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Exploring the Influence of Sound Culture on Oboe Timbre:

A Pilot Experimental Study at the University of Montreal

Ravi Shankar Magno Viana Domingues[*], Caroline Traube[**]

Abstract
This study examines the influence of sound culture on the semantic classification of oboe timbre, comparing Brazilian and Québécois musicians. The research investigates how physical reed characteristics and cultural contexts shape timbral perceptions. An online perceptual test was conducted using seven oboe recordings, evaluated through the Verbal Attribute Magnitude Estimation (VAME) method. Participants rated the timbre along six semantic scales: strident, bright, clear, muffled, round, and dark. Statistical analysis revealed no significant differences between Brazilian and Québécois classifications, except for the adjective "dull" The findings indicate overall similarities in timbral descriptions across cultures, though certain stimuli exhibited notable perceptual differences. Further research with larger, more diverse samples is recommended.

Keywords: oboe timbre, sound culture, timbre semantics, timbral accent.

Explorando a Influência da Cultura Sonora no Timbre do Oboé: Um Estudo Experimental Piloto na Universidade de Montreal

Resumo
Este estudo explora a influência da cultura sonora na classificação semântica do timbre do oboé, comparando músicos brasileiros e quebequenses. A pesquisa investiga como os parâmetros físicos das palhetas e os contextos culturais moldam as percepções do timbre. Foi realizado um teste perceptivo online com sete gravações de oboé, utilizando o método de Estimativa da Magnitude dos Atributos Verbais (VAME). Os participantes avaliaram o timbre usando seis escalas semânticas (estridente, brilhante, claro, abafado, redondo, escuro). A análise estatística não revelou diferenças significativas entre as classificações de brasileiros e quebequenses, exceto para o adjetivo "opaco." Os resultados sugerem semelhanças gerais nas descrições de timbre entre as culturas, embora alguns estímulos tenham mostrado diferenças perceptivas notáveis. Recomenda-se mais pesquisas com amostras maiores e mais diversas.

Palavras-chave: timbre do oboé, cultura sonora, semântica do timbre, acento timbral.

[*] Université de Montréal, Universidade Federal da Paraíba - UFPB - João Pessoa, PB
Email: ravishankaroboe@gmail.com
https://orcid.org/0000-0002-5402-9226

[**] Université de Montréal - Québec, Canada
Email: caroline.traube@umontreal.ca
https://orcid.org/0000-0001-8250-1893
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Introduction

The oboe, a double-reed instrument with a distinctive timbre, holds a prominent place in the orchestra. Its timbre varies widely depending on numerous factors related to both the instrument and the performer. Mastering reed-making from raw cane is essential in oboist training, as the playing style and technique are directly influenced by the materials used and the type of reed scraping adopted.

Each oboist develops a unique sound profoundly shaped by their surrounding sound culture, spanning from academic training to professional practice. In this context, "sound culture" refers to a range of sounds, sound sources, and sound events established through shared practice traditions and occurring within social interactions or performance contexts (Keyes, 2003).

This study is part of an ongoing doctoral research project exploring the influence of sound culture on the semantics of oboe timbre. A plausible hypothesis is that musicians immersed in a specific sound culture develop a distinct "accent," representing both individual and collective expressions of that culture. This phenomenon has been observed in linguistics, such as in a study where a unique accent developed among researchers isolated in Antarctica for an extended period. The accent emerged through social interactions, leading to gradual adaptations in vocal production (Harrington et al., 2019).

Timbral accents are evident when musicians from a particular time and place share similarities in tone quality and playing style. Such similarities often reflect the guiding principles and methods—conscious or unconscious—shaped by their perception of timbre, which is itself influenced by their sound culture. While technical and tonal outcomes differ among musicians due to physiological variations (affecting aspects like breathing methods and embouchure) and individual experiences, underlying principles tend to remain consistent (Ledet, 1981). Ideas, techniques, and principles related to timbre production, reed-making, and musical phrasing are passed down from teachers to students over generations.

In the reed-making process, scraping is regarded by oboists as one of the most influential factors affecting sound production. Scraping involves removing the outer layer of cane and refining its fiber structure at specific points to optimize vibration in response to the player's breath. Oboe reed scraping generally falls into two primary styles: short scraping and long scraping (Ledet, 1981). These styles differ in reed length, cane thickness, mold dimensions, and design, with scrape length being a decisive factor (Salter et al., 2018). Typically, short-scrape reeds have a scraping length covering up to 45% of the total reed length, from the binding to the tip, whereas long-scrape reeds extend beyond this threshold (Domingues, 2018).

Beyond physical parameters, oboe literature—including reed-making manuals, methods, and books—describes the timbral "accent" of different scraping styles using various adjectives (Burgess et al., 2004; Ledet, 1981; Rose, 2017). However, this vocabulary often persists without critical evaluation to confirm whether these descriptive terms are genuinely linked to the physical attributes of different scraping styles.

This research builds on findings from Domingues (2018), which observed that the physical parameters of various scraping techniques influence an oboist's sound and articulation. The study also noted that the personal preferences and requirements of individual oboists shape their manipulation of musical parameters, impacting reed-making choices and final adjustments.

To examine the influence of sound culture on oboists' timbre perception, the musical environments of Quebec (Canada) and Brazil offer unique opportunities for comparison. These settings involve oboists using distinct reed-scraping techniques (short and long scraping) within varied musical institutions. Brazil's dominant European sound culture (primarily German) has led to a homogenization of timbre, often suppressing individual differences. In contrast, Quebec benefits from the coexistence of both short and long scraping techniques, resulting in a broader range of timbral characteristics.

Poulin (2024) notes that Quebec is particularly interesting for research due to the diversity of sonic profiles among its oboists. Musicians from different schools and aesthetic backgrounds frequently collaborate within local orchestras. In Brazil, while both scraping styles are present, Mota (2017) observes that Brazilian oboists typically favor the "German sound" or "European sound," likely influenced by the significant presence of European musicians during the early development of Brazilian orchestras. The ongoing involvement of German oboists, such as George Meerwein, Ingo Goritsky, and Manfred Klement, at music festivals has also encouraged Brazilian oboists to specialize in Germany.

It is noteworthy that the prevailing sound culture in Brazil has also affected American scrape reed-making, with adaptations made to align with local timbral preferences. As Mota (2017) highlights, American scrape characteristics must often be adjusted to meet the timbral demands of Brazilian musical settings.

The primary objective of this research is to determine whether the semantic classification of oboe timbre differs across cultural contexts. This pilot study was developed and conducted during the Music Psychoacoustics course at the Faculty of Music, Université de Montréal.

Through the findings of this pilot study, we aim to assess the questionnaire and perception test's effectiveness to refine them for broader use in ongoing doctoral research.

The Semantics of Timbre

While timbre may seem like an intuitive concept, it actually represents a complex set of auditory attributes extending beyond traditional factors like frequency, intensity, duration, spatial position, and acoustic environment (McAdams et al., 2019). Timbre is a rich, multifaceted sensory dimension, yet its description is often constrained by a limited vocabulary, restricting our ability to fully capture its complexity and diversity (Wallmark, 2022). Musicians, for instance, employ a broad range of adjectives derived from different sensory modalities to describe the color, quality, or timbre of sounds (Traube, 2015).

Over recent decades, several researchers have investigated the semantic representations of timbre. Two prominent approaches are the Semantic Differential (SD), where sounds are evaluated on categorical scales with opposing verbal attributes like sharp-smooth, rough-smooth, or focused-diffuse, and Verbal Attribute Magnitude Estimation (VAME), where subjects assess the extent to which a stimulus embodies a particular attribute (e.g., "not bright" to "bright") (Saitis & Weinzierl, 2019).

Numerous studies have contributed to developing methodologies for analyzing timbre semantics, employing diverse techniques for perceptual evaluation and exploration. One of the earliest studies, by von Bismarck (1974), examined the descriptive dimensions of timbre using 35 auditory stimuli, including synthetic and complex harmonic sounds. Through semantic differential scales with 30 adjective pairs (such as round-angular and dark-bright), evaluated by musicians and non-musicians, four main axes were identified to describe almost all timbres: dull-bright, compact-dispersed, full-empty, and colored-colorless.

Building on this, Pratt & Doak (1976) formulated a subjective timbre evaluation scale using six synthetic sounds. With binary descriptors like dull/bright, pure/rich, and cold/warm, six participants rated sounds on continuous scales, revealing that the dull/bright scale offered the highest reliability, underscoring its importance in timbre description.

In subsequent research, Gabrielsson & Sjögren (1979) explored perceived sound quality in different reproduction systems, such as loudspeakers, headphones, and hearing aids. By combining similarity scales and free verbal descriptions, the study examined 60 adjectives capturing dimensions like clarity/distinction, brightness/darkness,

and spatial sensation, showing how the reproduction medium affects timbre perception.

In the 1990s, Kendall & Carterette (1993a, 1993b) expanded the analysis of similarities between the timbres of wind instruments, using both SD and VAME methods to evaluate pairs of wind instrument timbres. The first experiment applied eight binary adjectives (e.g., hard-soft, loud-soft) to 10 instrument pairs played by professional musicians, while the second phase increased the adjectives to 21, identifying four main factors explaining 86.34% of description variation: Power, Strident, Plangent, and Reed.

Later, Fitzgerald & Lindsay (2004) analyzed computational timbre descriptions using recordings of 24 isolated sounds performed by two oboists from different schools (British and American), applying the VAME method to investigate how acoustic representations influence timbre semantics. The study emphasized the need for multiple acoustic representations when examining the relationship between perceptual and computational descriptors.

Adding a new perspective, Zacharakis et al. (2014) studied the influence of native language on timbre description. Using 23 stimuli from acoustic and electric instruments, participants described sounds with 30 verbal descriptors, showing partial universality in timbre semantics while highlighting how linguistic differences influence perceptions of texture, brightness, and thickness.

In more recent research, Reymore (2021) explored timbral flexibility in a single instrument, specifically the oboe and English horn, using recordings of sustained notes across various registers and dynamics. Analysis across 20 qualia dimensions revealed significant timbre variations, with increased "brightness" in higher registers and a "woody" quality in lower ones.

In the same year, Zacharakis & Pastiadis (2021) examined how dynamic variations in inharmonicity impact the perception of qualities such as brightness, roughness, and tension. Using synthetic stimuli with different pitches and spectral forms, they found that inharmonicity affects both timbre semantics and perceived tension, underscoring the dynamic relationship between these variables.

Finally, Reymore et al. (2023) investigated semantic associations of timbre across different instruments and registers, using recordings of eight instruments, including the oboe, and applying the VAME method with 540 participants. Results highlighted that instrument type and fundamental frequency significantly influence timbre semantic associations, reflecting the intricate relationships instruments hold with tessitura and the complexities of semantic description in creative and research settings.

This trajectory of studies illustrates the evolution of timbre semantics analysis methodologies, from early differential scales to more nuanced methods like VAME, which deepen our understanding of timbre's perceptual descriptions across diverse instrumental and linguistic contexts.

In the specific case of oboe timbre semantics, Reymore (2021) noted certain trends associated with the instrument's various registers and dynamics. The dimensions most consistently classified across all registers and dynamics of the oboe include nasal, sustained, vibrant, compact, clear, and open. Within these general trends, oboists produce a range of tonal colors by manipulating musical parameters (e.g., pitch, intensity, articulation style) (Reymore, 2021) and the physical attributes of their instruments (Saitis et al., 2012). These variations are essential for conveying expressiveness and are shaped by the cultural contexts in which performers are trained, notably within interpretive schools that establish both a style and a timbral culture (Pototskaya, 2018; Wisniewski, 2016).

The role of perceptual and cognitive factors in establishing a timbral culture with distinct "accents" is significant, as musical systems evolve to align with the structural and functional characteristics of learners' sensory and memory systems over successive generations (Lumaca et al., 2018).

Our brains link auditory stimuli with emotional values and are responsible for physiological responses, such as chills, perceived as indicators of pleasure (Salimpoor et al., 2011). Studies suggest that musical compositions most likely to elicit pleasure are those that balance familiarity (predictable elements) with complexity (unexpected surprises) (Chmiel & Schubert, 2017; Gebauer et al., 2012; Gold et al., 2019; Van Den Bosch et al., 2013). Familiarity and complexity are closely tied to our learning processes and depend on factors like individual exposure to a work or genre, cultural context, personal interests, and perhaps exposure to a specific oboe timbre.

Methodology

Data collection was conducted in two distinct phases. Consequently, the materials and methods are described separately for each context analyzed.

First Study

Participants

The first perception test was administered to 73 native Portuguese speakers, including students and faculty from the music departments of three Brazilian universities. To ensure a specialized sample, participants were selected based on their instrumental training and professional background, comprising 22 undergraduate students, 12 graduates, 10 specialists, 20 master's degree holders, and 20 doctoral degree holders. They represented a diverse instrumental profile: 12 oboists, 22 woodwind players, 5 brass players, 18 string players, 12 pianists, 2 conductors, 1 composer, and 1 singer. This approach enabled us to gather insights not only from oboists but also from a wide range of musicians regarding oboe sound.

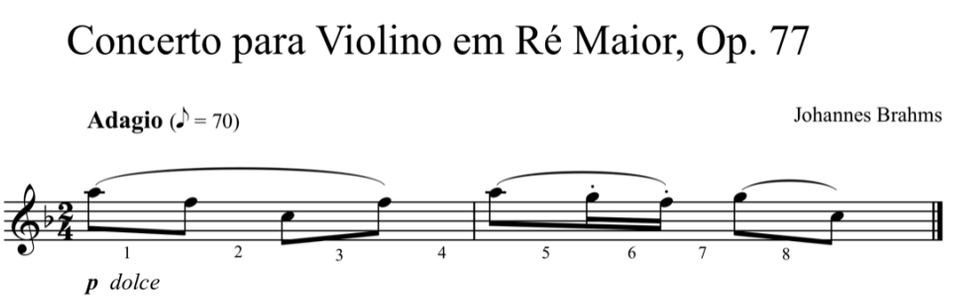
Materials

Auditory Stimuli: The perceptual test was based on recordings of the oboe solo from Johannes Brahms' *Violin Concerto in D Major, Op. 77*, performed by professional oboists. A total of 21 professional oboists from Brazil (14), Uruguay (1), the United States (2), Canada (1), and Europe (3) were recorded during the first international meeting of the Brazilian Double Reed Association. Some participants were recorded later due to scheduling conflicts with the event.

This excerpt was chosen due to its significance as one of the most frequently requested solos in orchestral auditions, allowing for the assessment of intonation, phrasing, dynamic flexibility, as well as the homogeneity and timbral characteristics of the oboists.

Figure 1

Excerpt from the oboe solo in the second movement of the Violin Concerto in D major, Op. 77 by J. Brahms.



The recordings took place in the studio at the Center for Communication, Tourism, and Arts (CCTA) at the Federal University of Paraíba (UFPB), Brazil. Audio was captured using a Zoom Q3 HD recorder, with a sampling frequency of 44,100 Hz.

Each oboist used their own instrument and reeds. All performers were seated, with the microphone positioned 60 cm from the oboe bell. The sheet music for the selected excerpt, along with a metronome, was provided on a nearby stand to assist the oboists in maintaining the intended tempo.

Oboists were asked to choose three reeds from their available selection. These reeds were then numbered for identification and categorized according to the performers' evaluations as either good (effective) or less good (less effective) for performing the excerpt.

After a preparation period that included an explanation of the procedures, instrument assembly, and reed moistening, the musicians performed the excerpt three consecutive times. Participants were given the option to repeat any of the performances if needed.

For the perceptual test, we selected the third recording made with a "good" quality reed, as this was typically the performance with no musical issues that could compromise data analysis.

Semantic Scales

After the recording sessions, all participants were asked to complete an open-ended questionnaire to collect data on the instruments (brand and model) and reeds used during the recording (brand, model, material, and tube size; brand, diameter, thickness, and density of the cane; mold used), as well as measurements of the reeds used for the performance.

This questionnaire also aimed to gather information about participants' perceptions of the relationship between the physical parameters of the reeds and musical parameters such as sound quality. The following information was collected:

- Characteristics of a "good" reed, as defined by the participants.
- The importance attributed to the reed in musical performance.
- Concepts/adjectives used to describe oboe sound or reed timbre.
- Adjustments made to tailor the reed's timbre to meet the oboist's expectations.
- References to other oboists in terms of sound quality.

Following data analysis from the questionnaire, a list of three bipolar axes was established, along with six adjectives frequently used by oboists to describe oboe timbre: strident – round, bright – dull, and clear – dark.

Procedure

The test was administered both individually and in groups, depending on the availability of the listeners. For stimulus playback, we used a portable JBL CHARGE 3 Bluetooth speaker, with a frequency response of 65 Hz to 20 kHz. The volume was adjusted based on the room's acoustics and the number of participants, ensuring listeners were positioned as close as possible to the sound source.

Due to the flexibility of certain participants who regularly play with both short and long scrape reeds in their musical activities, a total of 25 stimuli were organized. This was because three participants played with both short and long scrape reeds, and one participant, in addition to using short scrape Arundo Donax reeds, also used a short scrape reed made from synthetic material.

Each group of stimuli was played twice consecutively and independently for the listeners. The entire test took approximately 20 minutes to complete.

Participants were provided with answer sheets, which included a brief description of the research objectives, procedures, and instructions for completing the test. In addition to the multiple-choice section, there was space for additional comments on each grouping (free response).

During the instructions for the subjective perception test, it was emphasized that listeners were not required to use any of the suggested adjectives to classify the oboists' timbre and articulation. Instead, they were encouraged to rely solely on their own impressions.

Second Study (Pilot Test)

The test was conducted online using Microsoft Forms and was divided into two parts. The first part consisted of a sociodemographic questionnaire, and the second part involved a perceptual test.

The questionnaire aimed to collect the following information: country of origin, native language, duration of musical training, field of specialization, primary instrument, experience with the oboe, and terms used to describe timbre.

Participants

For this pilot online test, 8 students from the psychoacoustics courses (MUS3321 and MUS6321 – A - H24) at the Faculty of Music, Université de Montréal, participated. All participants were native French speakers. The average age was 29.6 years (range: 23–44, SD = 8), with an average of 9.3 years of musical training (range: 2–20, SD = 7.6).

Most participants (5) were enrolled in undergraduate programs, primarily focusing on digital music and musicology. Two participants were in graduate-level musicology (master's), and one was in a doctoral composition program. All participants had instrumental experience: three were string players, two were wind players, two were singers, and one was a percussionist. None of the participants reported having played the oboe during their musical training.

Materials

For the auditory stimuli, we used recordings of the oboe solo from Johannes Brahms' *Violin Concerto in D Major, Op. 77*, performed by seven professional oboists from Brazil, Uruguay, the United States, Canada, and Europe.

Of the 25 stimuli produced for the first study, only the most representative stimuli for each of the six semantic scales were selected for the second study. To evaluate potential intercultural variation between oboists and non-oboists, an additional stimulus was included—this stimulus was more frequently described by Brazilian oboists as "brilliant."

The presentation order of the stimuli was randomized, and participants were not informed of the results from the first study.

Semantic Scales

To explore different methodologies for the semantic description of oboe timbre, we employed the Verbal Attribute Magnitude Estimation (VAME) method (Reymore, 2021). Six semantic scales were used, based on the adjectives most frequently used to describe timbre by the oboists who recorded the excerpts in the first study: strident, brilliant, clear, dull, round, and dark (Domingues, 2018).

Table 1
Best-rated stimuli for each semantic scale.

Stimuli	Semantic scale
S1	Strident
S2	Dull
S3	Round
S4	Bright
S5	Clear
S6	Bright
S7	Dark

Procedure

Details about their musical background, participants were instructed to access the stimuli to begin the perception test. They were asked to use circumaural headphones during the experiment.

After listening to each of the seven stimuli, participants rated the oboists' timbre using six semantic scales ranging from 1 to 7, where 1 indicated "does not describe at all" and 7 indicated "describes extremely well." The experiment took an average of 22 minutes to complete (SD = 13.5).

Results

To investigate whether sound culture could influence the perception and classification of oboe timbre, this study focused on a comparative analysis of the primary representatives of six semantic scales, comparing the classifications made by Brazilian musicians with those of French-speaking musicians for the same stimuli.

In analyzing the terms used by French-speaking musicians to describe the timbre of a musical instrument, notable similarities were observed with the vocabulary used by Brazilian oboists. Except for the term " dull", all five other adjectives were mentioned by at least one French-speaking musician. The term "brilliant" was cited most frequently (5 times), followed by "round" (3 times), "clear" and "dark" (2 times each), while "strident" was mentioned only once.

For statistical analyses, IBM© SPSS© Statistics software, version 21 for Windows (IBM Corp., Armonk, NY, USA), was used. The association between variables was tested using Fisher's exact test, with significance levels set at 5% (p-value < 0.05).

To facilitate data analysis across different types of semantic tests, the various semantic scales were reduced to two conditions: yes (the scale represents the perception of the stimulus) or no (the scale does not represent the perception of the stimulus).

For the data obtained from the Semantic Differential (SD) test, the number of positive responses for an adjective was classified as "yes," while the remaining responses were classified as "no." For example, Stimulus 1 (S1) was classified as "strident" 50 times (yes), while the remaining 23 responses were classified as "not strident" (see Table 2).

For data collected during the pilot test using Verbal Attribute Magnitude Estimation (VAME), which used a 1-to-7 scale to rate the stimuli, the scale was divided into two categories: ratings from 1 to 4 were considered to mean that the scale did not represent the perception of the stimuli, while ratings from 5 to 7 were considered representative. Thus, five French-speaking musicians considered the adjective "stri-

dent" to be representative for describing their perception of S1 (see Table 2).

Table 2

Comparative analysis of semantic classification performed by Brazilian and French-speaking musicians.

Stimuli	Yes		No		χ^2
	n	%	n	%	p-value
Clear – stimulus S5					
Brazil	39	53.4	34	46.6	0.91
Montreal	5	62.5	3	37.5	
Round					
Brazil	44	60.3	29	39.7	0.84
Montreal	4	50.0	4	50.0	
Strident					
Brazil	50	68.5	23	31.5	0.99
Montreal	5	62.5	3	37.5	
Dull					
Brazil	28	38.4	45	61.6	0.28
Montreal	1	12.5	7	87.5	
Bright – stimulus S4					
Brazil	21	28.8	52	71.2	0.13
Montreal	5	62.5	3	37.5	
Bright – stimulus S6					
Brazil	30	41.1	43	58.9	0.90
Montreal	4	50.0	4	50.0	
Dark					
Brazil	21	28.8	52	71.2	0.60
Montreal	1	12.5	7	87.5	

As shown in Table 2, there was no statistically significant difference between the classifications made by Brazilian and French-speaking musicians for the analyzed stimuli.

However, when examining the semantic dimension of clarity for Stimulus 2 (S2), which was most representative of the adjective "dull" among Brazilian musicians, a significant difference was observed compared to French-speaking musicians (see Table 3).

Table 3

Comparative analysis of semantic classification performed by Brazilian and French-speaking musicians for Stimulus S2.

Stimulus			Non		χ^2
	n	%	n	%	p-value
Clear (S2)					
Brazil	14	19.2	59	80.8	**0.004**
Montreal	6	75.0	2	25.0	

In the first study, an analysis was conducted on data extracted from the audio signal of the recording, utilizing six acoustic descriptors from the EXPAN interface: spectral centroid, spectral flatness, spectral irregularity, attack duration, articulation index, and legato index (CAMPOLINA; LOUREIRO; MOTA, 2009). Comparative analysis between the acoustic data and subjective aural tests revealed that the semantic scale used was effective. The descriptors "light" and "bright"

were associated with higher spectral centroid values, while the descriptor "dull" correlated with lower spectral centroid values, shorter attack duration, and a higher articulation index.

The descriptors "dark" and "round" were associated with lower values of attack duration, spectral centroid, flatness, and spectral irregularity, alongside larger legato index values. Stridency in the sonority of certain oboists corresponded with higher flatness and spectral irregularity values, as well as a lower linearity between these values.

Notably, Stimulus 2 (S2), considered duller in Study 1, exhibited lower spectral centroid and spectral irregularity values compared to S15L. Additionally, the homogeneity and continuity of spectral descriptor values across certain notes may have influenced this classification.

Conclusion

The aim of this study was to investigate whether the semantic classification of oboe timbre varies across cultural contexts. The data analyzed in this pilot study indicate similarities in the verbal attributes used by Brazilian and French-speaking musicians to describe oboe timbre. However, comparative analysis associating different verbal attributes with the stimuli suggests that, in some cases, there may be significant perceptual differences among musicians from diverse musical backgrounds, as shown in Table 3.

One factor that may have influenced the results is the small sample size of French-speaking musicians, which limited the potential for more robust analyses. Future studies should include a larger number of participants from different sound cultures to enable more comprehensive analyses.

Although all participants were either studying or had at least an undergraduate degree in music-related fields and possessed consistent musical training likely influencing their perceptual abilities, the study did not include oboists. Oboists might have identified and classified nuances in the stimuli differently, given their expertise in manipulating and perceiving acoustic parameters for musical performance.

The results of this pilot study allowed for an evaluation of the questionnaire and perception test, helping refine them for use in my doctoral dissertation. The questionnaire effectively gathered information on musical training, country of origin, and native language, enabling grouping of participants based on their native language (Portuguese-speaking and French-speaking musicians). However, to better understand how sound culture influences oboe timbre percep-

tion, it will be necessary to identify which types of stimuli are commonly associated with the semantic scales used to describe timbre in different contexts.

Regarding the perception test, the feasibility of conducting the perceptual test online was demonstrated. However, a review of the literature led us to consider developing new strategies and tools, such as the GlistenIQ experimental design platform, to optimize data collection.

Analyzing data from different semantic tests emerged as one of the primary areas for refinement in future studies. We believe that the lack of statistical significance observed may be attributed to the type of responses obtained through the various tests. Therefore, to further explore the current data, it will be necessary to identify statistical tests capable of supporting this approach.

As observed in previous studies on timbre semantics (Table 1), Semantic Differential (SD) methods have proven less effective than Verbal Attribute Magnitude Estimation (VAME). Future tests will likely utilize VAME, as it allows for a more nuanced identification of musicians' perceptions, better database organization, and easier data analysis.

Additionally, while subjective evaluation is straightforward, it presents certain challenges, such as vague definitions, lack of clear opinion scales, and response bias. The use of acoustic descriptors may help mitigate these issues by supplementing objective data and achieving greater semantic stability, given that adjectives can carry different meanings across contexts. Future studies will aim not only to restructure the current methodology but also to explore other forms of data analysis, including the use of acoustic descriptors to further our understanding of oboe timbre perception in different sound cultures.

The findings from this and other studies suggest a certain degree of homogeneity in timbre semantics across cultures. However, further investigation with a larger sample size and the inclusion of oboists from diverse musical backgrounds may provide a deeper understanding of this phenomenon and allow for a more comprehensive testing of the hypothesis that timbre perception is influenced by the sound culture in which musicians are immersed.

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