello on the upper registral voice, and the bass trombone, tuba, and contrabass in unison on the lower registral voice. It is an addition of instrumental parts (and dynamics) from the iteration at m. 8.

Subito furioso ♩ = 100

Tbn 1.2 *fff* *f* *<fff*

B. Tbn *fff* *f* *<fff*

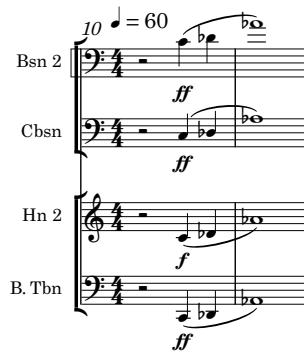
Tba *fff* *f* *<fff*

Vc. *fff* *f* *<fff*

Cb. *fff* *f* *<fff*

Example 5.37: Soden, *Overture*, mm. 187–189

A few measures later, theme 3 returns (after a brief statement of theme 1, see Example 5.26), the orchestrational idea returns, and then reveals an addition and an expansion, with the harmonic coupling of the trumpets 1, 2, and 3, all working together as part of the crescendo arising in these measures.



Example 5.39: Soden, *Overture*, mm. 10–11

The next four examples of orchestrational combinations and transformations emerge in the overture in close proximity to each other. In m. 53, shown in Example 5.40, the theme returns, orchestrated as a tetra-chroma unison and octave coupling. Oboe 1 is by itself on the upper registral voice, while the English horn, bassoon 1, and violin 1a are an octave below in unison on the lower registral voice.

Example 5.40: Soden, *Overture*, mm. 53–54

In m. 56 (Example 5.41), the orchestrational transformation prompts a transposition to a lower orchestral register, as well as an addition, reduction, and expansion. It is a quinta-chroma, multi-unison, multi-octave, three-registral-voice and five-part coupling.

♩ = 80

56 ord.

B. Cl. *mp*

Bsn 1 *mp*

Hn 1 *mp sub.*

Tbn 1 *mp*

Cb. *arco mp*

Example 5.41: Soden, *Overture*, mm. 56–57

In m. 59 (Example 5.42), the orchestrational transformation reveals an addition and expansion, now occurring as a poly-chroma, multi-unison, multi-octave, harmonic coupling.

59 ♩ = 80

Fl. 1.2 *ff*

Ob. 2 *ff*

Cl. 1.2 *ff*

B. Cl. *ff*

Bsn 1 *ff*

Tpt 1 *ff*

Tbn 2 *ff*

B. Tbn *ff*

Tba *ff*

Vln. I 1a *div. ff*

1b

Vln. II 2a *div. ff*

2b

Vla 1a *div. ff*

1b

Vc. 1a *div. ff*

1b

Cb. *ff*

Example 5.42: Soden, *Overture*, mm. 59–60

In m. 62 (Example 5.43), although still a poly-chroma, multi-unison, multi-octave, harmonic coupling, this orchestrational transformation of a reduction and contraction generates a much lighter and thinner texture.

62

Fl. 1 *mf sub.*

Fl. 2 *mf sub.*

Fl. 3 *mf sub.*

Ob. 1 *mf*

Cl. 1 *mf sub.*

Bsn 1 *mf sub.*

Cel. *mf*

1a *mf*

Vln. I 1b *mf*

2a *mf sub.*

Vln. II 2b

1a *mf sub.*

Vla. 1b

Example 5.43: Soden, *Overture*, mm. 62–64

The exemplifications of the orchestrations of theme 4 indicate the local structural changes created by a variety of orchestrational combinations and transformations.

5.7 SUMMARY OF ORCHESTRATION-BASED FORM

The primal *basis of form* is the repetition of some characteristic effect, and the problem of the composer is to bring about these repetitions in such a way that the ear will recognize them as being the same material and will nevertheless not grow weary of them. This is accomplished by varying the material, [...] by introducing contrasting material, and by choice of key. (Gehrken, 1914, p. 62)

Repetitions and changes of musical material comprise indispensable techniques in the art of structuring musical form. Orchestration principles that bring about strong or weak structural changes stand as the vertical organization strategies of registral and instrumental couplings, while horizontal organization strategies are conveyed through their orchestrational transformations and the perception of various kinds of segmental groupings, both local and large-scale. When relating to colour changes, orchestrational transformations foster connections between local and global tone-colour treatments through combinations and their progressions from one element to the next across a composition. “It is really the relations between these transformations which constitute the ‘shape’ of the object” (Snyder, 2000, p. 202). Considered in this manner, a composer’s orchestrational transformations constitute the recurrence and the ongoing modification of such musical elements, and orchestrational prolongations represent their connections throughout the musical work. By analyzing a composer’s orchestration practice from these fundamental perspectives, we gain insight into not only the basic mechanisms of the art, but also just how such recurrences and ongoing modifications of instrumental combinations become part of the very building blocks of musical structure.

6 CONCLUSION

This thesis presented an overview and introduction to score-based, perception-based, and form-based principles in orchestration. Each of these principles is presented by exploring taxonomic categories that elucidate the inherent basic principles.

6.1 SUMMARIES

Score-based principles encompass Orchestrational Combinations and Orchestrational Transformations. Orchestrational Combinations are defined as the couplings of instruments and couplings of orchestral registers. Traditionally, the default term to describe such types of couplings has been the word “doubling,” but this is confusing since “doubling” only represents certain aspects of the orchestration at hand—doubling of the pitch contour and the rhythmic profile. New terms were developed to describe the orchestrational elements involved in doublings.

Instrumental couplings denote the joining of two or more instruments, with each instrument exhibiting unique—if interrelated—tone-colours; and one classifies instrumental couplings consequently by the number of similar or different instruments being orchestrated (mono-, duo-, tri-chroma, etc.). Registral couplings represent the joining of two or more instruments at specific pitches in the orchestral register. Registral couplings can be pitch-based (unison), pitch-class-based (octaves), or be built with different pitch classes (thirds, fifths, etc.), or any combinations thereof.

Orchestrational Combinations operate over time, and thus involve types of simultaneous motion—parallel, similar, oblique, and/or contrary—or can even be chordal. Vertical structuring of instrumental couplings can be defined as the manner with which registral couplings are organized from high to low or low to high: instrumental couplings can be juxtaposed by being placed in a different unique register, or they can be placed so they are interlocked vertically, or they can be overlapping. In the case of multi-unisons, they can even appear in matching orchestral registers.

Orchestrational Transformations are a taxonomic classification with regard to how orchestrations change over time. The categories therein define different types of successive

changes or contrasts that occur in a musical work by comparing the changes of orchestrational combinations—instrumental and registral couplings—across two or more segments of music; it is a description of the type of change involved. Instrument-based changes include: 1) alterations representing the changes of instrument(s) when compared to a previous of section of music; 2) additions representing the accumulation of instruments in an orchestration when compared to a previous of section of music; and 3) reductions representing the liquidation or removal of instruments from an orchestration when compared to a previous of section of music. Register-based orchestrational transformations come about by 1) transposing or changing the orchestral register of the orchestration in contrast to a previous of section of music; 2) expanding the accumulation of register-based material (i.e., registral voices) in the orchestration in contrast to a previous of section of music; and 3) contracting the liquidation of register-based material (i.e., registral voices) in the orchestration in contrast to a previous section of music.

The perception-based (listening-based) principles that I have presented shed new light and new perspectives on timbral relationships while providing an overview of an innovative taxonomy based on auditory grouping principles. By way of timbral relationships, I have explored the concept behind the word timbre, and its polysemous nature, and I have proposed to expand the terminology with two new terms: metatimbre and paratimbre. Metatimbre represents the archetypical or relational quality of timbre and its grouping into a collection of related timbres that may be defined as either an instrument or as a hybrid combination of instruments. Paratimbre represents the connective quality that can group closely related timbres into a metatimbre; the near-sounding timbres exhibit paratimbral relationships.

The Taxonomy of Orchestral Grouping Effects (TOGE) is a perception-based system that supports analysis by way of annotating scores so that these annotations show the connections between listening-based and score-based principles. The TOGE classifies orchestrations that are based on how we as listeners group them, that is, based on auditory grouping principles such as: *Concurrent* grouping, that which occurs at a moment in time, creating timbres and fusing or separating the perception of the timbres of different instruments; *Sequential* grouping, that which represents a time-based analysis when we parse the musical surface into single or multiple auditory streams, and when multiple streams can be perceived as textures or co-equal lines or

musical layers; and lastly *Segmental* grouping, that which represents how we chunk concurrent or sequential groupings into discrete events—we perceive these segmentations as timbral contrasts or as larger-scale timbral progressions. Concurrent and Sequential groupings can have stable or transforming (changeable) instrumentations that contribute to segmentation as well.

We also saw how composers, in order to build musical structures with form-based principles, employ score-based principles in both local and large-scale structures within the listening-based medium—the musical experience. Pitch, harmonic, and rhythmic structures have been well studied and documented, but orchestration and timbre-based structuring have not been studied as much—perhaps because of their complexity.

Composers call upon combinations of instrumental and registers in conjunction with melodic or rhythmic motifs, or harmonic events, in order to anchor certain qualities of the orchestration—certain timbres—that have been consistently orchestrated throughout a piece. Timbral consistency, and consequently orchestrational consistency, stands as an important criterion in grounding a work. And I maintain that it is as important as pitch consistency is (consider that a suite by J.S. Bach written for cello remains orchestrated for the cello alone and doesn't switch to trumpet or percussion). Fittingly then, orchestrational qualities and their respective changes represent in a musical work a crucial structural feature. Composers employ basic orchestrational ideas and contrasting orchestrational ideas much like they steer pitch-based basic ideas and contrasting ideas: all recur at critical moments in a work, and they either evolve/change or stay consistent depending on what the compositional unfolding requires. By looking at orchestrational combinations and transformations and how they operate with regard to basic and contrasting orchestrational ideas, we can start to understand patterns and grasp the types of relationships and structures they help to generate across the duration of an entire work.

6.2 FUTURE RESEARCH

During the course of my masters and doctoral studies at McGill I was privileged to become involved in many orchestration-related projects, not only as part of the ACTOR project (Analysis, Creation, and Teaching of Orchestration) but also within the Music Perception and Cognition Lab's Orchestration and Perception project, and the e-orch project at the Haute école

de musique de Genève/Neuchâtel (Switzerland). My future research stems from many of the paths taken through these initiatives.

6.2.1 TAXONOMIES OF ORCHESTRATION

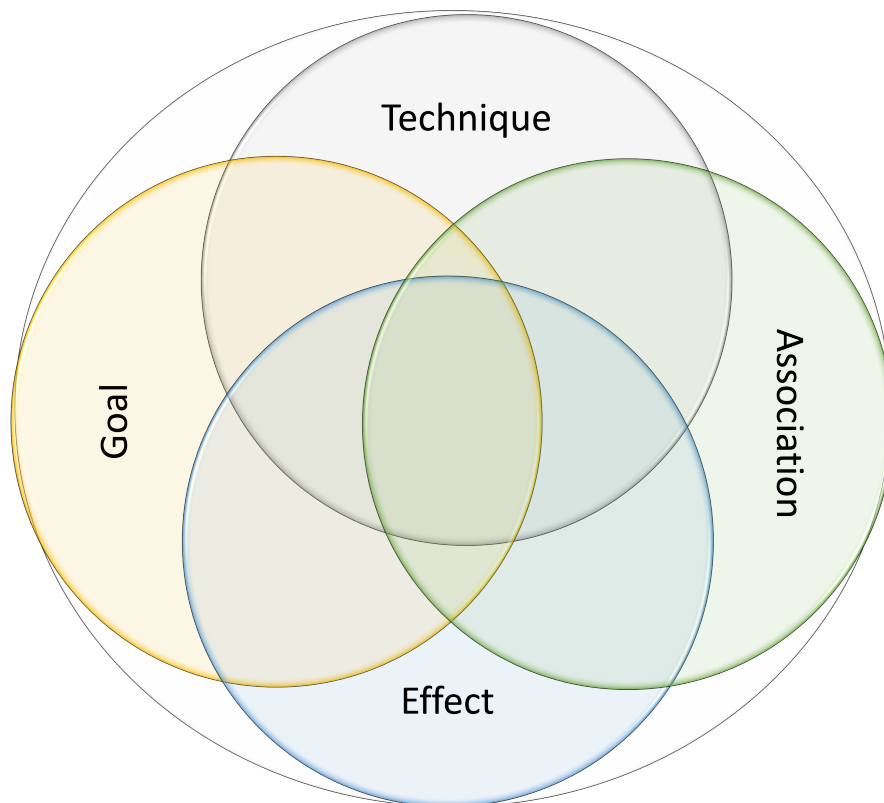
My doctoral thesis has attempted to define basic principles of orchestration, and how these principles can be used to understand the practical aspects of orchestration. Now one of the large-scale projects being undertaken by partners in the ACTOR Project concerns a more extensive exploration and development of orchestration-based taxonomies. By further studying the constructs of orchestrational practices, and seeing what components of knowledge, technique, and historical context go into their structuring, students can gain greater insight into the musical work. Building on the concepts and orchestration-based theories by Rea (2009), Sevsay (2013), Bouliane (2015), Cordero (2016), Goodchild & McAdams (2018), and Lévy (2020), and stemming from ideas discussed during an ACTOR Project funded congress on orchestration taxonomy in Paris, France, at IRCAM in 2018 (attended by Victor Cordero, Fabien Lévy, Philippe Esling, Denys Bouliane, Yan Maresz, Carmine Cella, Luis Naón, and myself), I propose an educational structure where essential facets of orchestration are defined and delineated, each creating a so-called pillar of knowledge in the teaching, creation, and analysis of orchestration. Such pillars form the supporting conceptual architecture of what we understand *as* orchestration.

These educational “Pillars of Orchestration Theory” comprise Technique, Goal, Association, and Effect.

- **Technique** is the action that the orchestrator takes; the actual technique and scoring method an orchestrator uses in creating one’s work (Cordero, 2016; Soden, 2019; Bouliane, 2020)
- **Goal** is the operational objective: what it is that the orchestrator wants to do; the perspective that the orchestrator envisions when orchestrating (Lévy, 2020).
- **Association** is the correlational objective: each instrument, each metatimbre retains a mimetic history and application, and an affective connotation as well as a semantic weight (Rea, 2009; Soden, 2019; Noble, Soden, and Wallmark, 2020)

- **Effect** is the end result of the orchestration: what the listener has experienced and perceived, the auditory grouping that has arisen, and the acoustic/psychoacoustic consequences of the orchestration (Sevsay, 2013; Goodchild & McAdams, 2018; McAdams, Goodchild, and Soden, in preparation)

Each essential facet of an orchestration can be analyzed through the lens of one of these pillars (see the visualization of this notion in Example 6.1)



Example 6.1: Visualization of the “Pillars of Orchestration” Theory.

6.2.2 SOFTWARE AND DATABASES

While at McGill, I conceived of and initiated two projects related to orchestration-based research that will continue beyond my doctoral studies: 1) *OrchView*, a software concept for automatic database integration and analytic co-relations (presently being developed), and 2) an interactive *Thesaurus of orchestration terminologies* for semantic co-relations (presently in alpha form). As well, 3) I worked as a research assistant for the Haute école de musique de Genève/Neuchâtel (Switzerland) looking into orchestration-related pedagogical tools that could, among other applications, be added to the computer-aided orchestration software *Orchidea*.

6.2.2.1 *OrchView*

OrchView, or the Orchestration Viewer, is a PDF and XML annotation software that can export individual score annotations into a database, and (with XML annotations) all the corresponding musical information contained in the data file. As has been shown in my thesis, orchestration can be analyzed from many perspectives—such as basic principles of orchestrational combinations and transformations, orchestrational effects, orchestrational techniques, functions, or timbral associations (all part of the Pillars of Orchestration theory). My future vision for the OrchView software is to eventually install all these branches of analysis right into it—as well as harmonic and formal function analysis—and have it elucidate analytic co-relations. The software therefore possesses an important pedagogical function: its platform creates the opportunity to see the annotated information where aural, symbolic, technical, and perceptual information all intersect and interact. By examining such interactions, let's call them vectors of musical information, a music scholar will gain greater insight into the function of such co-related attributes.

6.2.2.2 *Thesaurus of Orchestration*

The forthcoming “Thesaurus of Orchestration” is a gathering of terms and descriptors from treatise analysis research (McAdams and Goodchild, 2014; Wallmark, 2019; Soden and Jacyna, 2019; Noble, Soden, and Wallmark, 2020) that will provide music scholars the opportunity to discover the descriptive and associative terminology used in orchestration treatises and to examine the relationship of these terms to other technical, effect-based, operational, or associative terminologies.

6.2.2.3 *Orchidea*

Orchidea (Cella et al, 2020) is software that creates both a score-based and audio-based orchestrational rendering of a target audio file. Its mimetic concept exhibits similarities to other mimetic approaches that have been worked on for hundreds of years and, now aided by technology, this novel mimesis has advanced to a high level. It owes its most recent foundation to the philosophies and software developed since the 70's at IRCAM. Possibilities of how orchestrational combinations and transformations can be used in the software, and when doing machine learning or orchestration analysis, include:

- Addition and reduction = density of line
- Expansion and contraction = occupation of and density of register
- Alteration = change of line
- Transposition = change of register

6.2.3 *BACK TO THE FUTURE*

At the beginning of my studies, I had originally planned on researching the features of vocal timbre and its connection and differentiation from instrumental timbre. My research questions then were: why does the voice not blend (perceptually fuse) with instruments in the way instruments blend with each other? What are the qualities that create a segregated timbre when all the other concurrent auditory grouping principles are fulfilled? In the operatic repertoire, for example, a standard practice involves coupling the vocal line with one or more instrumental parts, however, the voice does not blend with the unison or octave couplings: the voice's unique timbre creates a timbral heterogeneity resulting in a segregated two-ness rather than a perceptual fusion. My hypothesis then and now is that composers exploit this perceptual quality, using the concurrent timbral heterogeneity to their advantage: listeners will always hear the voice as not fully blending with the instruments that are doubling its melodic line, and which may be perceptually fused themselves. This uniqueness, combined with the embellishing role of the instrumental timbre, aids the delivery and dramatic intent of the text by adding a depth of quality and contrast to the timbre of the melodic line. At that time, my goal was to analyze and understand a composer's use of the combinations of these auditory groupings in order to achieve maximum dramatic tension. The first roadblock I came across was that there was no clear

analytical language—or taxonomy—available to adequately describe the types of couplings that both the instruments and voices were part of, nor a way to compare them across the duration of the work. This absence of descriptive power prompted my early—and very important—background work that eventually would become large enough as to comprise my entire doctoral thesis work. In future research, I plan to return to this and other related research questions: what kinds of instrumental and registral couplings obtain in operatic arias, and how are they used within the narrative of the opera, what role do these same instrumental parts play when not playing with the voice, and how does the expressiveness of an instrument help shape the perception of the melodic line in unison with the voice?

As a first experimental step to research into the associative properties of orchestration, taken at the outset of my doctorate, I recorded six professional musicians (soprano voice, flute, English horn, clarinet, trumpet, cello) who reinterpreted three melodies, playing each one five times but with differing affects (Soden *et al*, 2016). In each of the five renderings, the performers used both a thematic transformation (Walker, 1983) and an orchestrational transformation (by altering temporal relationships, dynamics, articulations, phrasing, etc.) to reshape the expressive intent of each melody. In four separate experiments, participants (N=160) were asked to label or sort these ninety excerpts based on either emotion categories or timbral/temporal qualities. We examined both the extent to which expressive intent in a musical performance was perceived as a function of the melody and the instrument playing it, and the role of timbral and temporal shaping in this communication process. This study provides insight into the associative functions of timbral and temporal transformations.

6.3 CLOSING STATEMENT

To describe and converse about music accurately, without succumbing to affective or emotional language, one needs to draw upon a wide range of taxonomies that can detail music's many attributes and qualities. A wide range of taxonomies is available to the music theorist to describe pitch- and rhythm-based events. The orchestration-based taxonomies presented in this thesis attempt to close this gap in relation to timbre and orchestration studies in musical scholarship: the conversation around orchestration has been too unidimensional and without clear methodologies.

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- Auber, *Actéon*
- Beethoven, *Egmont Overture*
- Beethoven, *Leonore*, “Overture”
- Beethoven, Symphony No. 3, “Eroica,” mov. i, iii
- Beethoven, Symphony No. 5, mov. i
- Beethoven, Symphony No. 9, mov. ii
- Bellini, *Norma*, “Casta Diva”
- Berg, *Violin Concerto*
- Berlioz, *Roméo et Juliette*
- Berlioz, *Symphonie fantastique*, mov. iv
- Bizet, *Carmen*, “Overture”
- Bizet, *Carmen*, Entr'act between acts III and IV
- Brahms, Symphony No. 4, mov. iv
- Cherubini, *Médée*
- Debussy, *Images pour orchestre*, “Iberia”
- Debussy, *La Mer*
- Debussy, *Nocturnes*, “Nuages”
- d'Indy, *Choral varié*
- d'Indy, *Istar*
- Elgar, *Cockaigne*, Allegro
- Haydn, Symphony No. 99, mov. iii
- Haydn, Symphony No. 100, “Military,” mov. i, ii
- Hérold, *Le Pré aux Clercs*
- Gluck, *Alceste*
- Lully, *Armide*
- Mahler, Symphony No. 1, mov. i
- Mahler, Symphony No. 4, mov. iv

- Mendelssohn, Symphony No. 3
- Meyerbeer, *Robert le diable*, “Bacchanale des nonnes damnées
- Mozart, *Don Giovanni*, “Overture”
- Mozart, *Eine kleine Nachtmusik*
- Mozart, *The Magic Flute*, “Overture”
- Mozart, Symphony No. 35, mov. iii
- Mussorgsky, *Pictures at an Exhibition*, orchestrated by Ravel
- Mussorgsky, *Pictures at Exhibition*, orchestrated by Ravel, “Gnomus,” “Samuel Goldenberg und Schmuyl”
- Nicolai, *Die lustigen Weiber von Windsor*
- Puccini, *La Bohème*, “Sì, mi chiamano Mimì”
- Puccini, *Tosca*, “E lucevan le stelle”
- Puccini, *Tosca*, “Vissi d'arte”
- Ravel, *Boléro*
- Ravel, *Daphnis and Chloe*
- Ravel, *La valse*
- Ravel, *Rapsodie espagnole*, mov. i
- Rimsky-Korsakov, *Tsar's Bride*, “Overture”
- Rimsky-Korsakov, *Overture on Three Russian Themes*
- Rimsky-Korsakov, *Sadko*
- Rimsky-Korsakov, *Scheherazade*, mov. i, ii
- Rimsky-Korsakov, *Snegourochka*
- Rossini, *La Gazza Ladra*, “Overture”
- Rossini, *William Tell*, “Overture”
- Saint-Saëns, *Danse Macabre*
- Schubert, *Rosamunde*, “Entr'acte I”
- Smetana, *Bartered Bride*, “Overture”
- Smetana, *Die Moldau*
- Strauss, *Till Eulenspiegel*

- Tchaikovsky, *Capriccio Italien*, mm. 77-83
- Tchaikovsky, *The Nutcracker*, “Danse des Mirlitons”
- Tchaikovsky, *The Nutcracker*, “Pas de Deux”
- Tchaikovsky, *Romeo and Juliette*
- Tchaikovsky, Symphony No. 6, mov. i, iv
- Schoenberg, *Five pieces for orchestra*, II (1909)
- Sibelius, Symphony no. 5, mov. ii, iii
- Vaughan Williams, *The Lark Ascending*
- Verdi, *Aida*, “Celeste Aida”
- Verdi, *La Traviata*, “Prelude”
- Wagner, *Flying Dutchman*, “Overture”
- Wagner, *Lohengrin*
- Wagner, *Tristan und Isolde*, “Prelude”

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VOLUME II

OVERTURE: VOYAGING THROUGH TIME'S DARK BRANCHES TO THE LUCID STARS

Kit Vaughan Soden

Overture

to a ballet lyrique

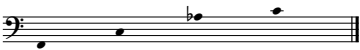
For Orchestra

Commissioned by the Andrew Svoboda Memorial Prize in Orchestral Composition
Schulich School of Music, McGill University
For the McGill Symphony Orchestra, Directed by Alexis Hauser
2019

Instrumentation

3 Flutes (Fl. 3 doubling Piccolo)
3 Oboes (Ob. 3 doubling English Horn)
3 Clarinets in Bb (Cl. 3 doubling Bass Clarinet in Bb)
3 Bassoons (Bsn. 3 doubling Contrabassoon)

4 French Horns in F
3 Trumpets in C
2 Trombones (tenor)
1 Bass Trombone
Tuba

Timpani (4) 

Percussion I :
Large Bass drum, Tam-tam (large), Suspended Cymbal (large), Snare drum, Glockenspiel, Crash Cymbals, Vibraphone.

Percussion II :
Medium Bass drum, Tam-tam (medium) , Suspended Cymbal (medium), Tenor drum, Tubular Bells, Crotales, Crash Cymbals.

Mallets and bows: soft mallets, medium yarn, bass bow, Gong mallet, timpani mallet, chime hammer.

Piano (doubling on Celeste)

2 Harps

Violin I
Violin II
Viola
Cello
Contrabass

Duration: Approx. 12:26

Score is in Concert Pitch, with the exception of:

- a. Piccolo and celeste sounding one octave higher than written;
- b. Glockenspiel and crotales sounding two octaves higher than written;
- c. Contrabassoon and contrabass sounding one octave lower than written.

Voyaging through Time's dark branches to the lucid stars

Score in C

This page of a musical score is for a symphony orchestra. It features 32 staves, each representing a different instrument or section. The instruments are listed on the left: Flute 1, Flute 2, Flute 3, Oboe 1, Oboe 2, English horn, Clarinet 1, Clarinet 2, Bass Clarinet, Bassoon 1, Bassoon 2, Contrabassoon, Horn 1, Horn 2, Horn 3, Horn 4, Trumpet 1, Trumpet 2, Trumpet 3, Trombone 1, Trombone 2, Bass Trombone, Tuba, Timpani, Glockenspiel, Bass Drum 2, Celesta, Harp 1, Harp 2, Violin I, Violin II, Viola, Violoncello, and Contrabass.

The score is written in 4/4 time and includes various musical notations such as notes, rests, and dynamic markings. The dynamics range from *ppp* (pianissimo) to *pp* (piano). Performance instructions are provided for several instruments, including "soft mallets muted w/cloth" for the Glockenspiel, "arco" for the Violoncello, and "pizz." for the Contrabass.

The tempo is marked "Andante sostenuto" with a metronome marking of 60. The score is written in a key signature of one flat (B-flat major or D-flat minor).

This is a page from a musical score, likely for a symphony. The score is written for a large ensemble of instruments, including woodwinds, brass, percussion, and strings. The page is divided into two systems, with the second system starting at measure 7. The instruments listed on the left include Fl. 1, Fl. 2, Fl. 3, Ob. 1, Ob. 2, Eng. Hn., Cl. 1, Cl. 2, B. Cl., Bsn 1, Bsn 2, Cbsn, Hn 1, Hn 2, Hn 3, Hn 4, Tpt 1, Tpt 2, Tpt 3, Tbn 1, Tbn 2, B. Tbn, Tba, Timp., Sus. Cym. 1, B. Dr. 2, Cel., Hp 1, Hp 2, Vln. I, Vln. II, Vla, Vc., and Cb. The score includes various musical notations such as notes, rests, and articulation marks. Dynamic markings like *pp*, *p*, *f*, *mp*, and *ff* are used throughout. There are also markings for *bisb.* and *nat.*. A section labeled 'A' is indicated by a box at the top right. The page number '7' is in a circle at the top left. The bottom of the page has a dashed line and the text '8va...'.

molto accel..

This is a page from a musical score, likely for a symphony or concert band. The score is written for a large ensemble of instruments, including woodwinds, brass, percussion, and strings. The page is numbered 13 in the top left corner. The music is in 3/4 time, as indicated by the large '3' and '4' time signature markings. The key signature is one flat (B-flat major or D minor). The score includes various dynamic markings such as *mf* (mezzo-forte), *f* (forte), *p* (piano), *pp* (pianissimo), and *ppp* (pianississimo). There are also articulation marks like accents and slurs. A 'molto accel.' (much acceleration) instruction is present at the bottom of the page. The score is divided into measures by vertical bar lines, and the instruments are listed on the left side of the page. The instruments include Fl. 1, Fl. 2, Fl. 3, Ob. 1, Ob. 2, Eng. Hn., Cl. 1, Cl. 2, B. Cl., Bsn 1, Bsn 2, Cbsn, Hn 1, Hn 2, Hn 3, Hn 4, Tpt 1, Tpt 2, Tpt 3, Tbn 1, Tbn 2, B. Tbn, Tba, Timp., B. Dr. (soft mallets), Tam-t 2, Cel., Hp 1, Hp 2, Vln. I, Vln. II, Vla, Vc., and Cb. The score is written in a standard musical notation with staves and notes. The page is numbered 13 in the top left corner. The music is in 3/4 time, as indicated by the large '3' and '4' time signature markings. The key signature is one flat (B-flat major or D minor). The score includes various dynamic markings such as *mf* (mezzo-forte), *f* (forte), *p* (piano), *pp* (pianissimo), and *ppp* (pianississimo). There are also articulation marks like accents and slurs. A 'molto accel.' (much acceleration) instruction is present at the bottom of the page. The score is divided into measures by vertical bar lines, and the instruments are listed on the left side of the page. The instruments include Fl. 1, Fl. 2, Fl. 3, Ob. 1, Ob. 2, Eng. Hn., Cl. 1, Cl. 2, B. Cl., Bsn 1, Bsn 2, Cbsn, Hn 1, Hn 2, Hn 3, Hn 4, Tpt 1, Tpt 2, Tpt 3, Tbn 1, Tbn 2, B. Tbn, Tba, Timp., B. Dr. (soft mallets), Tam-t 2, Cel., Hp 1, Hp 2, Vln. I, Vln. II, Vla, Vc., and Cb. The score is written in a standard musical notation with staves and notes.

[illegible]

rit......

54

D

Con affetto♩ = 80

42

2
4

2
4

2
4

Fl. 1

f

f

p

Fl. 2

f

f

p

Picc.

f

To Fl.

Ob. 1

f

p

Ob. 2

f

pp

Eng. Hn.

mf

f

pp

Cl. 1

f

p

Cl. 2

pp

B. Cl.

mf

f

Bsn 1

flz.

pp

mf

f

Bsn 2

mf

f

Cbsn

mf

f

Hn 1

pp sempre

sf

sf

Hn 2

pp sempre

sf

sf

Hn 3

pp

pp sempre

sf

sf

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

f

senza sord.

pp sempre

sf

sf

Tba

f

senza sord.

Timp.

mf

B. Dr. 1

B. Dr.

p

mf

Tam-t

p

Sus. Cym.

ppp sempre

B. Dr. 2

B. Dr.
soft mallets

mp

mf

p

Cel.

Hp 1

Hp 2

Vln. I

f

mf

mp

Vln. II

f

mf

mp

Vla

f

mf

mp

Vc.

nat.

pp

Cb.

pp

ord. pizz.

p sempre

48

Fl. 1

Fl. 2

Fl. 3

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Sus. Cym. 1

B. Dr. 2

Cel.

Hp 1

Hp 2

Vln. I

2a

Vln. II

2b

1a

Vla.

1b

1a

Vc.

1b

Cb.

This image shows a page of a musical score, likely for a symphony orchestra. The score is written for multiple staves, including woodwinds (Flutes 1-3, Oboes 1-3, Clarinets 1-2, Bass Clarinet, Bassoons 1-3, Horns 1-4, Trumpets 1-3, Trombones 1-3, Tuba, Timpani, Suspended Cymbals 1-2, Celesta, Harp 1-2, Violins 1-2, Viola, Violoncello, and Contrabass). The score includes various musical notations such as notes, rests, and dynamic markings (e.g., *p*, *ff*, *f*, *mf*, *mp*, *sub.*). A large, bold, black text "molto accel." is written across the top of the page, indicating a tempo change. Additionally, large numbers (5, 2, 8, 4) are overlaid on the staves, possibly indicating measures or rehearsal marks. The score is written in a standard musical notation style, with a key signature of one flat (B-flat) and a time signature of 4/4.

The image shows a page from a musical score, likely for a symphony, featuring a woodwind and brass section. The score is divided into two systems, each with a "rit." (ritardando) and "♩ = 104 accel." (accelerando) section. The woodwind section includes Flutes 1-3, Oboes 1-3, Clarinets 1-3, Bassoons 1-3, Horns 1-4, and Truets 1-3. The brass section includes Trumpets 1-3, Trombones 1-2, Baritone Trombone, and Tuba. The percussion section includes Timpani, Vibraphone, and Suspended Cymbal. The string section includes Violins I and II, Viola, Violoncello, and Contrabass. The score is written in a complex, multi-measure format with various dynamics and articulations.

The image displays a page from a musical score, likely for a symphony, featuring multiple staves for various instruments. The score is written in a standard musical notation with a key signature of one flat (B-flat) and a common time signature (C). The instruments listed on the left include Flutes (Fl. 1, 2, 3), Oboes (Ob. 1, 2), English Horn (Eng. Hn.), Clarinets (Cl. 1, 2, 3), Bassoons (Bsn 1, 2, 3), Horns (Hn 1, 2, 3, 4), Trumpets (Tpt 1, 2, 3), Trombones (Tbn 1, 2, B. Tbn), Tuba (Tba), Timpani (Timp.), Vibraphone (Vib.), Suspended Cymbal (Sus. Cym. 2), Celesta (Cel.), Harp (Hp 1, 2), Violins (Vln. I, II), Viola (Vla.), Violoncello (Vc.), and Contrabass (Cb.). The score includes various musical notations such as notes, rests, and dynamic markings (e.g., *mf*, *p*, *f*, *pp*, *mp*, *ppp*). There are also articulation marks and performance instructions like "soft mallets" and "play near rim". The score is divided into measures by vertical bar lines, and there are tempo markings: "Subito a tempo (♩ = 126)", "rit." (ritardando), and "Subito a tempo (♩ = 104)". The page number "74" is visible in the top left corner.

80

accel......♩ = 140

Fl. 1

Fl. 2

Fl. 3

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

Cl. 3

Bsn 1

Bsn 2

Bsn 3

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Sn. Dr.

B. Dr. 2

Cel.

Hp 1

Hp 2

accel......♩ = 140

Vln. I

Vln. II

Vla

Vc.

Cb.

nat. bisb. *tr*

pp sempre

bish. *tr*

pp

mp

flz.

p

mf

nat. bisb. *tr*

pp

bish. *tr*

pp sempre

flz.

p

mf

bish. *tr*

pppp sempre

bish. *tr*

pp

flz.

p

mf

mp

f

mf

pp

mf

pp

con sord.

mf

pp

p

snare off

fp

ff

p

To Pno

sfz

sfz

sfz

sfz

sfz

sfz

sfz

sfz

senza sord.

sfz

senza sord.

sfz

senza sord.

sfz

senza sord.

sfz

senza sord.

sfz

half the section arco

pp

arco

p

92

Fl. 1

pp

flz.

pp

p

pp nat.

ppp

pp

flz.

Fl. 2

pp

flz.

p

pp

flz.

pp

p

Fl. 3

flz.

pp

p

flz.

pp

p

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

pp

Cl. 2

pp

Cl. 3

pp

To B. Cl.

Bsn 1

p

mf

mf

p

pp

3

3

Bsn 2

Bsn 3

Hn 1

con sord.

ppp sempre

Hn 2

Hn 3

con sord.

pp

senza sord.

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

con sord.

ppp sempre

Tbn 2

B. Tbn

Tba

Timp.

Glock.

Glock.
arco

p

mp

To Vib.

Crot.

arco

p

Pno

Hp 1

Hp 2

Vln. I

mf

pp

Vln. II

p

mf

pp

tutti s.t.

ppp sempre

Vla

Vc.

s.t.

ppp sempre

solo ord.

mf

p sub.

tutti

pp

Cb.

pp

mf

pp

tutti s.t.

ppp sempre

molto rall.....

molto rall.....

98 (♩ = 55) accel.

Fl. 1 *p*

Fl. 2

Fl. 3

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Bsn 3

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Vib. *Vib. arco* *p* *To Glock.* *mp* *Glock. arco* *p* *mf*

Crot. *arco* *p* *mf*

Pno

Hp 1

Hp 2

Vln. I

Vln. II

Vla

Vc.

Cb.

34

104

H

Subito a tempo (♩ = 80)

poco rit.

Fl. 1

nat.
pp

pp

p

ppp

Fl. 2

nat.
pp

pp

p

ppp

Fl. 3

nat.
pp

pp

p

ppp

Ob. 1

Ob. 2

Eng. Hn.

pp

Cl. 1

Cl. 2

B. Cl.

Bsn 1

p

pp

Bsn 2

pp

p

ppp

Bsn 3

pp

pp

p

ppp

Hn 1

pp

senza sord.

Hn 2

pp

senza sord.

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

senza sord.

Tbn 2

B. Tbn

senza sord.

Tba

senza sord.

Timp.

pp

Glock.

arco
p

Sus. Cym.

soft mallets
pp

Crot.

arco
p

Pno

Hp 1

pp

p

Hp 2

p

H

Subito a tempo (♩ = 80)

poco rit.

Vln. I

tutti
ord.
p

Vln. II

ord.
p

Vla

tutti
p

Vc.

pizz.
pp

Cb.

ord.
pp sempre

110

Meno mosso (♩ = 76)

Fl. 1

Fl. 2

Picc.

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Tam-t

Glock.

medium yarn

medium yarn

Pno

Hp 1

Hp 2

Vln. I

Vln. II

Vla

Vc.

Cb.

pizz.

pizz.

115

rall.....

Fl. 1

Fl. 2

Picc.

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Glock.

Crot.

Pno

Hp 1

Hp 2

Vln. I

Vln. II

Vla

Vc.

Cb.

rall.....

rall.....

[illegible]

125

Fl. 1

Fl. 2

Picc.

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Sus. Cym. 1

Sus. Cym. 2

Pno

Hp 1

Hp 2

1a

Vln. I

1b

2a

Vln. II

2b

Vla

1a

Vc.

1b

Ch.

131

Fl. 1

f
mf
f
mp sub.
mp

Fl. 2

f
mf
f
mp sub.
mp

Picc.

f
mf
f
mp sub.
mp

Ob. 1

f
mf
f
mp sub.
mp

Ob. 2

f
mf
f
mp sub.
mp

Eng. Hn.

f
mf
f
mp sub.
mp

Cl. 1

f
mf
f
mp sub.
mp

Cl. 2

f
mf
f
mp sub.
mp

B. Cl.

f
mf
f
mp sub.
mp

Bsn 1

f
mf
f
mp sub.
mp

Bsn 2

f
mf
f
mp sub.
mp

Cbsn

f
mf
f
mp sub.
mp

Hn 1

f
mf
f
mp
mp

Hn 2

f
mf
f
mp
mp

Hn 3

f
mf
f
mp
mp

Hn 4

f
mf
f
mp
mp

Tpt 1

f
mf
f
mp sub.
mp

Tpt 2

f
mf
f
mp sub.
mp

Tpt 3

f
mf
f
mp sub.
mp

Tbn 1

f
mf
f
mp sub.
mp

Tbn 2

f
mf
f
mp sub.
mp

B. Tbn

f
mf
f
mp sub.
mp

Tba

f
mf
f
mp sub.
mp

Timp.

f
mf
f
mp sub.
mp

B. Dr. 1

f
mf
f
mp sub.
mp

Sus. Cym. 2

f
mf
f
mp sub.
mp

Pno

f
mf
f
mp sub.
mp

Hp 1

f
mf
f
mp sub.
mp

Hp 2

f
mf
f
mp sub.
mp

1a

f
mf
f
mp sub.
mp

Vln. I

f
mf
f
mp sub.
mp

1b

f
mf
f
mp sub.
mp

2a

f
mf
f
mp sub.
mp

Vln. II

f
mf
f
mp sub.
mp

2b

f
mf
f
mp sub.
mp

Vla

f
mf
f
mp sub.
mp

1a

f
mf
f
mp sub.
mp

Vc.

f
mf
f
mp sub.
mp

1b

f
mf
f
mp sub.
mp

Cb.

f
mf
f
mp sub.
mp

143

Fl. 1

Fl. 2

Fl. 3

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Sus. Cym. 1

Tub. Bells

Cel.

Hp 1

Hp 2

1a

Vln. I

1b

2a

Vln. II

2b

Vla

1a

Vc.

1b

1a

Cb.

1b

This image shows a page from a musical score, likely for a symphony. The page is filled with musical staves for various instruments, including Flutes (Fl. 1, 2, 3), Oboes (Ob. 1, 2), English Horn (Eng. Hn.), Clarinets (Cl. 1, 2), Bass Clarinet (B. Cl.), Bassoons (Bsn 1, 2), Contrabassoon (Cbsn), Horns (Hn 1, 2, 3, 4), Trumpets (Tpt 1, 2, 3), Trombones (Tbn 1, 2), Baritone Trombone (B. Tbn), Tuba (Tba), Timpani (Timp.), Suspended Cymbal (Sus. Cym. 1), Tubular Bells (Tub. Bells), Cello (Cel.), Harp 1 (Hp 1), Harp 2 (Hp 2), Violins I (Vln. I), Violins II (Vln. II), Viola (Vla), Violoncello (Vc.), and Double Bass (Cb.).

The score is written in a standard musical notation, including notes, rests, and dynamic markings such as *pp* (pianissimo) and *p* (piano). There are also performance instructions like *espressivo* and *arco*. A large, stylized number '54' is prominently displayed in the center of the page, serving as a page number or section marker. The text 'rall.' (rallentando) is visible at the top left, and 'Appassionato' is at the top right, indicating the tempo and mood of the music.

Con gran espressione(♩ = 60) **rall.**.....**A tempo**

This image shows a page from a musical score, likely for a symphony or concert piece. The score is written for a large ensemble, including woodwinds, brass, percussion, piano, harp, and strings. The notation is complex, with many notes, rests, and dynamic markings. A large number '4' is prominently displayed on the left side of the page, possibly indicating a measure number or a section marker. The score includes various performance instructions and dynamics, such as 'f' (forte), 'ff' (fortissimo), 'p' (piano), 'mp' (mezzo-piano), 'pp' (pianissimo), and 'ppp' (pianissimissimo). There are also markings for 'gliss.' (glissando) and 'div.' (divisi). The bottom of the page features a tempo change instruction: 'Con gran espressione (♩ = 60) rall. A tempo'. The overall layout is typical of a professional musical manuscript.

170

Agitato ♩ = 96

Fl. 1

Fl. 2

Fl. 3

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

Cl. 3

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

B. Dr. 1

Cr. Cym. 2

Pno

Hp 1

Hp 2

1a

Vln. I

1b

2a

Vln. II

2b

1a

Vla.

1b

1a

Vc.

1b

1a

Cb.

1b

[illegible]

[illegible]

[illegible]

201 M

Fl. 1 *f*

Fl. 2 *f*

Picc.

Ob. 1

Ob. 2

Ob. 3

Cl. 1 *f*

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1 *p* *ff*

Hn 2 *p* *ff*

Hn 3

Hn 4

Tpt 1 *ff*

Tpt 2 *ff*

Tpt 3 *ff*

Tbn 1 *ff*

Tbn 2 *ff*

B. Tbn

Tba *ff*

Timp. *ff*

Sus. Cym. 1 *ff*

Cr. Cym. 2 *ff*

Cel.

Hp 1 *f* *ff*

Hp 2

Vln. I *f* *ff*

Vln. II *f* *ff*

1a

Vla. *ff*

1b *ff*

Vc. *ff*

Cb. *ff*

[illegible]

Overture

41

[illegible]

[illegible]

224

$\text{♩} = 116$ **molto rit.** $\text{♩} = 80$ **molto accel.**

Fl. 1

Fl. 2

Picc.

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Sn. Dr.

B. Dr. 2

Pno

Hp 1

Hp 2

$\text{♩} = 116$ **molto rit.** $\text{♩} = 80$ **molto accel.**

1a

Vln. I

1b

Vln. II

1a

Vla.

1b

Vc.

1a

Cb.

1b

..(♩ = 116)

molto rit......

228

Fl. 1
Fl. 2
Picc.
Ob. 1
Ob. 2
Eng. Hn.
Cl. 1
Cl. 2
B. Cl.
Bsn 1
Bsn 2
Cbsn
Hn 1
Hn 2
Hn 3
Hn 4
Tpt 1
Tpt 2
Tpt 3
Tbn 1
Tbn 2
B. Tbn
Tba
Timp.
Sn. Dr.
B. Dr. 2
Pno
Hp 1
Hp 2
Vln. I
Vln. II
Vla.
Vc.
Cb.
Cb.

(♩ = 116) molto rit.

[illegible]

242

Fl. 1

p *p* *mf*

p sub.

p *ff*

Fl. 2

p *p* *mf*

p sub.

p *ff*

Picc.

p *p* *mf*

p sub.

p *ff*

Ob. 1

p *p* *mf*

p sub.

p *ff*

Ob. 2

p *p* *mf*

p sub.

p *ff*

Eng. Hn.

mf

To Ob.

ff

Cl. 1

mf

Cl. 2

p *ff*

B. Cl.

p sub.

p *f*

Bsn 1

p *mf*

p sub.

p *ff*

Bsn 2

p *mf*

p sub.

p *ff*

Cbsn

p *ff*

Hn 1

p *f*

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

pp

Sn. Dr.

Sn. Dr.
snares off

pp

f

B. Dr. 2

B. Dr.

p

Pno

Hp 1

p

mf

Hp 2

mf

1a

1b

2a

2b

2c

2d

1a

1b

Vc.

1a

1b

P Subito con gran espressione ♩ = 80

247 ord.

Fl. 1 *mp sub. ord.*

Fl. 2 *mp sub.* To Fl.

Fl. 3

Ob. 1 *mp sub.*

Ob. 2 *mp sub.*

Ob. 3

Cl. 1 *mp sub.*

Cl. 2 *mp sub.*

B. Cl.

Bsn 1 *mp sub.*

Bsn 2

Cbsn

Hn 1 *mf*

Hn 2 *mf*

Hn 3

Hn 4

Tpt 1 *f*

Tpt 2 *f*

Tpt 3 *f*

Tbn 1 *f*

Tbn 2 *mf*

B. Tbn *mf*

Tba *mf*

Timp. *f*

B. Dr. *ff* B. Dr. *mf* Sus. Cym. B. Dr. *mp* *f*

Tam-t 2 *ff* *p*

Pno *mp* *p*

Hp 1 *f*

Hp 2 *f* *8va.*

P Subito con gran espressione ♩ = 80

1a *mp*

Vln. I 1b *mp* *div. en 2*

2a *mp*

Vln. II 2b *mp*

1a *mp*

Vla. 1b *mp* *div.*

1a *mp*

Vc. 1b *mp*

1a *f*

Cb. 1b *f*

253

molto rall......**Dolce** ♩ = 60

molto rall......**Dolce** ♩ = 60

[illegible]

263

molto accel.....

Sognando♩ = 96

Fl. 1

Fl. 2

Fl. 3

Ob. 1

Ob. 2

Ob. 3

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Tam-t 1

Tub. Bells

Cel.

Hp 1

Hp 2

1a

Vln. I 1b

2a

Vln. II 2b

Vla

Vc.

1a

Cb. 1b

molto accel.....

Sognando♩ = 96

[illegible]

Q Subito solenne ♩ = 96

Fl. 1 *mp*

Fl. 2 *mp*

Fl. 3 *mp*

Ob. 1 *p*

Ob. 2 *p*

Eng. Hn. To Eng. Hn.

Cl. 1 *p*

Cl. 2 *p*

B. Cl. *mp*

Bsn 1 *mp* *mf* *p*

Bsn 2

Cbsn

Hn 1 *mp* *mf* *p sub.* *mf*

Hn 2 *mp* *mf*

Hn 3 *mp*

Hn 4

Tpt 1 *mp* *mf* *p sub.* *mf*

Tpt 2

Tpt 3

Tbn 1 *mp* *mf* *p sub.* *mf*

Tbn 2 *mp* *mf* *p sub.* *mf*

B. Tbn *mp* *mf* *p sub.* *mf*

Tba

Timp. *mf* *cresc.* *f*

Tam-t 1 *mf* B. Dr. *f*

Tub. Bells *mp* *mf* *pp* *ff* *ppp*

Cel.

Hp 1

Hp 2

Q Subito solenne ♩ = 96

1a *mp* *mf* *p sub.* *mf*

Vln. I 1b *mp* *mf* *p sub.* *mf*

2a *mp* *mf* *p sub.* *mf*

Vln. II 2b *mp* *mf* *p sub.* *mf*

Vla *mp* *mf* *p sub.* *mf*

Vc. *mp* *mf* *p sub.* *mf*

1a *mp* *mf* *p sub.* *mf*

Cb. 1b *mp* *mf* *p sub.* *mf*

[illegible]

290 $\text{♩} = 120$ **rit.** $\text{♩} = 90$

Fl. 1 *mf* *mf* *ppp* *g^{na}*

Fl. 2 *mf*

Fl. 3 To Picc.

Ob. 1 *pp* *mf* *mp*

Ob. 2 *pp* *mp*

Eng. Hn.

Cl. 1 *mf* *mp* *mp* *f*

Cl. 2 *mp*

B. Cl.

Bsn 1 *p* *f* *pp* *mp*

Bsn 2 *mf* *mp*

Cbsn

Hn 1 *pp*

Hn 2

Hn 3

Hn 4

Tpt 1 *f*

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp. *p* *ff*

B. Dr. 1 *mp* *Tam-t* *ff*

B. Dr. 2 *ppp* *ff* *ppp* *Sus. Cym.* *ff*

Cel. *mf* *mf* *f* *To Pno*

Hp 1 *mf* *mf*

Hp 2 *mf* *mf*

$\text{♩} = 120$ **rit.** $\text{♩} = 90$

1a *p* *ppp* *f*

Vln. I *p* *ppp*

1b *p* *ppp*

Vln. II *unis.* *g^{na}* *ppp*

Vla

Vc. *p* *ppp* *f*

1a

Cb.

1b

R Affettuoso ♩ = 100

[illegible]

molto rall.

317 Subito a tempo

Fl. 1

Fl. 2

Picc.

Ob. 1

Ob. 2

Eng. Hn.

Cl. 1

Cl. 2

B. Cl.

Bsn 1

Bsn 2

Cbsn

Hn 1

Hn 2

Hn 3

Hn 4

Tpt 1

Tpt 2

Tpt 3

Tbn 1

Tbn 2

B. Tbn

Tba

Timp.

Tam-t 1

Sus. Cym. 2

Pno

Hp 1

Hp 2

Subito a tempo

Vln. I

Vln. II

Vla

1a

Vc.

1b

1a

Cb.

1b