

Supplementary Material

A workflow and digital filters for correcting speed and equalisation errors on digitised audio open-reel magnetic tapes

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Supplementary Table 1

Descriptive statistics of Similarity ratings for each piece, separated by variant. Pieces are also split by Set (A, B, and C). Descriptive statistics are listed as M (SD), with the lowest possible rating as 1 and the highest possible rating as 100.

Set A (music stimuli, 7kHz Anchor, $n = 23$)					
Piece	Hidden reference	Foil	Anchor	Web API correction	Matlab correction
Shake it off	84.3 (13.7)	34.3 (17.3)	19.0 (20.7)	66.6 (20.9)	73.0 (18.3)
We will rock you	80.6 (18.9)	34.1 (18.7)	29.7 (20.5)	78.0 (16.2)	75.0 (25.6)
Continuo	64.9 (27.6)	41.5 (24.9)	38.3 (24.6)	65.0 (26.4)	58.7 (27.6)
Differences	79.9 (19.3)	49.5 (26.2)	49.3 (33.4)	74.0 (18.2)	72.7 (22.8)
Set B (voice stimuli, 3.5 kHz Anchor, $n = 21$)					
Piece	Hidden reference	Foil	Anchor	Web API correction	Matlab correction
Female voice 1	77.9 (17.8)	27.3 (20.8)	10.3 (10.8)	69.2 (19.4)	75.9 (19.3)
Male voice 1	79.3 (20.3)	31.3 (22.8)	15.8 (18.1)	64.2 (28.8)	69.3 (22.9)
Female voice 2	71.3 (22.4)	20.4 (16.2)	11.9 (15.6)	61.3 (26.7)	59.1 (24.3)
Male voice 2	74.5 (28.8)	30.2 (20.7)	16.2 (16.4)	66.7 (25.7)	68.1 (24.1)
Set C (music stimuli, 7kHz Anchor, $n = 21$)					
Piece	Hidden reference	Foil	Anchor	Web API correction	Matlab correction
Musica su due d.	76.0 (19.9)	67.0 (23.3)	56.1 (25.2)	64.3 (26.8)	70.1 (22.7)
Syntaxis	71.9 (18.7)	60.0 (26.1)	57.9 (23.2)	73.3 (20.3)	69.2 (22.6)
Save your tears	80.1 (16.2)	26.3 (18.7)	26.0 (20.0)	69.8 (19.7)	68.8 (21.7)
Hotel california	79.8 (15.6)	35.9 (22.7)	21.6 (26.3)	69.6 (23.2)	76.2 (22.5)

Supplementary Table 2

Results of Šidák–corrected post hoc results comparing Similarity ratings between the Hidden reference and other variants, for each piece in Sets A, B, and C. For cases that reach statistical significance at $p < .05$, the higher variant is italicised.

Set A (music stimuli)		
Piece	Variants compared	Significance
Shake it off	<i>Hidden reference – Foil</i>	$p < .001$
	<i>Hidden reference – Anchor</i>	$p < .001$
	<i>Hidden reference – Web API</i>	$p = .014$
	Hidden reference – Matlab	$p = .089$
We will rock you	<i>Hidden reference – Foil</i>	$p < .001$
	<i>Hidden reference – Anchor</i>	$p < .001$
	Hidden reference – Web API	$p > .999$
	Hidden reference – Matlab	$p = .881$
Continuo	<i>Hidden reference – Foil</i>	$p = .009$
	Hidden reference – Anchor	$p = .055$
	Hidden reference – Web API	$p > .999$
	Hidden reference – Matlab	$p = .991$
Differences	<i>Hidden reference – Foil</i>	$p = .001$
	<i>Hidden reference – Anchor</i>	$p = .005$
	Hidden reference – Web API	$p = .883$
	Hidden reference – Matlab	$p = .876$
Set B (voice stimuli)		
Piece	Variants compared	Significance
Female voice 1	<i>Hidden reference – Foil</i>	$p < .001$
	<i>Hidden reference – Anchor</i>	$p < .001$
	Hidden reference – Web API	$p = .576$
	Hidden reference – Matlab	$p > .999$
Male voice 1	<i>Hidden reference – Foil</i>	$p < .001$
	<i>Hidden reference – Anchor</i>	$p < .001$
	Hidden reference – Web API	$p = .433$
	Hidden reference – Matlab	$p = .402$

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Female voice 2	<i>Hidden reference – Foil</i>	$p < .001$
	<i>Hidden reference – Anchor</i>	$p < .001$
	Hidden reference – Web API	$p > .914$
	Hidden reference – Matlab	$p = .605$
Male voice 2	<i>Hidden reference – Foil</i>	$p = .001$
	<i>Hidden reference – Anchor</i>	$p < .001$
	Hidden reference – Web API	$p = .956$
	Hidden reference – Matlab	$p = .997$
Set C (music stimuli)		
Piece	Variants compared	Significance
Musica su due dim.	Hidden reference – Foil	$p = .899$
	Hidden reference – Anchor	$p = .186$
	Hidden reference – Web API	$p = .538$
	Hidden reference – Matlab	$p = .884$
Syntaxis	Hidden reference – Foil	$p = .552$
	Hidden reference – Anchor	$p = .450$
	Hidden reference – Web API	$p > .999$
	Hidden reference – Matlab	$p > .999$
Save your tears	<i>Hidden reference – Foil</i>	$p < .001$
	<i>Hidden reference – Anchor</i>	$p < .001$
	Hidden reference – Web API	$p = .376$
	Hidden reference – Matlab	$p = .293$
Hotel california	<i>Hidden reference – Foil</i>	$p < .001$
	<i>Hidden reference – Anchor</i>	$p < .001$
	Hidden reference – Web API	$p = .329$
	Hidden reference – Matlab	$p = .999$

Supplementary Table 3

Descriptive statistics of additional variables (Familiarity, Complexity, Unusualness, Task difficulty, and Time spent on each page) split by Piece and Set. Time is measured in seconds. Descriptive statistics are listed as M (SD), with the lowest possible rating as 1 and the highest possible rating as 100. N.B. that Familiarity, Complexity, Unusualness ratings were not collected for Set B as these variables are not relevant to speech stimuli.

Set A (music stimuli, 7kHz Anchor, n = 23)					
Piece	Familiarity	Complexity	Unusualness	Task difficulty	Time
Shake it off	72.0 (33.8)	29.7 (16.5)	23.2 (20.9)	37.1 (17.9)	155.1 (91.9)
We will rock you	91.8 (15.6)	35.3 (24.0)	18.0 (22.9)	41.6 (21.2)	164.2 (115.8)
Continuo	21.1 (26.4)	67.5 (22.8)	76.7 (22.5)	66.8 (19.8)	158.0 (115.8)
Differences	39.7 (32.5)	58.6 (16.5)	55.4 (24.1)	63.1 (17.4)	173.5 (117.4)
Set B (voice stimuli, 3.5 kHz Anchor, n = 21)					
Piece	Familiarity	Complexity	Unusualness	Task difficulty	Time
Female voice 1	n/a	n/a	n/a	50.4 (19.9)	80.4 (43.9)
Male voice 1	n/a	n/a	n/a	48.8 (21.1)	84.7 (62.6)
Female voice 2	n/a	n/a	n/a	39.6 (20.4)	96.3 (90.1)
Male voice 2	n/a	n/a	n/a	48.0 (20.6)	64.7 (32.2)
Set C (music stimuli, 7kHz Anchor, n = 21)					
Piece	Familiarity	Complexity	Unusualness	Task difficulty	Time
Musica su due d.	24.0 (26.8)	71.2 (13.5)	74.5 (27.5)	75.1 (15.7)	225.6 (327.1)
Syntaxis	13.5 (20.5)	79.9 (15.5)	80.4 (23.6)	76.5 (21.3)	160.0 (166.6)
Save your tears	57.2 (32.9)	31.7 (19.3)	21.5 (18.7)	41.7 (17.4)	102.4 (41.5)
Hotel california	89.7 (11.0)	34.4 (16.3)	16.6 (17.4)	42.3 (19.1)	95.2 (43.5)

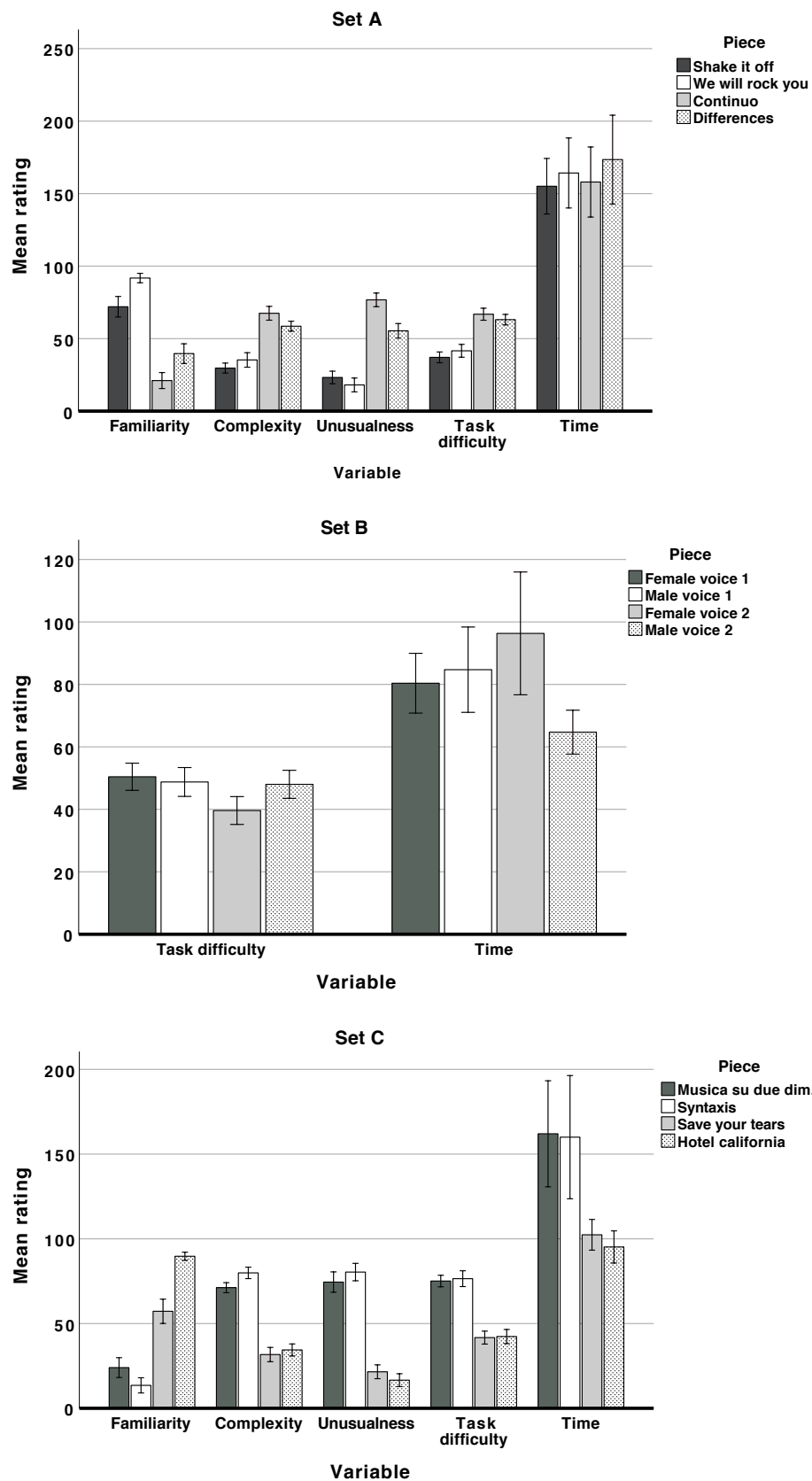
Supplementary Table 4

Statistical significance of the MANOVA for each set. Each set contains an omnibus test, as well as a main effect for each dependent variable. In each case Piece was the only independent variable.

Set A (music stimuli)	
Test type	Statistical output
Omnibus	$(F(15,258) = 5.53, p < .001, \eta_p^2 = .243)$
Main effect – Familiarity	$(F(3,88) = 29.48, p < .001, \eta_p^2 = .501)$
Main effect – Complexity	$(F(3,88) = 18.45, p < .001, \eta_p^2 = .386)$
Main effect – Unusualness	$(F(3,88) = 34.52, p < .001, \eta_p^2 = .541)$
Main effect – Task difficulty	$(F(3,88) = 14.10, p < .001, \eta_p^2 = .325)$
Main effect – Time	$(F(3,88) = 0.11, p = .956, \eta_p^2 = .004)$
Set B (voice stimuli)	
Test type	Statistical output
Omnibus	$(F(6,160) = 1.10, p = .363, \eta_p^2 = .040)$
Main effect – Task difficulty	$(F(3,80) = 1.16, p = .330, \eta_p^2 = .042)$
Main effect – Time	$(F(3,80) = 0.96, p = .416, \eta_p^2 = .035)$
Set C (music stimuli)	
Test type	Statistical output
Omnibus	$(F(15,234) = 8.79, p < .001, \eta_p^2 = .360)$
Main effect – Familiarity	$(F(3,80) = 42.77, p < .001, \eta_p^2 = .616)$
Main effect – Complexity	$(F(3,80) = 48.52, p < .001, \eta_p^2 = .645)$
Main effect – Unusualness	$(F(3,80) = 49.03, p < .001, \eta_p^2 = .648)$
Main effect – Task difficulty	$(F(3,80) = 23.33, p < .001, \eta_p^2 = .467)$
Main effect – Time	$(F(3,80) = 2.23, p = .091, \eta_p^2 = .077)$

Supplementary Figure 1

Mean ratings of the Additional variables, separated by Set and Piece. Error bars = ± 1 SE.



Supplementary Table 5

Results of Šidák-corrected post hoc results comparing ratings of each Additional between pieces in Sets A and C. N.B. that post hoc tests are not included for Set B, or for the variable Time in Sets A and C, as in these cases the MANOVA did not reach statistical significance. For cases that reach statistical significance at $p < .05$, the higher piece is italicised.

Set A (music stimuli)		
Dependent variable	Pieces compared	Significance
Familiarity	Shake it off – We will rock you	$p = .108$
	<i>Shake it off</i> – Continuo	$p < .001$
	<i>Shake it off</i> – Differences	$p = .001$
	<i>We will rock you</i> – Continuo	$p < .001$
	<i>We will rock you</i> – Differences	$p < .001$
	Continuo – Differences	$p = .151$
Complexity	Shake it off – We will rock you	$p = .925$
	Shake it off – <i>Continuo</i>	$p < .001$
	Shake it off – <i>Differences</i>	$p < .001$
	We will rock you – <i>Continuo</i>	$p < .001$
	We will rock you – <i>Differences</i>	$p = .001$
	Continuo – Differences	$p = .593$
Unusualness	Shake it off – We will rock you	$p = .969$
	Shake it off – <i>Continuo</i>	$p < .001$
	Shake it off – <i>Differences</i>	$p < .001$
	We will rock you – <i>Continuo</i>	$p < .001$
	We will rock you – <i>Differences</i>	$p < .001$
	<i>Continuo</i> – Differences	$p = .011$
Task difficulty	Shake it off – We will rock you	$p = .964$
	Shake it off – <i>Continuo</i>	$p < .001$
	Shake it off – <i>Differences</i>	$p < .001$
	We will rock you – <i>Continuo</i>	$p < .001$
	We will rock you – <i>Differences</i>	$p = .002$
	Continuo – Differences	$p = .986$

Set C (music stimuli)		
Dependent variable	Pieces compared	Significance
Familiarity	Musica su. – Syntaxis	$p = .660$
	Musica su. – <i>Save your tears</i>	$p < .001$
	Musica su. – <i>Hotel california</i>	$p < .001$
	Syntaxis – <i>Save your tears</i>	$p < .001$
	Syntaxis – <i>Hotel california</i>	$p < .001$
	<i>Save your tears</i> – <i>Hotel california</i>	$p < .001$
Complexity	Musica su. – Syntaxis	$p = .422$
	<i>Musica su.</i> – <i>Save your tears</i>	$p < .001$
	<i>Musica su.</i> – <i>Hotel california</i>	$p < .001$
	<i>Syntaxis</i> – <i>Save your tears</i>	$p < .001$
	<i>Syntaxis</i> – <i>Hotel california</i>	$p < .001$
	<i>Save your tears</i> – <i>Hotel california</i>	$p = .995$
Unusualness	Musica su. – Syntaxis	$p = .949$
	<i>Musica su.</i> – <i>Save your tears</i>	$p < .001$
	<i>Musica su.</i> – <i>Hotel california</i>	$p < .001$
	<i>Syntaxis</i> – <i>Save your tears</i>	$p < .001$
	<i>Syntaxis</i> – <i>Hotel california</i>	$p < .001$
	<i>Save your tears</i> – <i>Hotel california</i>	$p = .978$
Task difficulty	Musica su. – Syntaxis	$p > .999$
	<i>Musica su.</i> – <i>Save your tears</i>	$p < .001$
	<i>Musica su.</i> – <i>Hotel california</i>	$p < .001$
	<i>Syntaxis</i> – <i>Save your tears</i>	$p < .001$
	<i>Syntaxis</i> – <i>Hotel california</i>	$p < .001$
	<i>Save your tears</i> – <i>Hotel california</i>	$p > .999$

Supplementary Table 6

Statistical outputs for the Multiple Linear Regression analyses performed on all three sets. No significant interactions were observed.

Hidden reference as dependent variable		
Independent variable	Coefficient (β)	Significance
Task difficulty	0.54	$p = .001$
Time	0.12	$p = .025$
Age	0.11	$p = .581$
Years playing	-0.43	$p = .349$
Years training	-0.19	$p = .617$
Foil as dependent variable		
Independent variable	Coefficient (β)	Significance
Task difficulty	0.36	$p < .001$
Time	0.03	$p = .017$
Age	0.68	$p < .001$
Years playing	-0.82	$p < .001$
Years training	-0.17	$p = .565$

Supplementary Table 7

Statistical outputs for the Multiple Linear Regression analyses performed on the two music sets. This allowed inclusion of the additional variables Familiarity, Complexity, and Unusualness. No significant interactions were observed.

Hidden reference as dependent variable		
Independent variable	Coefficient (β)	Significance
Familiarity	0.11	$p = .101$
Complexity	0.22	$p = .032$
Unusualness	-0.10	$p = .274$
Task difficulty	0.15	$p = .160$
Time	0.02	$p = .081$
Age	0.33	$p = .157$
Years playing	-0.43	$p = .164$
Years training	-0.33	$p = .464$
Foil as dependent variable		
Independent variable	Coefficient (β)	Significance
Familiarity	-0.04	$p = .432$
Complexity	0.35	$p < .001$
Unusualness	0.09	$p = .176$
Task difficulty	0.37	$p < .001$
Time	0.01	$p = .480$
Age	0.71	$p < .001$
Years playing	-0.93	$p < .001$
Years training	-0.16	$p = .659$

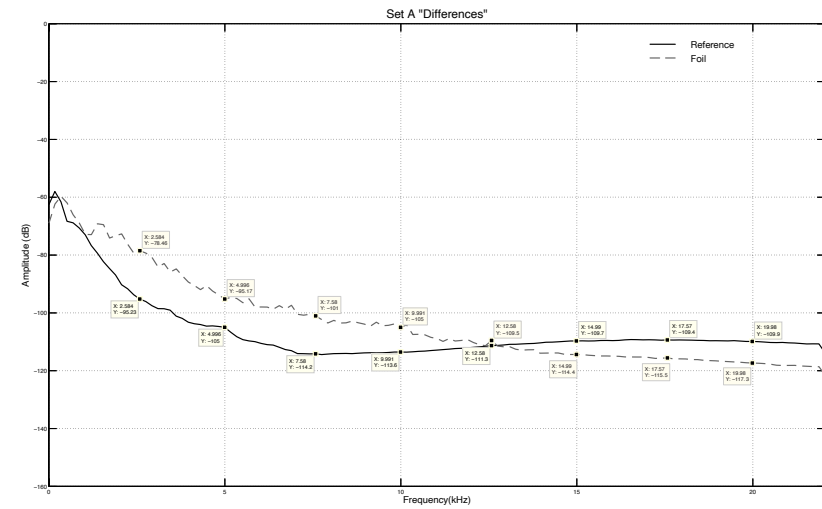
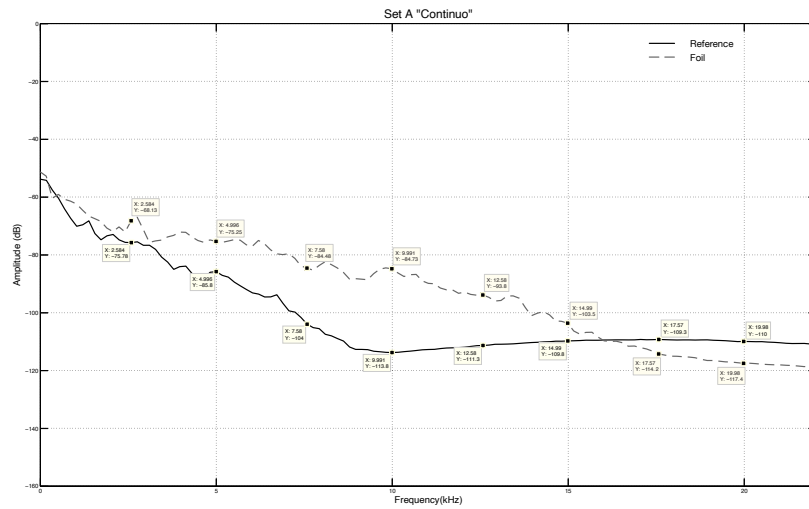
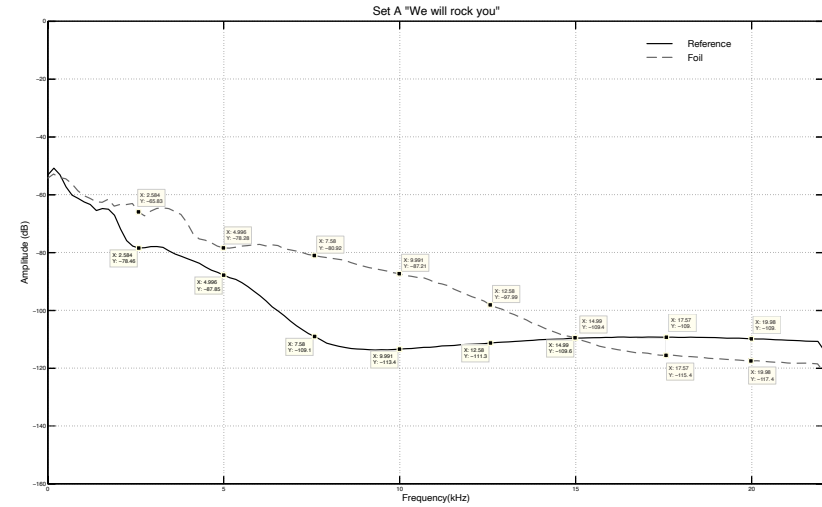
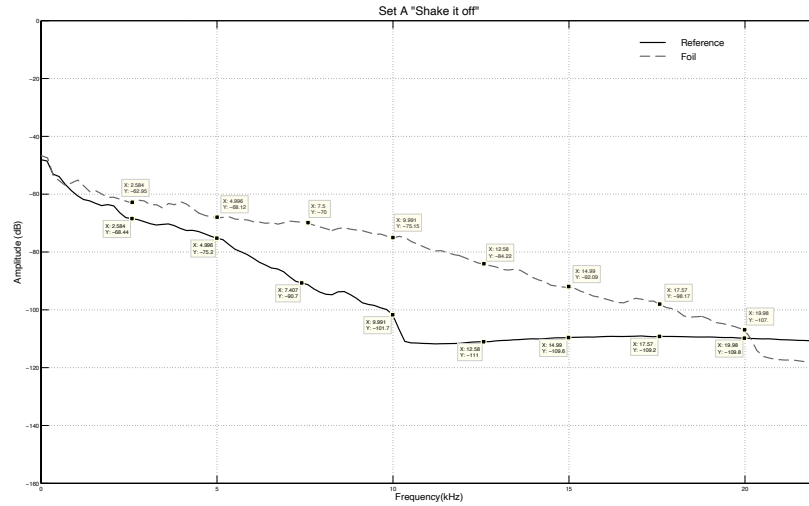
Supplementary Table 8

Spectral difference between the Reference and Foil variants reported for each piece. The difference was calculated by comparing amplitude in dB at each interval of 2.5kHz. The values reported below are the M (SD) of each interval comparison. Approach 1 examines differences at all frequencies, whereas Approach 2 only examines frequencies above 7.5kHz.

Stimulus	Approach 1 difference value	Approach 2 difference value
Shake it off	14.7 (9.5)	17.5 (9.4)
We will rock you	13.0 (9.7)	13.6 (11.3)
Continuo	12.9 (8.5)	14.1 (9.5)
Differences	8.5 (4.8)	7.0 (3.8)
Musica su due dim.	12.5 (9.2)	10.2 (9.6)
Syntaxis	10.0 (8.1)	10.7 (8.5)
Save your tears	15.7 (11.0)	18.0 (11.5)
Hotel california	17.0 (10.9)	20.8 (9.8)

Supplementary Figure 2

LTAS plots depicting the Reference and Foil variants for each stimulus in Set A. The output from the Matlab “FindPeaks” function can be seen at each interval of approximately 2.5kHz, depicting the dB level at that particular frequency.



Supplementary Figure 3

LTAS plots depicting the Reference and Foil variants for each stimulus in Set C. The output from the Matlab “FindPeaks” function can be seen at each interval of approximately 2.5kHz, depicting the dB level at that particular frequency.

