

## The Semantics of Orchestration: A Corpus Analysis

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### Introduction

The burgeoning field of timbre semantics has revealed many insights into cognitive-linguistic and cross-modal bases for ways we experience and describe timbre (e.g., Saitis, 2019; Wallmark, 2019; Zacharakis & Pasiadis, 2016), but has usually focused on the semantics of *individual* timbres, especially the timbres of musical instruments. There remain many questions about the semantics of timbres and textures arising from orchestral *combinations*: for example, what leads orchestration pedagogue Samuel Adler (2002) to describe some orchestral textures as “flickering” while others are “noble,” “bombastic,” or “muddy”? Semantics of combinations of timbres and textures are germane to ecologically valid experiences of music, especially ensemble music. They also complement the much-discussed gray area between timbre and harmony (e.g., Hasegawa 2009; Harvey 2000) with another equally fascinating liminality: between timbre and texture.

A rich source of information about the semantics of orchestral combinations comes from the many published orchestration treatises. Wallmark (2019) analyzed a corpus of eleven treatises and manuals, focusing on descriptions of individual instrumental timbres. He organized the resulting sample of descriptors into seven basic categories and analyzed the frequency with which particular terms and categories appeared in the corpus as indices of timbre conceptualization and cognition. Building upon this precedent, we analyze a corpus of six orchestration treatises published over the last century (Table 1) for semantic descriptions of orchestral combinations.

Table 1: Orchestration treatises used in our corpus study.

Author	Title	Publication year
Adler, Samuel	<i>The Study of Orchestration</i>	1982/2002
Blatter, Alfred	<i>Instrumentation and Orchestration</i>	1997
Jacob, Gordon	<i>Orchestral Technique: A Manual for Students</i>	1982
Read, Gardner	<i>Style and Orchestration</i>	1979
Piston, Walter	<i>Orchestration</i>	1955
Forsyth, Cecil	<i>Orchestration</i>	1935

### Method

The authors and their research assistants thoroughly reviewed the treatises and catalogued all semantic descriptions of timbres and textures arising from combinations of instruments (i.e., two or more instruments sounding concurrently). Information captured for each entry included the descriptive terms used, the instruments involved, the numbers of instruments, and the number of instrument families. Where possible, each entry was catalogued according to the orchestral effects taxonomy developed by Goodchild, Soden, and McAdams (in prep), using categories such as blend, surface texture, stratification, and timbral contrasts. Information about register, dynamics, articulations and so forth was also captured, and will be analyzed in future stages of this research, along with the inclusion of descriptors mined from additional treatises.

Here we present the first stage of analysis, based primarily on conventional corpus linguistic measures and preliminary qualitative descriptions of the contents of our corpus. A more detailed statistical analysis will be the subject of a future paper.

## Results

From these six books, we extracted a total of 1288 instances (tokens) of semantic descriptions of timbres and textures arising from instrumental combinations, of which 545 were unique (types), resulting in a Type/Token Ratio of .42 (CTTR; a simple index of lexical diversity on 0–1 scale). Table 2 shows the top 43 semantic types in descending order by frequency (*f*), each of which had at least six tokens in this corpus. An additional 502 types appeared with five tokens or fewer.

Table 2: Top 43 most frequently occurring semantic descriptors for instrumental combinations.

descriptor	<i>f</i>	descriptor	<i>f</i>	descriptor	<i>f</i>	descriptor	<i>f</i>
reinforcing	40	warm	13	fresh	9	exciting	7
soft	38	bright	11	full	9	expressive	7
rich	37	colorful	11	heavy	9	penetrating	7
powerful	25	emphatic	11	sharp	9	subdued	7
brilliant	23	homogeneous	11	sonorous	9	intense	6
light	18	interesting	11	strengthening	9	interlocking	6
dark	17	loud	11	blending	8	nasal	6
beautiful	16	smooth	10	dominant	8	pulsating	6
prominent	16	balanced	9	ethereal	8	thickening	6
contrasting	15	clear	9	supportive	8	transparent	6
strong	13	deep	9	background	7		

A thorough comparison with the findings of Wallmark (2019) is beyond the scope of this short paper, but even at a glance, it is clear that the treatise authors do not simply apply the same descriptive vocabulary to timbral combinations as to individual timbres. Comparing the top 43 types from each study, there are 18 terms in common (*bright, brilliant, clear, dark, deep, expressive, full, heavy, intense, nasal, penetrating, powerful, rich, smooth, soft, sonorous, strong, warm*). Of the 25 remaining terms in the top 40 from our corpus, 14 specifically invoke combination, comparison, or multiplicity (*background, balanced, blending, colorful, contrasting, dominant, homogeneous, interlocking, prominent, reinforcing, strengthening, supportive, thickening, transparent*).

About half of the semantic descriptions were applied to generic accounts of multiple instruments with no number specified (e.g., “violins,” “strings”; see Table 3a). Those that did specify numbers of instruments followed a classic long-tail distribution, with descriptions of smaller combinations being generally higher in tokens and types. A similar pattern obtains for family representation (Table 3b), with 45% of descriptions referring to only one of the four families of standard orchestral instruments (strings, woodwinds, brass, percussion), and only 4% referring to all four. In both cases, lexical diversity increased as a function of the number of instruments/families involved in the orchestral combination.

Table 3a: Breakdown of corpus by # instruments.

# instruments	%	tokens	types	TTR
2	17.24	222	150	.67
3	10.02	129	88	.68
4	6.13	79	67	.85
5	5.59	72	54	.75
6	2.25	29	23	.79
7	1.40	18	16	.89
8	1.32	17	16	.94
9	2.02	26	25	.96
10	1.16	15	14	.93
11+	1.79	23	20	.87
not specified	51.09	658	352	.53

Table 3b: Breakdown of corpus by # families.

# families	%	tokens	types	TTR
1	44.71	494	271	.55
2	32.40	358	209	.58
3	18.91	209	130	.62
4	3.98	44	36	.82

Table 4 shows the types with five or more tokens for semantic descriptions involving 1–3 families (there were no types for 4 families with more than 3 tokens).

Table 4: Most frequently occurring descriptors per number of families

1 family		2 families		3 families	
descriptor	<i>f</i>	descriptor	<i>f</i>	descriptor	<i>f</i>
rich	17	reinforcing	14	reinforcing	9
soft	16	rich	14	powerful	7
reinforcing	13	soft	12	soft	6
powerful	12	light	8	beautiful	5
brilliant	8	brilliant	7	colorful	5
homogeneous	8	strengthening	6	dark	5
strong	8	warm	6	emphatic	5
beautiful	7	dark	5		
bright	7	dramatic	5		
expressive	7				
penetrating	7				
balanced	6				
sonorous	6				
contrasting	5				
dark	5				
dominant	5				
full	5				
interesting	5				
loud	5				
smooth	5				
warm	5				

Analyzing these descriptions in light of the orchestral effects taxonomy reveals interesting asymmetries of distribution. Although many perceptual effects can arise from combinations of orchestral instruments, a few seem to be disproportionately represented in this corpus (Table 5), which may indicate aesthetic priorities of the authors and/or the composers about whose works they were writing. *Blend*, defined as “the fusion of different sources of acoustic information into a more or less unified auditory event,” appears to be of singular importance. Although blend is only the third-most represented category, *timbral augmentation* and *timbral emergence* are sub-categories of blend, and *timbral heterogeneity* is the negation of blend, so 649 tokens (50.4% of the corpus) are blend-related. Also emphasized are musical layers and musical lines. *Stratification*, “groupings of events into strata of different prominence (e.g., foreground, middleground, background),” accounts for 20.4% of the corpus, and stream, stream segregation, and stream integration, which deal with groupings of sequential events into unitary musical patterns, account for 6.3% of the corpus.

Table 5: Breakdown of corpus by orchestral effects taxonomy

taxonomic category	<i>f</i>	%	taxonomic category	<i>f</i>	%	taxonomic category	<i>f</i>	%
timbral augmentation	284	22.0	surface texture	24	1.9	general contrast	8	0.6
stratification	263	20.4	stream integration	22	1.7	gradual reduction	5	0.4
blend	248	19.3	stream	16	1.2	sudden addition	4	0.3
timbral heterogeneity	77	6.0	gradual addition	14	1.1	sectional contrast	3	0.2
stream segregation	43	3.3	sudden reduction	13	1.0	timbral shifts	3	0.2
timbral emergence	40	3.1	antiphonal contrast	9	0.7	timbral echo	1	0.1

Table 6 shows the types with six or more tokens for the most represented taxonomic categories. Note the high count for *reinforcing* and the moderately high count for *supportive*, which are functional paraphrases of “timbral augmentation.”

Table 6: Most frequently occurring types per taxonomic category

timbral augmentation		stratification		blend	
reinforcing	29	light	13	rich	10
brilliant	8	soft	11	reinforcing	8
soft	8	prominent	8	powerful	7
emphatic	7	brilliant	6	soft	7
rich	7	beautiful	5	blending	6
supportive	6	dominant	5		

## Discussion

Before we even begin to analyze the specific instrumentations denoted in these semantic descriptions and the acoustical attributes to which they may correspond, a number of interesting observations may be made about the semantic conventions of instrumental combinations. There is substantial overlap between the terminology used by authors of orchestration treatises to describe individual instruments and their terminology for combinations, but there also appear to be substantial differences. Many new terms appear, often reflecting an intuitive awareness of perceptual grouping principles (Goodchild & McAdams, 2018; McAdams et al., in prep). Smaller combinations, along with those that do not specify a number of instruments, tend to receive more discussion than larger combinations; this holds true for both instruments and families. Of all the different perceptual effects that may arise from combining orchestral timbres, these authors seem to focus on blends, layers, and lines.

This study begins to address questions of great importance to musical experience that have received relatively little attention in the scholarship. We anticipate that a more thorough statistical analysis will yield many greater insights, and we hope that this corpus analysis will lay a foundation for future empirical studies.

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## References

- Adler, S. (2002). *The study of orchestration*, Third ed. New York: W.W. Norton and Company.
- Goodchild, M., & McAdams, S. (2018). Perceptual processes in orchestration. In A. Rehding & E. I. Dolan (eds.), *Oxford Handbook of Timbre*. New York: Oxford University Press.
- Harvey, J. (2000). Spectralism. *Contemporary Music Review*, 19(3), 11–14.
- Hasegawa, R. (2009). Gérard Grisey and the 'nature' of harmony. *Music Analysis*, 28(2-3), 349–71.
- McAdams, S., Goodchild, M., & Soden, K. (manuscript in preparation). *A taxonomy of perceptual effects of orchestration related to auditory grouping principles*.
- Saitis, C., & Weinzierl, S. (2019). The semantics of timbre. In K. Siedenburg, C. Saitis, S. McAdams, A. Popper, & R. Fay (eds.), *Timbre: Acoustics, Perception, and Cognition* (pp. 119–149). Springer Handbook of Auditory Research, vol 69. Springer, Cham.
- Wallmark, Z. (2019). A corpus analysis of timbre semantics in orchestration treatises. *Psychology of Music*, 47(4), 585–605.
- Zacharakis, A., & Pasiadis, K. (2016). Revisiting the luminance-texture-mass model for musical timbre semantics: A confirmatory approach and perspectives of extension. *Journal of the Audio Engineering Society*, 64(9), 636-645.