Statistical analysis of the survey results (Study two)

This document presents the statistical tests performed on the answers for the survey of study 2. All the translations of the descriptions are presented in the supplementary file, 'translations/all_translations.docx'.

Tables 1, 2, 3 and, 4 present the tests results for the descriptions of the four attributes. In addition, we give some details on the nature of the tests, the criterion for selecting the descriptions based on the tests results, and the choice made regarding the management of multiple comparisons. The English translations of the French descriptions were formulated by the authors.

Statistical tests
In the tables, the columns ***Familiarity*** and ***Relevance*** group the results of two Chi-squared tests (χ^2) evaluating the familiarity (question 1) and the relevance (question 2A) of a description with the test value and p-value. The third column presents the test for ***tendencies*** on Likert scales (question 2B). It is a Wilcoxon signed-rank test (T, p), with an assessment of the sign of the tendency on Likert scales (sign) and an estimate of the effect size by calculating a pseudo-median (Mdn).

Selection of descriptions
The three tests were performed for each sentence in the corpus with R. Following the order of the questions, if a description was not significantly familiar, relevant, or with a clear tendency, then it was discarded. For example, the description *fermé* (closed) for bright was not considered significantly familiar and was therefore rejected. On the other hand, the description *résonant* (resonant) was found to be significantly familiar but also not significantly relevant and was therefore discarded.

Italicized p-values for familiarity and relevance tests mean that the description was rated as significantly unfamiliar or irrelevant.
For example, the description *court* (short) for bright was evaluated as significantly irrelevant (p=.001).

Note on multiple comparison
For each description we performed three tests for the three questions that allow to filter the descriptions sequentially with regards to:
1. Familiarity
2. Relevance
3. Tendency

Therefore, a description with a p-value below an alpha level of .05 for all three tests would be equivalent to an overall p-value being below a alpha level resulting of the product of the three test alpha levels ($.05^3=.0001$). The probability of type 1 error is therefore very low.
If we applied a Bonferroni correction to those alpha levels, the chances of type 1 errors would remain very low. For instance, the most numerous descriptions concerned roundness.

$$\alpha_{corrected} = 68*.05^3$$
$$= 0.009 \ (<.05)$$

The p-values of the selected descriptions are below the criterion of .05. Therefore, no correction was applied for the selection of the descriptions.

TABLE 1. BRIGHT *BRILLANT*

Phrase	χ^2 (2, N=51) *Familiarity*		χ^2 (2, N=51) *Relevance*		Wilcoxon signed-rank test *Tendency*			
	χ^2	p	χ^2	p	T	p	sign	Mdn
closed *fermé*	1.58	.208						
resonant *résonant*	47.08	**<.001**	0.49	.110				
with a soft attack *avec une attaque douce*	51.0	**<.001**	0.96	.327				
with little precision/definition *avec peu de précision/définition*	43.31	**<.001**	18.84	**<.001**	23.0	**<.001**	-	1.5
soft *doux*	39.71	**<.001**	21.35	**<.001**	47.0	**<.001**	-	2.0
with a lot of high harmonics *avec beaucoup d'harmoniques aigus*	43.31	**<.001**	32.96	**<.001**	899.0	**<.001**	+	5.0
low *grave*	51.0	**<.001**	4.41	**.036**	29.50	**<.001**	-	1.5
matte *mat*	51.0	**<.001**	21.35	**<.001**	0	**<.001**	-	1.0
round *rond*	51.0	**<.001**	24.02	**<.001**	116.0	**<.001**	-	1.5
short *court*	39.71	**<.001**	10.37	***.001***				
medium *medium*	1.40	**<.001**	7.80	**.008**	63.0	**.001**	-	2.0
warm *chaud*	47.08	**<.001**	16.50	**<.001**	68.0	**<.001**	-	1.5
high-medium *médium-aigu*	43.31	**<.001**	16.49	**<.001**	447.0	**<.001**	+	4.0
with a lot of harmonics *avec beaucoup d'harmoniques*	51.0	**<.001**	29.82	**<.001**	818.0	**<.001**	+	4.5
with attack *avec de l'attaque*	39.70	**<.001**	0.96	.327				
dull *sourd*	43.31	**<.001**	29.82	**<.001**	0	**<.001**	-	1.0
with a lot of low harmonics *avec beaucoup d'harmoniques graves*	36.25	**<.001**	16.49	**<.001**	70.0	**<.001**	-	1.5
pure *pur*	39.70	**<.001**	0.49	.484				
with little attack *avec peu d'attaque*	39.70	**<.001**	2.37	.123				
metallic *métallique*	51.0	**<.001**	26.84	**<.001**	560.0	**<.001**	+	4.0
with little harmonics *avec peu d'harmoniques*	51.0	**<.001**	21.35	**<.001**	40.0	**<.001**	-	1.5
low-medium *bas-médium*	43.31	**<.001**	4.41	**.036**	9.0	**<.001**	-	1.5
rough *rugueux*	36.25	**<.001**	0.18	.674				

BRIGHT

Phrase	χ^2	p	χ^2	p	T	p	sign	Mdn
wooden *boisé*	32.96	**<.001**	3.31	.069				
with a posed attack *avec une attaque posée*	0.96	0.327						
muffled *étouffé*	51.0	**<.001**	39.70	**<.001**	0	**<.001**	-	1.0
with a clear attack *avec une attaque franche*	51.0	**<.001**	0.49	.484				
with clarity in the attack *avec de la clarté dans l'attaque*	43.31	**<.001**	3.31	.069				
dark *sombre*	24.01	**<.001**	21.35	**<.001**	0	**<.001**	-	1.0
high *aigu*	51.0	**<.001**	12.25	**<.001**	459.50	**<.001**	+	4.0
with little high harmonics *avec peu d'harmoniques aigus*	43.31	**<.001**	29.82	**<.001**	58.50	**<.001**	-	1.5
that stands out *qui ressort*	12.25	**<.001**	0.49	.484				
with a precise attack *avec une attaque précise*	51.0	**<.001**	0.02	.889				
loud *fort*	39.70	**<.001**	2.37	.123				
piano/pianissimo	51.0	**<.001**	0.18	.674				
with shine *avec de l'éclat*	21.35	**<.001**	21.35	**<.001**	861.0	**<.001**	+	4.5
with a dull attack *avec une attaque molle*	43.31	**<.001**	0.18	.674				
with projection *avec de la projection*	18.84	**<.001**	0.02	.889				
with impact *avec de l'impact*	12.25	**<.001**	2.37	.123				
with clarity of articulation *avec une clarté d'articulation*	12.25	**<.001**	2.37	.123				
inharmonic *inharmonique*	14.29	**<.001**	4.41	***.036***				
clear *clair*	51.0	**<.001**	32.96	**<.001**	739.50	**<.001**	+	4.2
dull *terne*	26.84	**<.001**	18.84	**<.001**	0	**<.001**	-	1.0
with clarity *avec de la clarté*	47.08	**<.001**	29.82	**<.001**	848.50	**<.001**	+	4.5
velvety *feutré*	39.70	**<.001**	26.84	**<.001**	0	**<.001**	-	1.0

TABLE 2. WARM *CHAUD*

Phrase	χ^2 (2, N=51) *Familiarity*		χ^2 (2, N=51) *Relevance*		Wilcoxon signed-rank test *Tendency*			
	χ^2	p	χ^2	p	T	p	sign	Mdn
comfortable *confortable*	10.37	**.001**	4.41	.036	0485	**<.001**	+	4.5
with little high harmonics *avec peu d'harmoniques aigus*	43.31	**<.001**	24.01	**<.001**	349.0	.172		
unpleasant *désagréables*	29.82	**<.001**	1.59	.207				
generous *généreux*	18.84	**<.001**	14.29	**<.001**	703.0	**<.001**	+	4.0
with a dense timbre *avec un timbre dense*	29.82	**<.001**	4.41	**.036**	332.0	**<.001**	+	4.0
loud *fort*	32.96	**<.001**	14.29	***<.001***				
with a loud attack *avec une attaque forte*	39.70	**<.001**	3.31	.069				
piano	43.31	**<.001**	10.37	***.001***				
low *grave*	51.0	**<.001**	5.67	**<.001**	304.0	**<.001**	+	4.0
sharp / net *net*	21.35	**<.001**	1.59	.208				
with a lot of low harmonics *avec beaucoup d'harmoniques graves*	39.71	**<.001**	21.35	**<.001**	570.0	**<.001**	+	4.0
wide *large*	36.25	**<.001**	4.41	**<.001**	331.0	**<.001**	+	4.0
with clarity *avec de la clarté*	32.96	**<.001**	7.08	**.008**	82.0	**.003**	-	2.0
with a hard attack *avec une attaque dure*	39.71	**<.001**	0.49	.484				
expressive *expressif*	8.65	**<.001**	0.18	.674				
with little harmonics *avec peu d'harmoniques*	51.0	**<.001**	18.84	**<.001**	52.5	**<.001**	-	2.0
mezzoforte-forte	51.0	**<.001**	12.25	***<.001***				
that emit breadth *qui dégage de l'ampleur*	18.84	**<.001**	2.37	.123				
high *aigu*	51.0	**<.001**	10.37	**<.001**	0	**<.001**	-	1.5
with low frequencies in the attack *avec du grave dans l'attaque*	26.84	**<.001**	0.49	.484				
breathing *avec du souffle*	43.31	**<.001**	0.49	.484				
with a lot of high harmonics *avec beaucoup d'harmoniques*	47.08	**<.001**	26.84	**<.001**	49.50	**<.001**	-	2.0
that vibrates *qui vibre*	21.35	**<.001**	0.96	.327				

WARM Phrase	χ^2	p	χ^2	p	T	p	sign	Mdn
hard *dur*	29.82	**<.001**	10.37	**.001**	0	**<.001**	-	1.0
narrow in frequency *resserré en fréquence*	26.84	**<.001**	3.31	.069				
rich *riche*	39.71	**<.001**	12.26	**<.001**	465.0	**<.001**	+	4.5
full *plein*	39.71	**<.001**	24.02	**<.001**	665.5	**<.001**	+	4.0
with a lot of medium harmonics *avec bcp d'harmoniques médium*	39.71	**<.001**	21.35	**<.001**	360.0	**<.001**	+	4.0
with little low-medium harmonics *avec peu d'harmoniques bas-méd.*	32.96	**<.001**	12.26	**<.001**	60	**<.001**	-	2.0
with a lot of low-medium harmonics *avec bcp. d'harmoniques bas-méd.*	39.71	**<.001**	16.49	**<.001**	691.0	**<.001**	+	5.0
not vibrated *non vibré*	16.49	**<.001**	2.37	.123				
without variation *sans variation*	24.02	**<.001**	5.67	***.017***				
pleasant *agréable*	32.96	**<.001**	18.24	**<.001**	728.5	**<.001**	+	4.5
with little low harmonics *avec peu d'harmoniques aigus*	39.70	**<.001**	14.29	**<.001**	50.5	**<.001**	-	1.5
metallic *métallique*	51.0	**<.001**	12.25	**<.001**	0	**<.001**	-	1.0
cold *froid*	18.84	**<.001**	5.67	**.017**	0	**<.001**	-	1.0
poor *pauvre*	36.25	**<.001**	4.41	**.036**	0	**<.001**	-	1.0
organic *organqiue*	8.65	**.003**	0.49	.484				
rough *rugueux*	39.71	**<.001**	.020	.889				
balanced *équilibré*	26.84	**<.001**	5.67	**.035**	153.5	.318		
brassy *cuivré*	47.08	**<.001**	16.49	**<.001**	237.0	.299		
pure *pur*	43.31	**<.001**	5.67	**.017**	35.0	**<.001**	-	1.5
smooth *lisse*	32.96	**<.001**	0.49	.888				
soft *doux*	36.25	**<.001**	24.02	**<.001**	585.5	**<.001**	+	4.0
with a presence *avec une présence*	5.67	**.017**	0.02	.889				
resonant *résonant*	47.08	**<.001**	4.41	**.036**	219.50	**.005**	+	4.0
with life *avec de la vie*	4.41	**.036**	0.96	0.33				
straight *droit*	0.49	.484						

WARM Phrase	χ^2	p	χ^2	p	T	p	sign	Mdn
aggressive *agressif*	43.31	**<.001**	16.49	**<.001**	6.50	**<.001**	-	1.5
a little rough *un peu rugueux*	39.71	**<.001**	0.49	.484				
with a soft attack *avec une attaque douce*	51.0	**<.001**	3.31	.069				
neutral *neutre*	0.96	.327						
sustained *entretenu*	32.96	**<.001**	2.37	.123				
bright *brillant*	51.0	**<.001**	29.82	**<.001**	106.0	**<.001**	-	2.0
medium-high *médium-aigu*	43.31	**<.001**	4.41	**.036**	34.0	**<.001**	-	2.0
stable *stable*	29.82	**<.001**	5.67	*.017*				
enveloping *enveloppant*	36.26	**<.001**	21.35	**<.001**	741.0	**<.001**	+	4.5
with little medium harmonic *avec peu d'hamroniques médium*	36.26	**<.001**	16.49	**<.001**	22.50	**<.001**	-	1.5
which gives a proximity sensation *qui donne une sensation de proximité*	24.02	**<.001**	0.18	.674				
distant *distant*	32.96	**<.001**	0.02	.889				
short *court*	32.96	**<.001**	8.65	*.003*				
defined *défini*	36.25	**<.001**	0.18	.674				
with a human touch *avec une dimension humaine*	1.59	.208						
low-medium *bas-médium*	36.25	**<.001**	12.26	**<.001**	493.50	**<.001**	+	4.0
medium *médium*	39.71	**<.001**	10.37	**.001**	267.0	**.006**	+	4.0
with a lot of harmonics *avec beaucoup d'harmoniques*	51.0	**<.001**	12.26	**<.001**	327.0	**.006**	+	3.5
with a wide spectrum *avec un spectre large*	39.70	**<.001**	8.65	**.003**	270.5	**.005**	+	4.0

TABLE 3. ROUND *ROND*

Phrase	χ^2 (2, N=51) *Familiarity*		χ^2 (2, N=51) *Relevance*		Wilcoxon signed-rank test *Tendency*			
	χ^2	p	χ^2	p	T	p	sign	Mdn
rich *riche*	43.31	**<.001**	8.65	**.003**	278.5	**.038**	+	3.5
little rich *peu riche*	32.96	**<.001**	8.65	**.003**	78.0	**<.001**	-	2.0
comforting *réconfortant*	10.37	**.003**	1.59	.208				
with a dry attack *avec une attaque sèche*	26.84	**<.001**	0.96	.327				
with a bouncy attack *avec une attaque rebondie*	0.02	.889						
with little attack *avec peu d'attaque*	43.31	**<.001**	4.41	**.04**	346.0	**.002**	+	4.0
hard *dur*	29.82	**<.001**	21.35	**<.001**	0	**<.001**	-	1.5
pleasant *agréable*	29.82	**<.001**	10.37	**.001**	561.0	**<.001**	+	4.5
high *aigu*	51.0	**<.001**	51.0	**<.001**	8	**<.001**	-	1.5
sour *aigre*	4.41	**.036**	0.17	.674				
uncomfortable *inconfortable*	10.37	**.001**	0.96	.327				
with emergin harmonics *avec des harmoniques qui ressortent*	36.25	**<.001**	5.67	**.017**	68.0	**.013**	-	2.0
with a resonance close to the f0 *avec une resonance proche de la f0*	18.84	**<.001**	2.37	.123				
homogeneous *homogène*	39.71	**<.001**	7.08	**.008**	433.5	**<.001**	+	4.0
noisy *bruité*	29.82	**<.001**	1.59	.208				
with little high harmonics *avec peu d'harmoniques aigus*	39.71	**<.001**	16.49	**<.001**	242.0	.332		
dry *sec*	32.96	**<.001**	8.65	**.003**	0	**<.001**	-	1.50
with a clear attack *avec une attaque franche*	47.08	**<.001**	0.96	.327				
with a lot of attack *avec beaucoup d'attaque*	47.08	**<.001**	7.08	**.008**	44.0	**<.001**	-	1.50
with a slow decrease *avec une décroissance lente*	29.82	**<.001**	10.37	***.001***				
piano	39.71	**<.001**	10.37	***.001***				
sharp *pointu*	0.96	.327						
brassy *cuivré*	47.08	**<.001**	2.37	.123				

ROUND Phrase	χ^2	p	χ^2	p	T	p	sign	Mdn
laid *posé*	1.59	.208						
with a clean attack *avec une attaque nette*	51.0	**<.001**	0.02	.889				
short *court*	43.31	**<.001**	0.490	.484				
with a lot of low harmonics *avec bcp. d'harmoniques graves*	36.25	**<.001**	24.02	**<.001**	509.0	**<.001**	+	4.0
with a soft decrease *avec une décroissance douce*	26.84	**<.001**	3.31	.069				
precise *précis*	14.29	**<.001**	0.18	.674				
with a lot of harmonics *avec bcp. d'harmoniques*	51.0	**<.001**	12.25	**<.001**	196.0	.438		
forte	51.0	**<.001**	8.65	***.003***				
unstable *instable*	21.35	**<.001**	0.02	.889				
with a dull attack *avec une attaque molle*	39.71	**<.001**	0.96	.327				
aggressive *agressif*	39.71	**<.001**	26.84	**<.001**	0	**<.001**	-	1.0
sustained *entretenu*	32.96	**<.001**	0.17	.674				
breathing *avec du souffle*	47.08	**<.001**	1.59	.208				
vibrating *qui vibre*	26.84	**<.001**	0.02	.886				
with a short envelope *avec une enveloppe courte*	7.08	**.02**	3.31	.069				
bright *brillant*	51.0	**<.001**	16.49	**<.001**	25.5	**<.001**	-	1.5
soft *doux*	39.71	**<.001**	24.02	**<.001**	725.0	**<.001**	+	4.0
resonant *résonant*	47.08	**<.001**	8.64	**.003**	329.0	**.001**	+	4.0
expressive *expressif*	10.37	**.003**	3.31	.069				
with a soft attack *avec une attaque douce*	51.0	**<.001**	8.64	**.003**	370.0	**.001**	+	4.0
pure *pur*	39.71	**<.001**	0.96	.327				
with low-medium spectral balance *avec un équilibre spectral bas-méd.*	21.35	**<.001**	7.08	**.008**	457.5	**<.001**	+	4.0
stable *stable*	32.96	**<.001**	0.49	.484				
with little low harmonics *avec peu d'harmoniques graves*	36.25	**<.001**	18.84	**<.001**	97.0	**<.001**	-	2.0
with a lot of medium-high harmonics *avec bcp. d'harmoniques méd.-aigu*	39.71	**<.001**	16.49	**<.001**	184.0	.054		

ROUND Phrase	χ^2	p	χ^2	p	T	p	sign	Mdn
low *grave*	47.08	**<.001**	7.08	**.008**	316.0	**<.001**	+	4.0
with a varying dynamic *avec une dynamique qui varie*	39.71	**<.001**	4.41	**.036**	16.5	**.002**	-	1.5
with a lot of low-medium harmonics *avec bcp. d'harmoniques bas-méd.*	39.71	**<.001**	21.35	**<.001**	674.0	**<.001**	+	4.0
smooth *lisse*	29.82	**<.001**	7.08	**.008**	223.0	**.012**	+	4.0
with a lot of high harmonics *avec beaucoup d'harmoniques aigus*	39.71	**<.001**	18.84	**<.001**	41.0	**<.001**	-	1.5
soft *doux*	4.41	.035	0.490	0.484				
with a precise attack *avec une attaque précise*	47.08	**<.001**	0.02	.887				
without asperities *sans aspérités*	18.84	**<.001**	10.37	**.001**	457.5	**<.001**	+	4.0
with a hard attack *avec une attaque dure*	43.31	**<.001**	4.41	**.046**	6.5	**<.001**	-	1.5
rough *rugueux*	36.25	**<.001**	8.65	**.003**	4.5	**<.001**	-	1.0
without noise *sans bruit*	5.67	**.051**	4.41	*.035*				
with a long attack *avec une attaque longue*	39.71	**<.001**	0.02	.887				
timbred *timbré*	29.82	**<.001**	8.64	**.003**	287.0	**.023**	+	3.5
screaming *criard*	36.25	**<.001**	24.02	**<.001**	0	**<.001**	-	1
metallic *metallique*	51.0	**<.001**	12.25	**<.001**	0	**<.001**	-	1
full *plein*	36.25	**<.001**	21.35	**<.001**	498.0	**<.001**	+	4.5
with little harmonics *avec peu d'harmoniques*	51.0	**<.001**	14.29	**<.001**	111.0	**.003**	-	2.0
low-medium *bas-médium*	32.96	**<.001**	14.29	**<.001**	502.0	**<.001**	+	4.0
wide *large*	29.82	**<.001**	5.67	**.017**	245.0	**.002**	+	4.0

TABLE 4. ROUGH *RUGUEUX*

Phrase	χ^2 (2, N=51) Familiarity		χ^2 (2, N=51) Relevance		Wilcoxon signed-rank test Tendency			
	χ^2	p	χ^2	p	T	p	sign	Mdn
that rasps *qui râpe*	16.49	**<.001**	16.49	**<.001**	771.0	**<.001**	+	4.5
friction *de frottement*	39.71	**<.001**	18.84	**<.001**	615.0	**<.001**	+	4.5
bright *brillant*	51.0	**<.001**	1.59	.208				
not spectrally pure *pas pur spectralement*	12.25	**.001**	0.96	.327				
organic *organique*	10.37	**.004**	5.67	***.017***				
with little attack *avec peu d'attaque*	47.08	**<.001**	5.67	***.017***				
with a lot of attack *avec beaucoup d'attaque*	47.08	**<.001**	1.59	.208				
with little harmonic *avec peu d'harmoniques*	47.08	**<.001**	0.02	.887				
resonant *résonant*	43.31	**<.001**	0.96	.327				
raw *brut*	8.64	**.007**	0.02	.887				
with parasites *avec des parasites*	43.31	**<.001**	14.29	**<.001**	564.5	**<.001**	+	4.0
rugged *accidenté*	2.37	.123						
round *rond*	47.08	**<.001**	18.84	**<.001**	7.0	**<.001**	-	1.5
sustained *entretenu*	32.96	**<.001**	2.37	.123				
harsh / bitter *âpre*	10.37	**.001**	8.65	**.003**	386.0	**<.001**	+	4.0
with frequency variations *avec des variations fréquentielles*	21.35	**<.001**	0.49	.483				
noisy *bruité*	32.96	**<.001**	5.67	**.017**	320.0	**<.001**	+	4.0
soft *doux*	39.71	**<.001**	10.37	**.001**	5.0	**<.001**	-	1.0
with little vibrations *avec peu de variations*	18.84	**<.001**	0.02	.887				
full *plein*	39.71	**<.001**	0.02	.887				
unstable *instable*	21.35	**<.001**	0.96	.327				
with pulses *avec des battements*	36.25	**<.001**	5.67	**.017**	177.5	.484		
stable *stable*	32.96	**<.001**	0.02	.887				
itchy *qui gratte*	5.67	**.035**	5.67	**.017**	457.0	**<.001**	+	4.5

ROUGH Phrase	χ^2	p	χ^2	p	T	p	sign	Mdn
with fast variations *avec des variations rapides*	24.02	**<.001**	0.18	.674				
smooth *lisse*	39.71	**<.001**	32.96	**<.001**	0	**<.001**	-	1.0
with grain *avec du grain*	43.31	**<.001**	36.25	**<.001**	848.0	**<.001**	+	4.5
with asperities *avec des aspérités*	24.02	**<.001**	21.35	**<.001**	848.5	**<.001**	+	4.5
that rubs *qui frotte*	29.82	**<.001**	21.35	**<.001**	693.5	**<.001**	+	4.5
aggressive *agressif*	43.31	**<.001**	2.37	.123				
pure *pur*	39.71	**<.001**	8.65	**.003**	42.0	**<.001**	-	1.5
with a harsh attack *avec une attaque âpre*	2.37	.123						
grainy *granuleux*	39.71	**<.001**	29.82	**<.001**	847.5	**<.001**	+	4.5
which gives an impression of non-homogeneous material *qui donne une impression de matière non-homogène*	7.08	**.008**	2.37	.123				

bcp. : beaucoup
méd. : médium