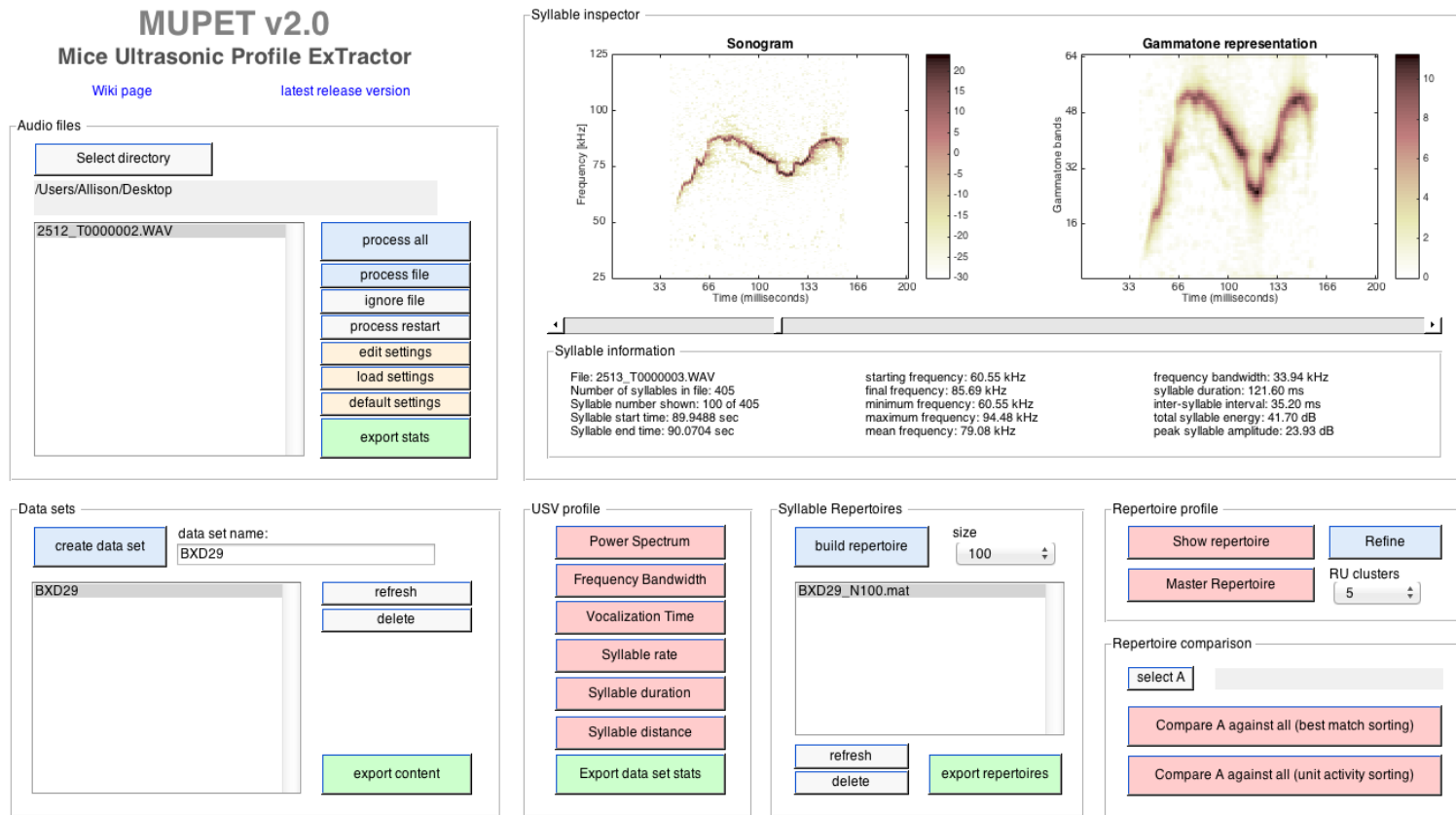
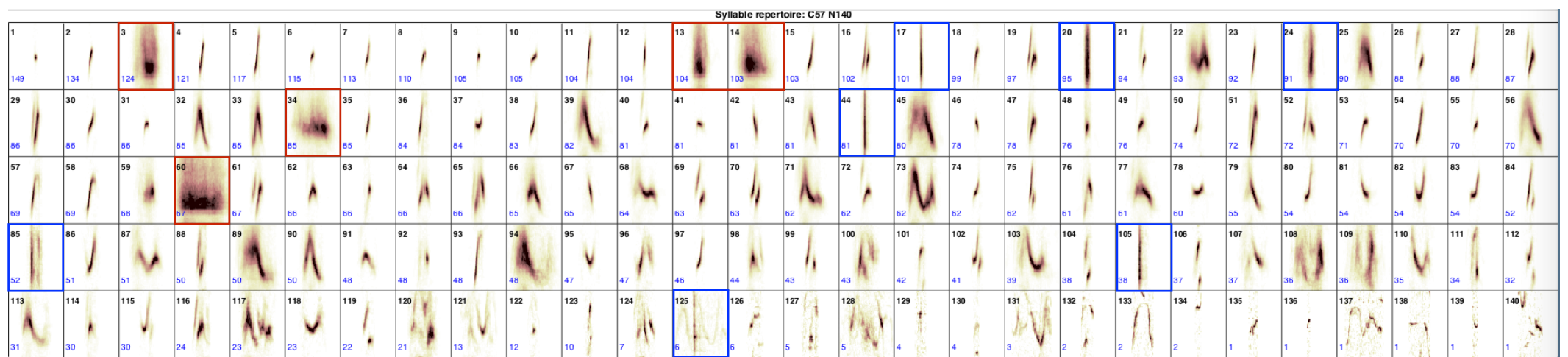


Figure S1, Related to Figure 3

A



B



C

Syllable Measures (CSV A)	Repertoire Unit (RU) Measures (CSV C)	Syllable & RU Sequence (CSV E)
Start and end time (sec)	Syllable number (count)	Dataset name
Duration (msec)	Syllable-to-centroid distance - mean & std	Audio file name
Inter-syllable interval (msec)	Syllable-to-centroid correlation - mean & std	Syllable number
Starting, final, minimum, maximum, and mean frequency (kHz)	Final frequency minus starting frequency (kHz)	Syllable start and end time (sec)
Frequency bandwidth (kHz)	Mean frequency minus starting frequency (kHz)	RU designation number
Total syllable amplitude (dB)	Mean frequency minus final frequency (kHz)	
Peak syllable amplitude (dB)	Average frequency bandwidth (kHz)	Similarity Matrix Correlations (CSV F)
	Duration (msec)	Pearson's correlations for each RU pair
Dataset Measures (CSV B)	Syllable Repertoire Modeling Scores (CSV D)	Similarity Boxplot Correlations (CSV G)
Power spectral density - mean & std (kHz)	Overall repertoire modeling score	Pearson's correlations for the top 5, 25, 50, 75 and 95% most frequently used RU pairs
Frequency bandwidth (kHz)	Average log-likelihood	Pearson's correlations for RU pairs in 1% increments of use from 1-100%
Syllables/second - mean, median, std (counts)	Bayesian information criterion	
Inter-syllable interval - mean, median, std (msec)		RU-Cluster Syllable Counts (CSV H)
Syllable duration - mean, median, std (msec)		RU-cluster designation number
Total syllable number (counts)		Number of RUs within RU-cluster
Total syllable activity (total syllable duration, sec)		RU-to-centroid correlation - mean & std
Total recording activity (sec)		Number of syllables in RU-cluster

Figure S1. Overview of MUPET's graphical user interface, noise refinement functionality, and exportable datasets.

(A) Image of MUPET's graphical user interface. **(B)** Initial (unrefined) C57BL/6 repertoire (size 140). Repertoire units (RUs) learned from full-spectrum background noise are highlighted in blue and RUs reflecting spectrally impure units learned from noisy, complex, and/or low frequency events are highlighted in red. We suggest removing all full-spectrum noise events. Depending upon user objectives, highly spectrally-impure units can either be removed or larger repertoires can be built to attempt to identify more spectrally pure syllables types. **(C)** Summary of the measures available in each exportable CSV file.

Figure S2, Related to Figure 1

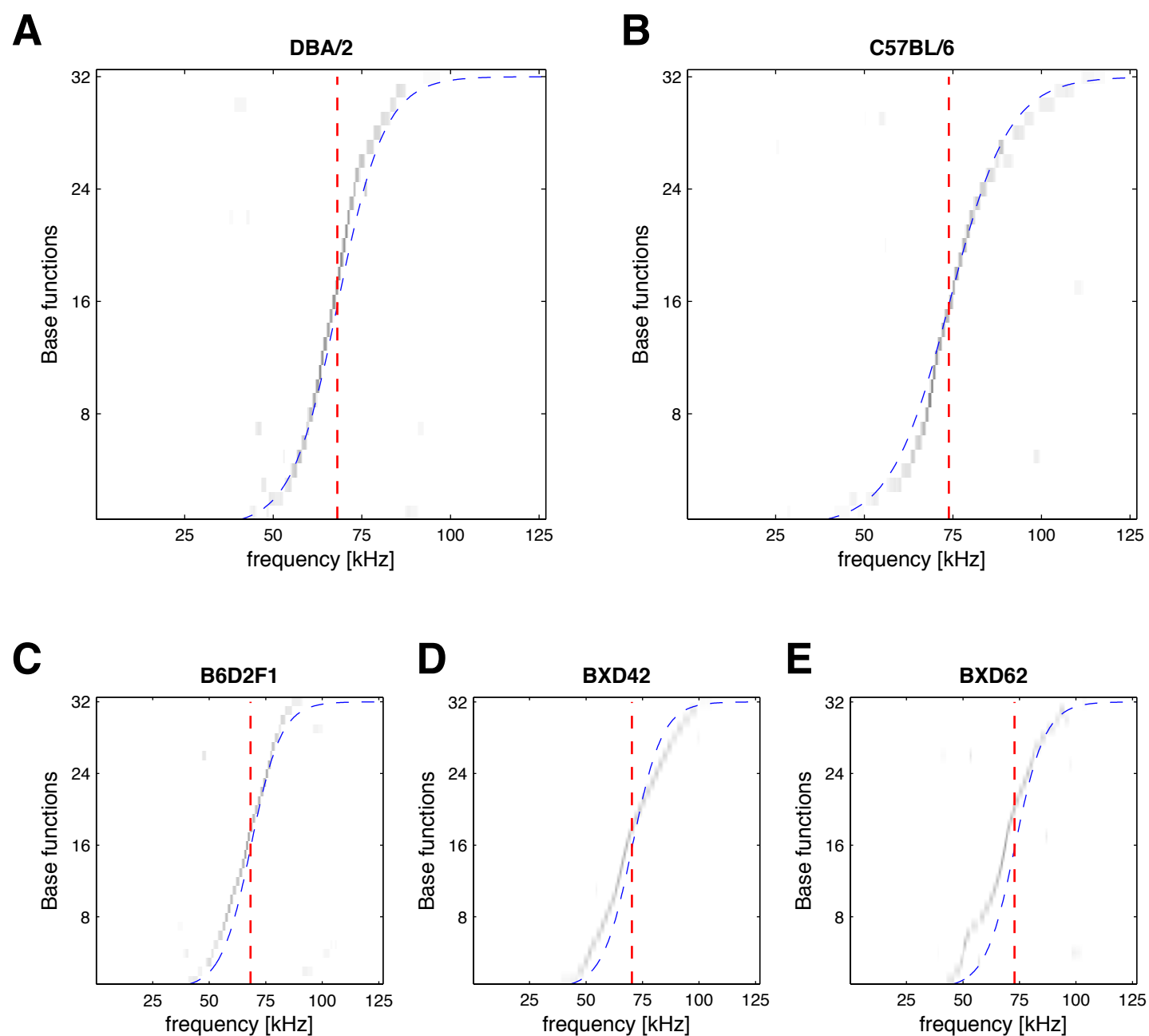


Figure S2. Spectral basis functions found by non-negative matrix factorization.

(A-E) Spectral basis functions found by non-negative matrix factorization (NMF) (basis vectors) applied on the power spectra (normalized to unit energy and computed from a 512 point FFT using 2 msec frames with a frame shift of 1.6 msec) of the audio recordings of the **(A)** DBA/2 and **(B)** C57BL/6 parental strains, **(C)** F1 cross (B6D2F1) and **(D-E)** two example offspring strains (BXD42 and BXD62). The columns correspond to the NMF basis vectors and were sorted by peak frequency of spectral amplitude. NMF factorization obtains a set of spectral envelope functions with peak amplitudes lying on a curve that can be approximated mathematically by a logistic function (dashed blue curve) with a center frequency equal to the mean of the Gaussian fit function of the PSD curves in **Figure 4 A-C**. The dashed red lines indicate the mean frequencies.

Figure S3, Related to Figure 4

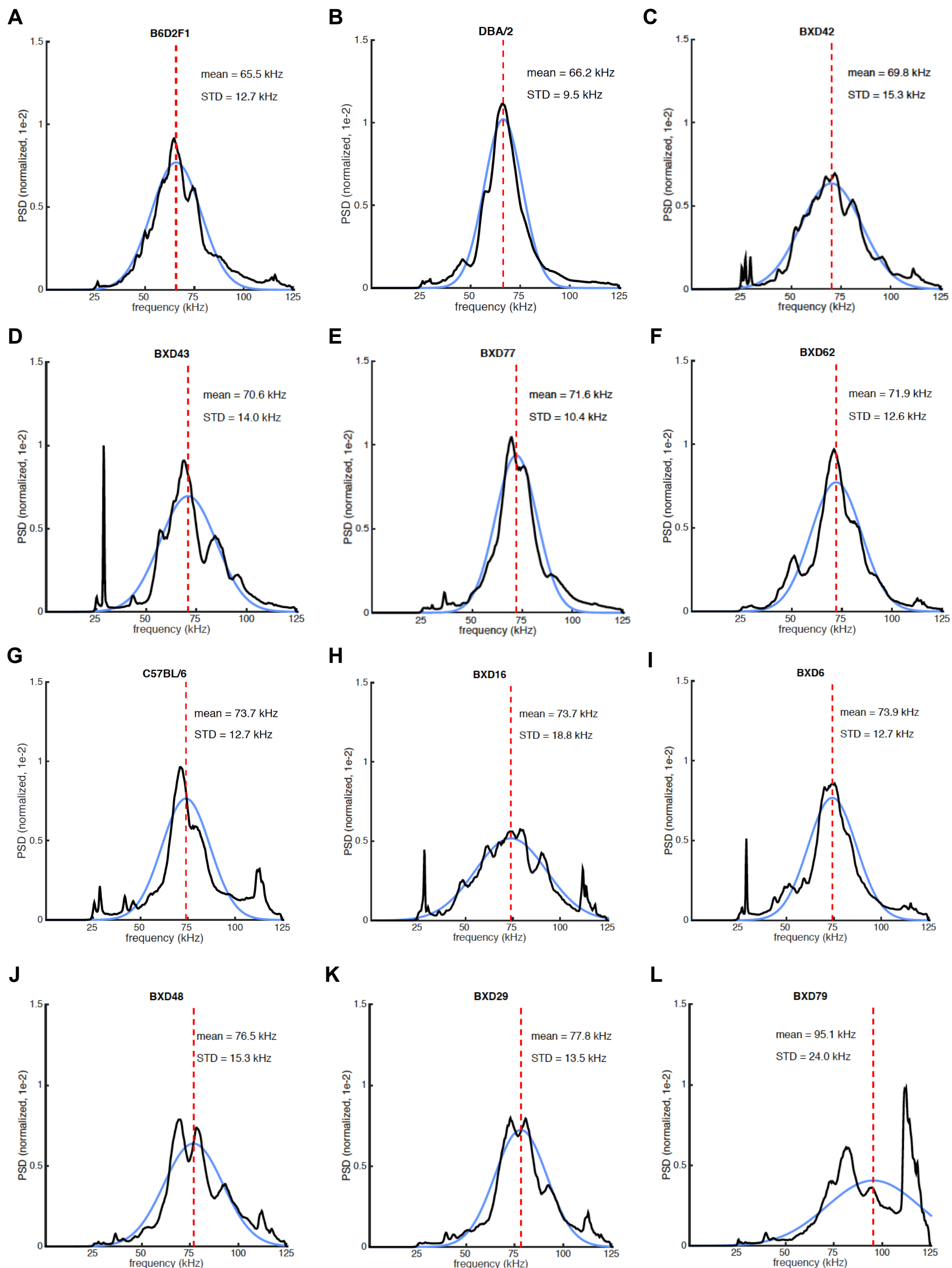


Figure S3. Power spectral densities for each strain.

(A-L) Power spectral density (PSD) plots for each strain, listed in order from lowest to highest mean frequency.

Figure S4, Related to Figure 5

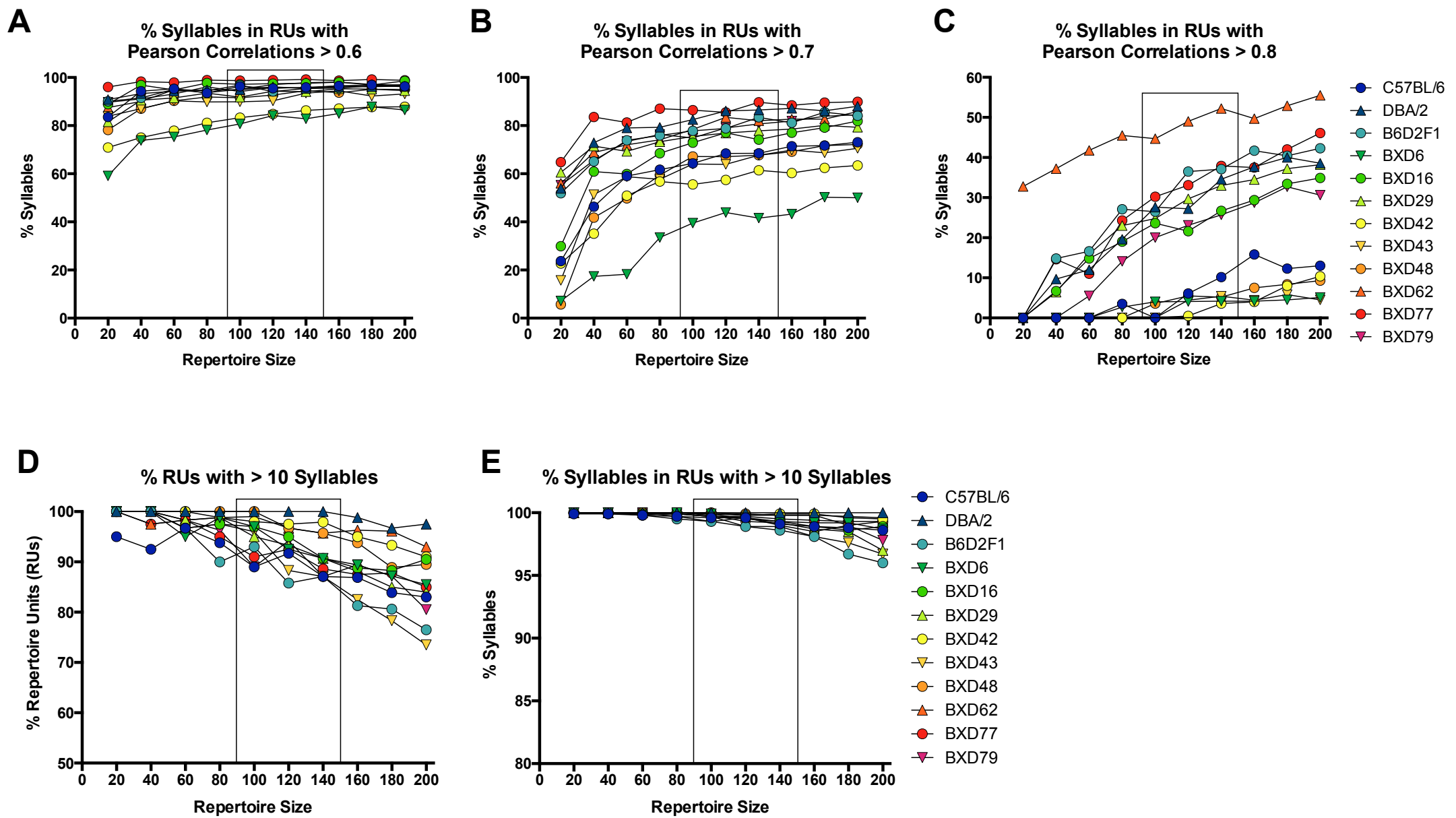
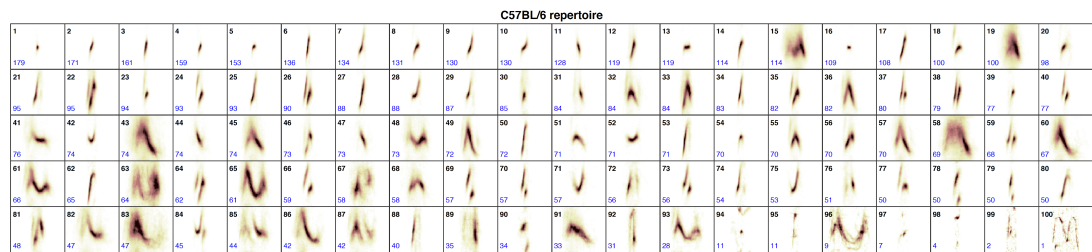


Figure S4. Syllable repertoire modeling measures and Pearson correlations for different syllable repertoire build sizes.

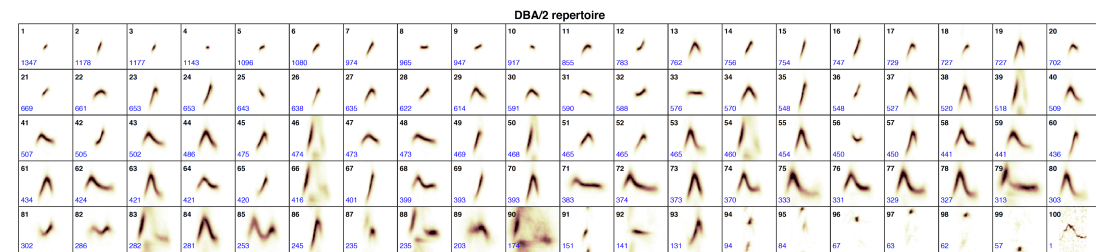
(A-C) Pearson correlations for different syllable repertoire sizes as a percentage of the total number of syllables in the repertoire units (RUs). Boxes highlight the optimal syllable repertoire sizes determined here and in **Figure 5**. Optimal syllable repertoire build sizes generally maximize Pearson correlations for each RU as well as the the proportion of (D) RUs and (E) syllables in RUs that contain a user-defined minimum number of syllables (here > 10 syllables per RU learned from datasets of ~5-50K syllables).

Figure S5, Related to Figure 5

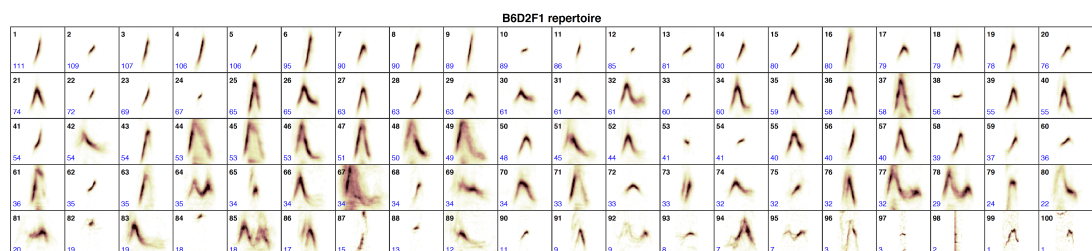
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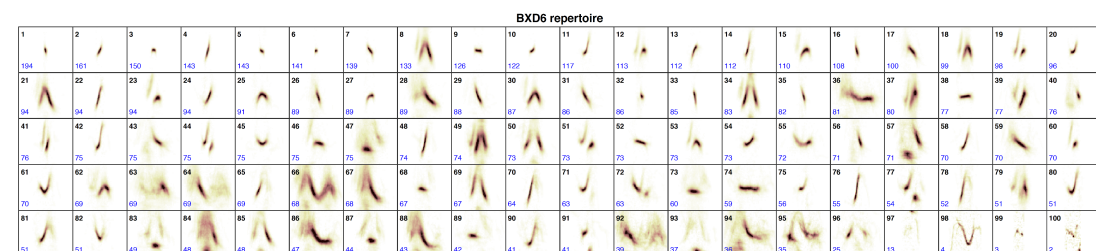
B



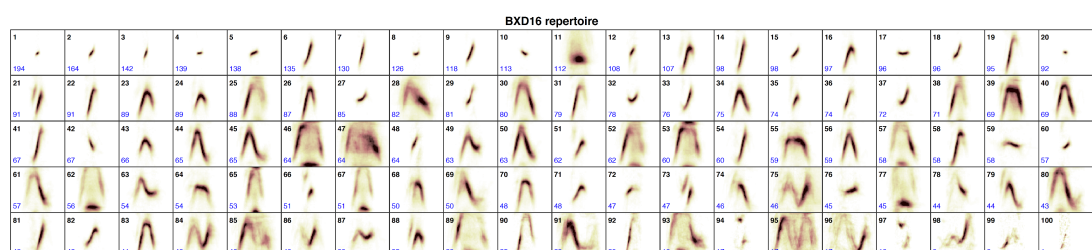
C



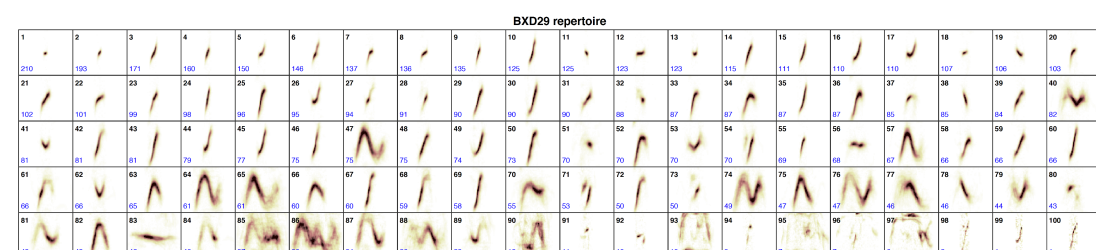
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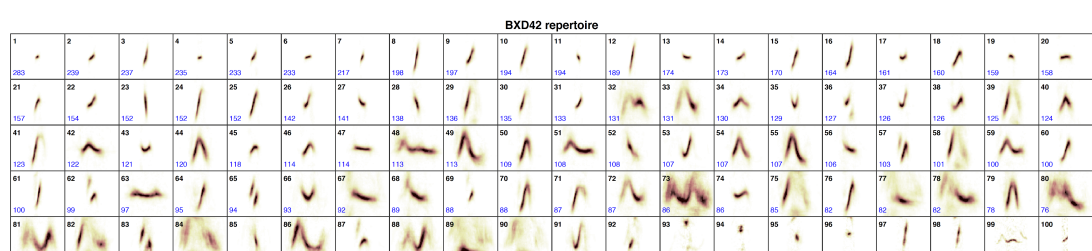
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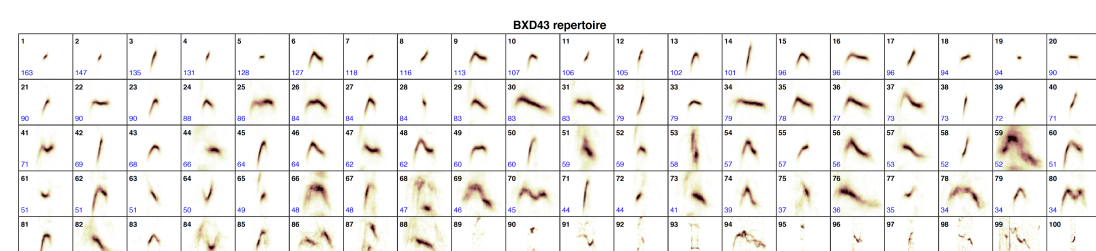
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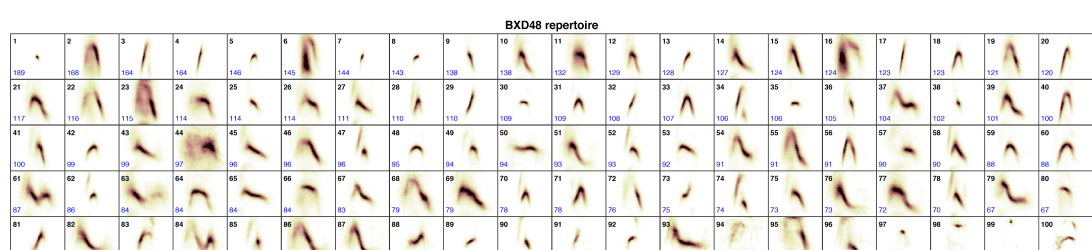
G



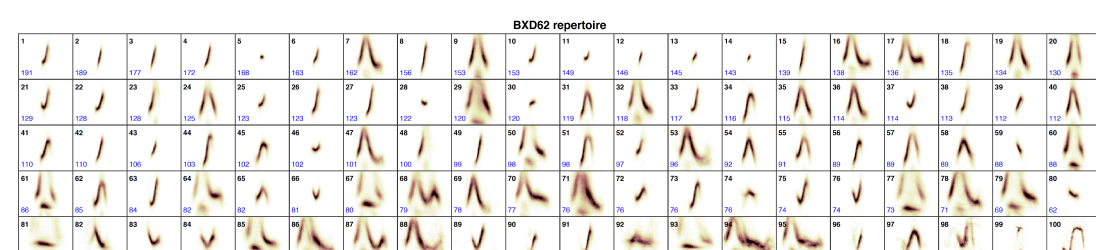
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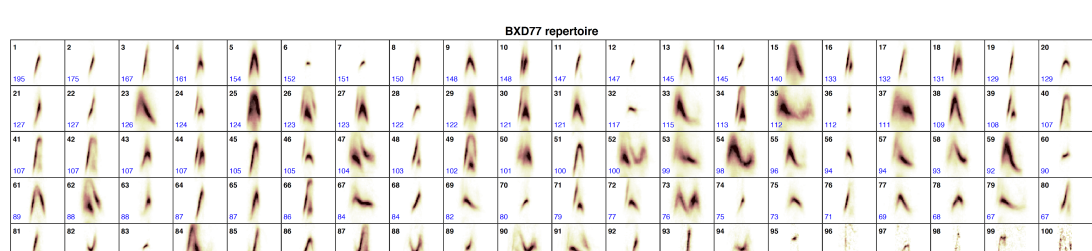
I



J



K



L

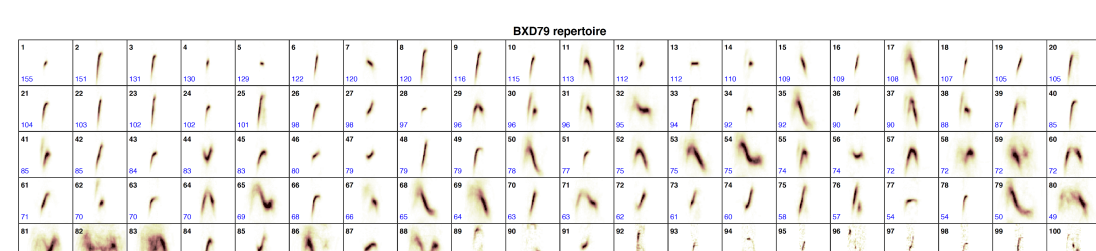


Figure S5. Syllable repertoires for each strain.

(A-L) Syllable repertoires of size 100 repertoire units generated for each strain.

Figure S6, Related to Figure 6

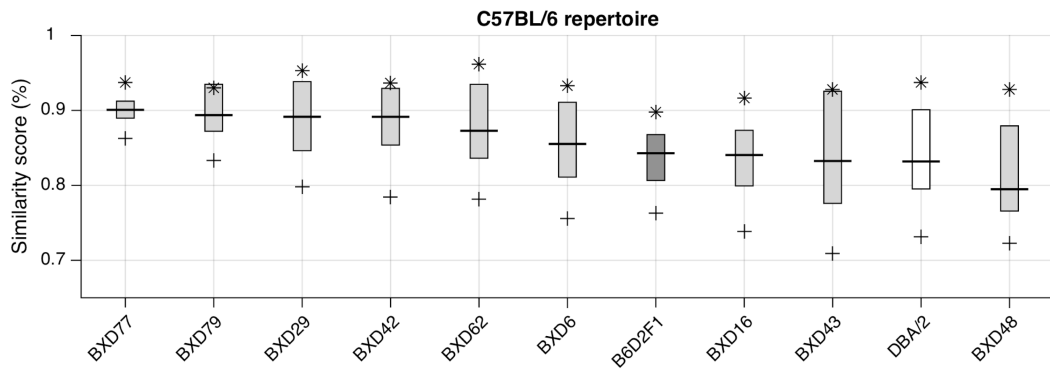
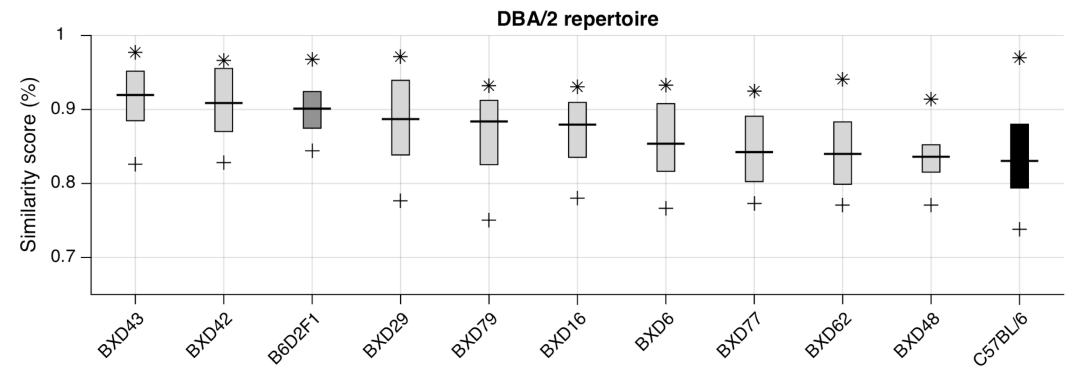
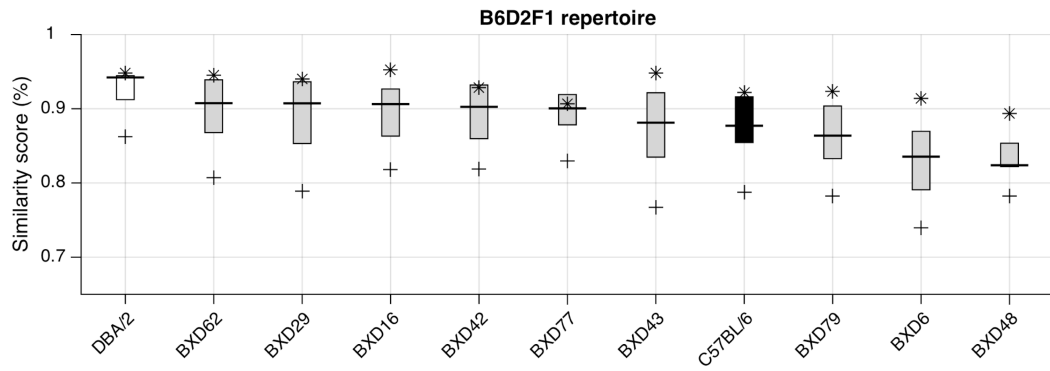
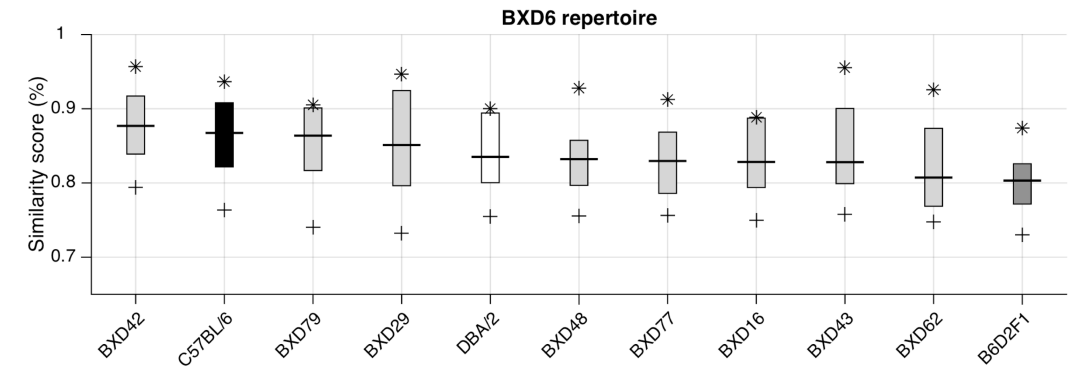
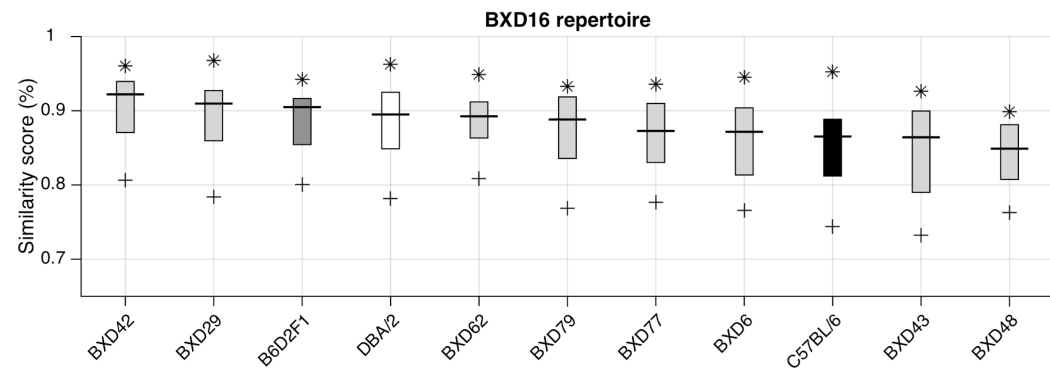
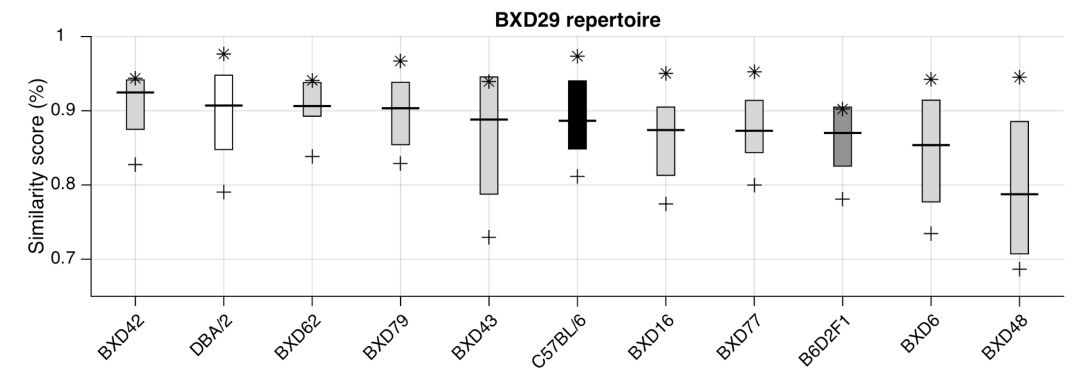
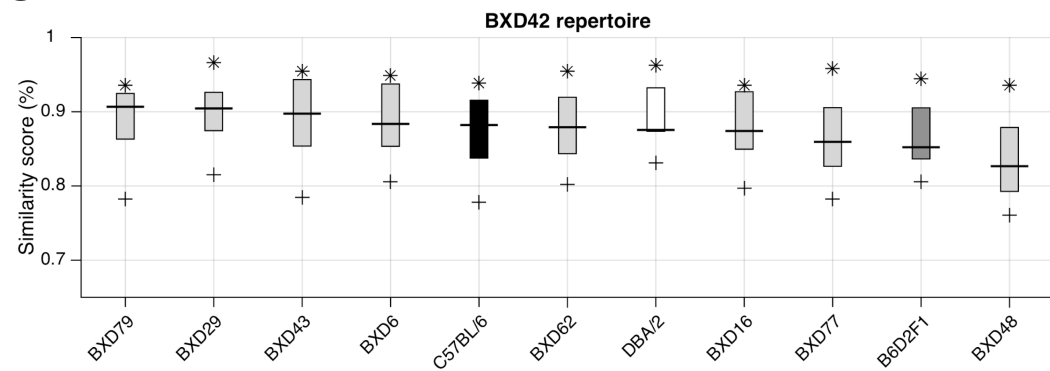
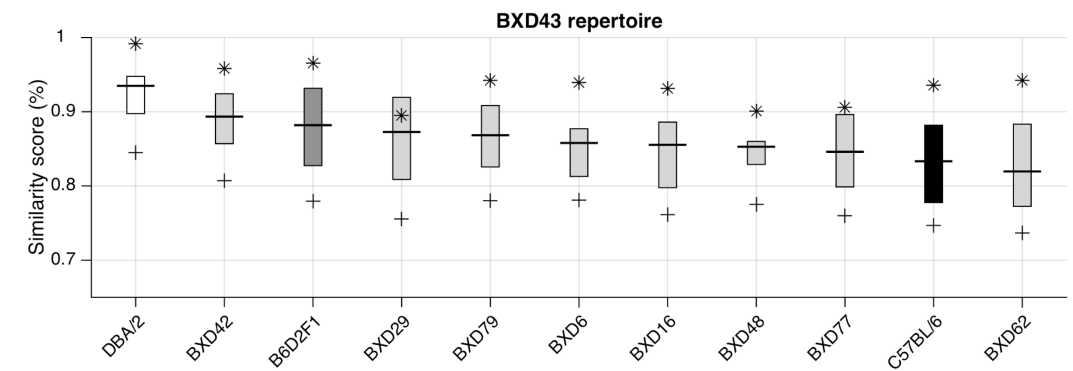
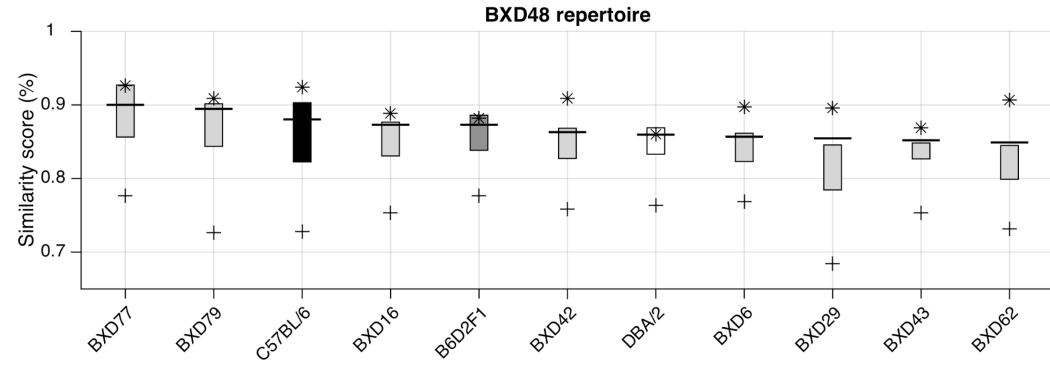
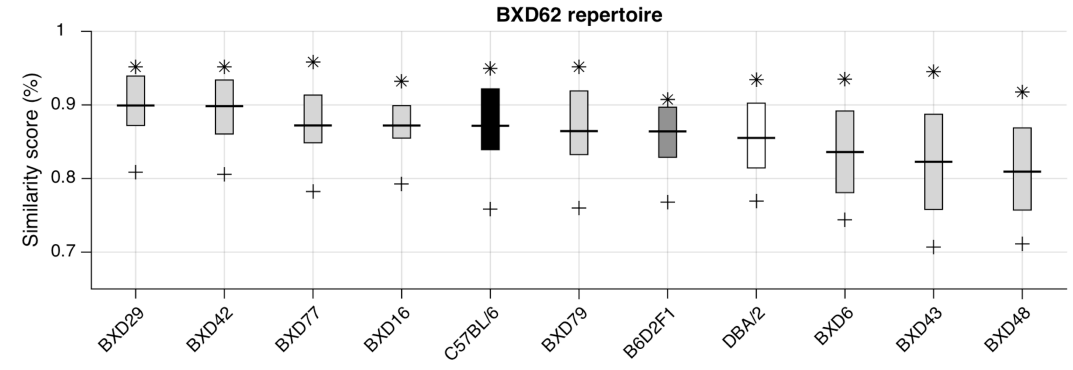
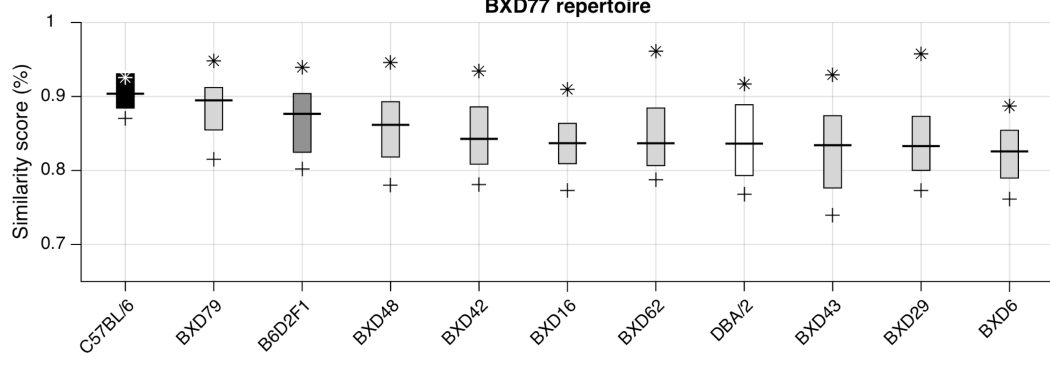
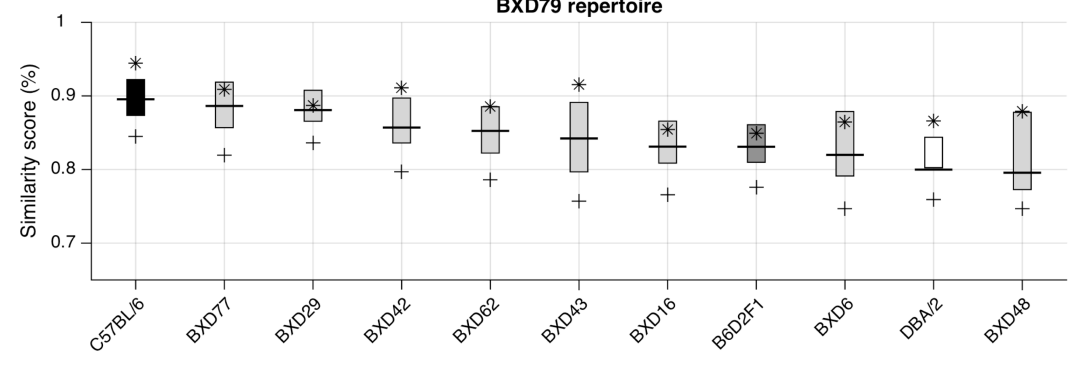
A**B****C****D****E****F****G****H****I****J****K****L**

Figure S6. Cross Repertoire Similarity Boxplots for each strain.

(A-L) Cross Repertoire Similarity Boxplots using each individual strain as the reference strain (indicated by the title) with the 11 comparison strains shown on the X-axis.

Figure S7, Related to Figure 6

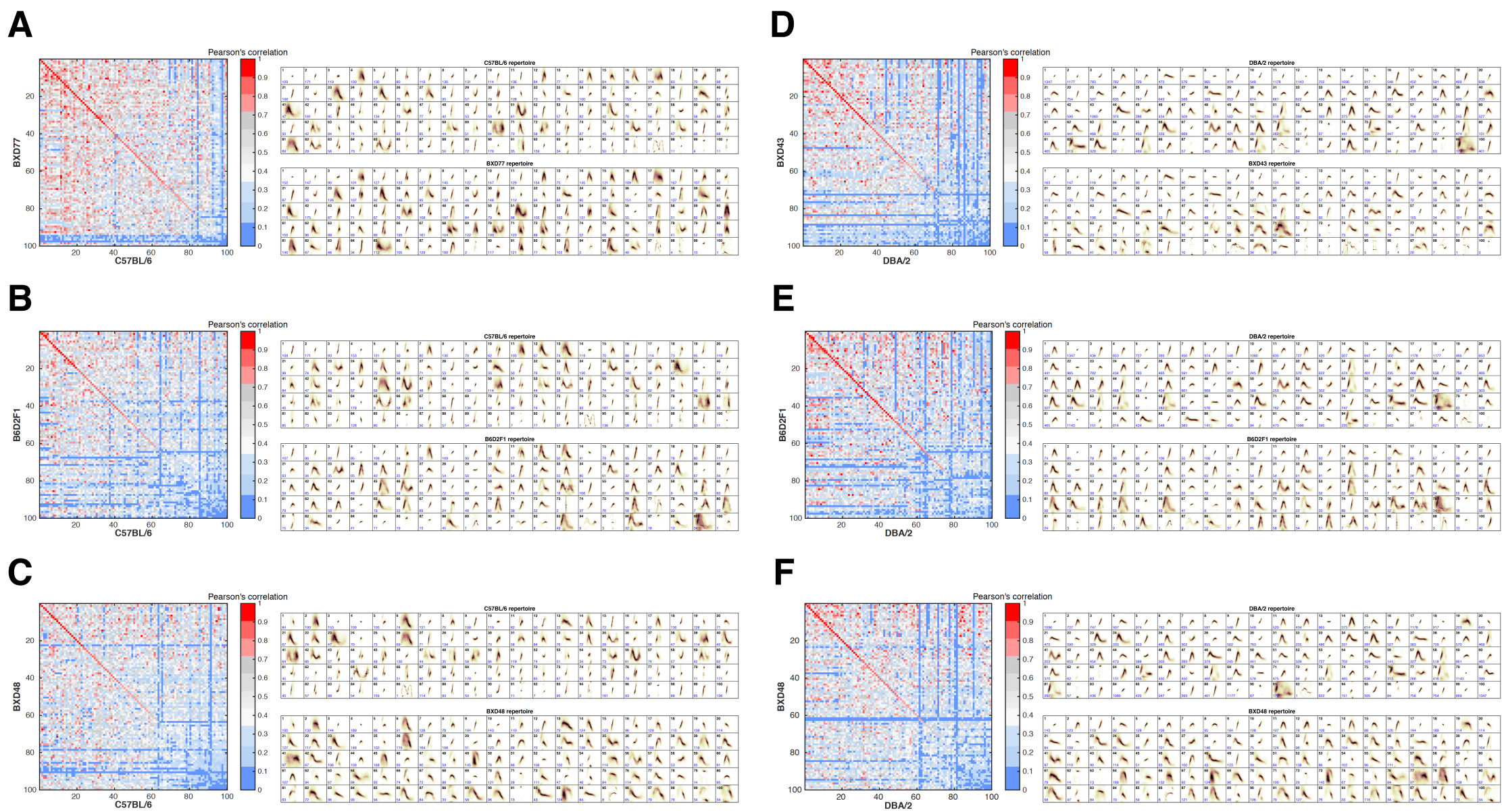


Figure S7. Cross Repertoire Similarity Matrix for the C57BL/6 and DBA/2 reference syllable repertoires in comparison to B6D2F1 as well as the most and least similar strains.

(A-C) Cross Repertoire Similarity Matrix used to assess the similarity of the spectral shapes of pairs of repertoire units (RUs) learned from the C57BL/6 reference syllable repertoire and the **(A)** BXD77, **(B)** B6D2F1, and **(C)** BXD48 comparison syllable repertoires. The matrix diagonal gives the Pearson correlation for sequential pairs of C57BL/6 and other-strain RUs ranked from most to least similar (e.g., Unit 1 in both repertoires are highly similar). The Cross Repertoire Similarity Boxplot metric (shown in **Figure 6B**) identified BXD77 and BXD48 as, respectively, the most and least similar offspring syllable repertoires compared to C57BL/6. The F1 cross shows moderate similarity to the C57BL/6 syllable repertoire.

(D-F) Cross Repertoire Similarity Matrix used to assess the similarity of the spectral shapes of pairs of RUs learned from the DBA/2 reference syllable repertoire and the **(A)** BXD43, **(B)** B6D2F1, and **(C)** BXD48 comparison syllable repertoires. The matrix diagonal gives the Pearson correlation for sequential pairs of DBA/2 and other-strain RUs ranked from most to least similar. The Cross Repertoire Similarity Boxplot metric (shown in **Figure 6C**) identified BXD43 and BXD48 as, respectively, the most and least similar offspring syllable repertoires compared to DBA/2. The F1 cross shows higher similarity to the DBA/2 syllable repertoire compared to C57BL/6 syllable repertoire.

Figure S8, Related to Figure 8

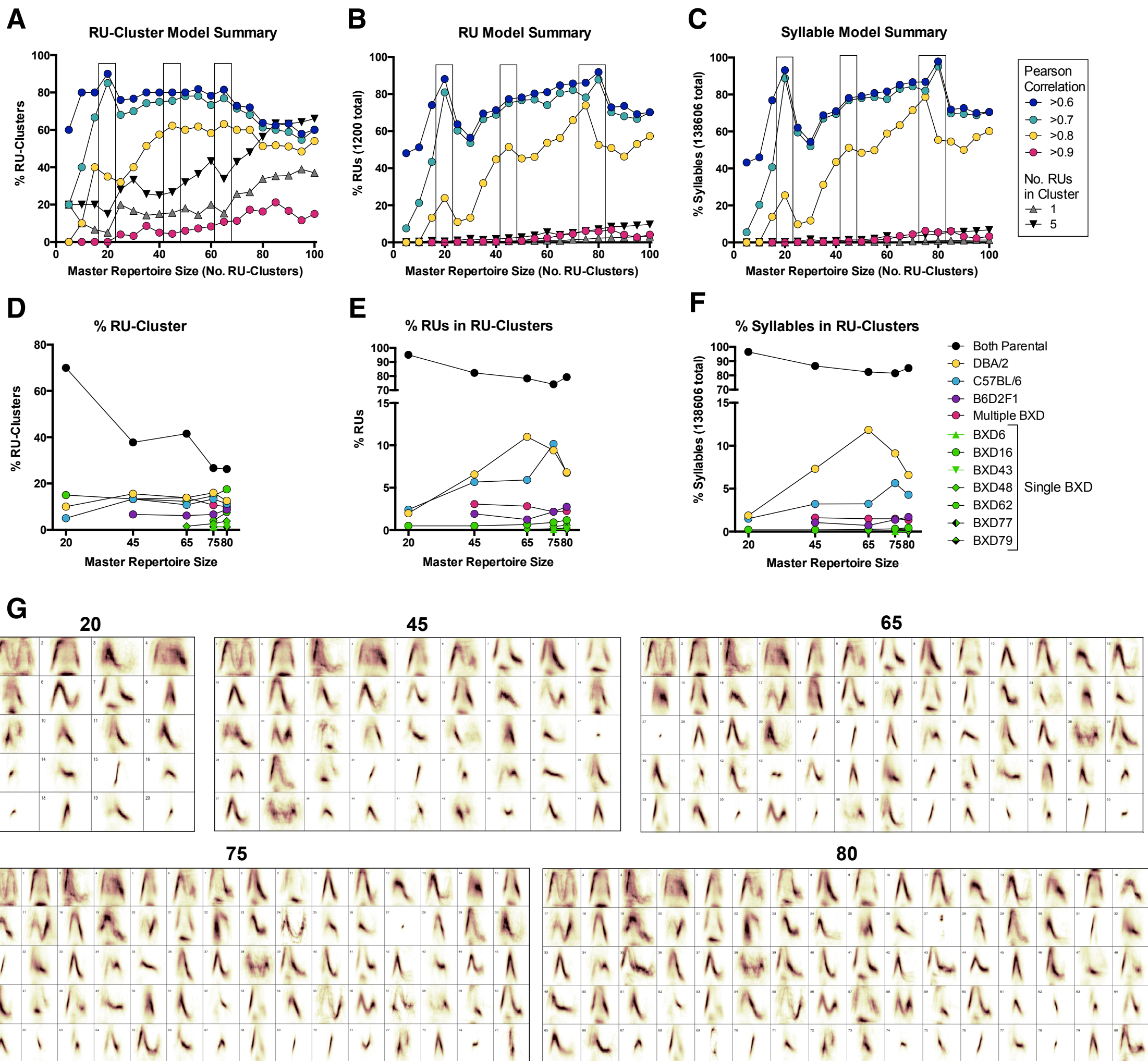


Figure S8. Pearson correlations and strain of origin analyses for different master repertoire build sizes.

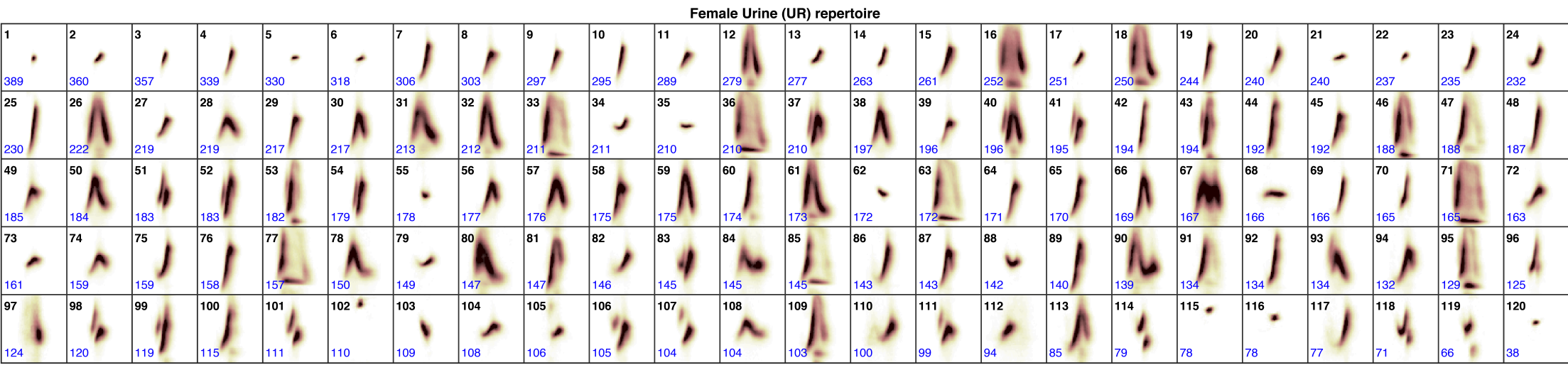
(A-C) Pearson correlations for different master repertoire sizes (i.e., number of repertoire unit (RU)-clusters) used to model the 12 strain syllable repertoires. Pearson correlations are shown as a percentage of the total number of **(A)** RU-clusters (5-100), **(B)** RUs (1200), and **(C)** syllables (138606) meeting different threshold correlation values. Boxes highlight master repertoire sizes that maximize the Pearson correlations while minimizing the proportion of RU-clusters, and proportion of RUs and syllables that are present within RU-clusters, that contain a small number of RUs (e.g., 1 or ≤ 5).

(D-F) Strain of origin analysis for master repertoires of different sizes. Sizes were selected based on the optimal modeling determined in **A-C** (see boxes). For each RU-cluster the strain of origin was determined based on whether the RU-cluster contains RUs (and consequently syllables) learned from both parental strains, a single parental strain, the F1 cross but neither parental strain, multiple BXD strains (but not the parental strains or F1 cross), or a single BXD strain. Data are presented as the percentage of **(D)** RU-clusters, **(E)** RUs, and **(F)** syllables that originate from each of the possible strains of origin.

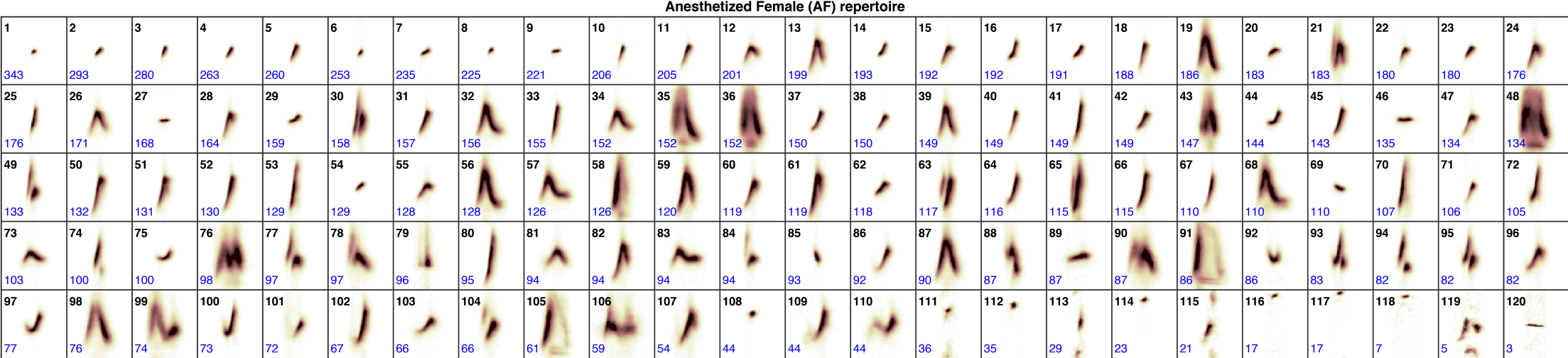
(G) Images of master repertoire sizes analyzed in **D-F**.

Figure S9, Related to Table 1

A



B



C

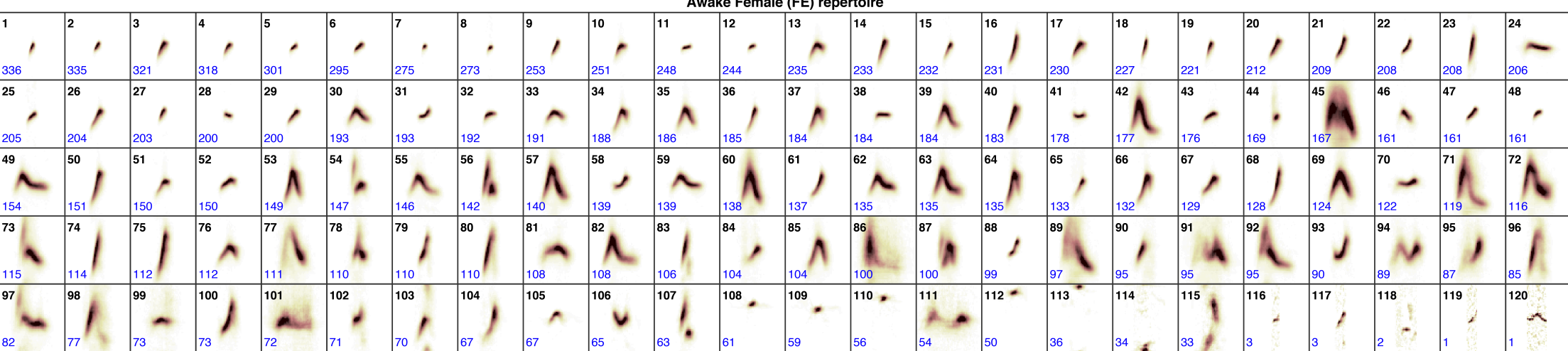
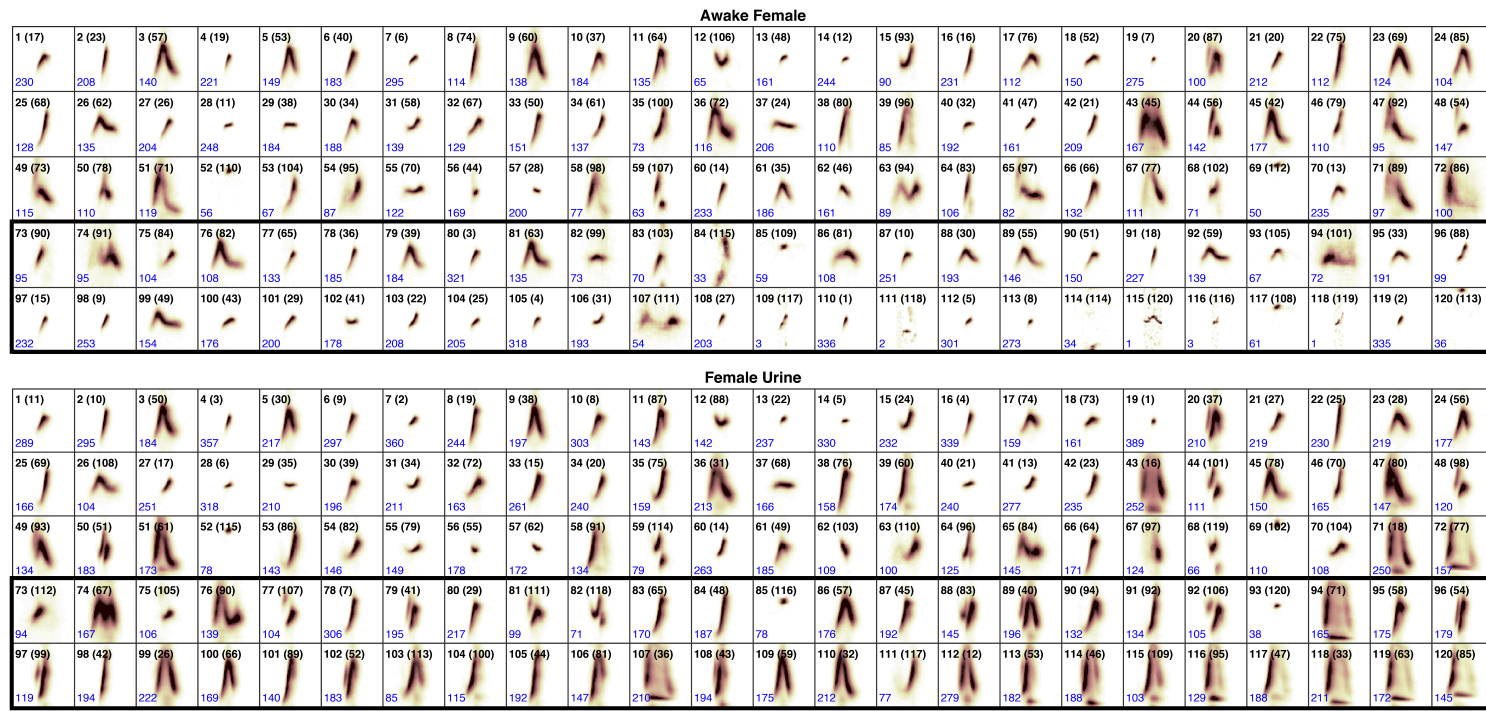
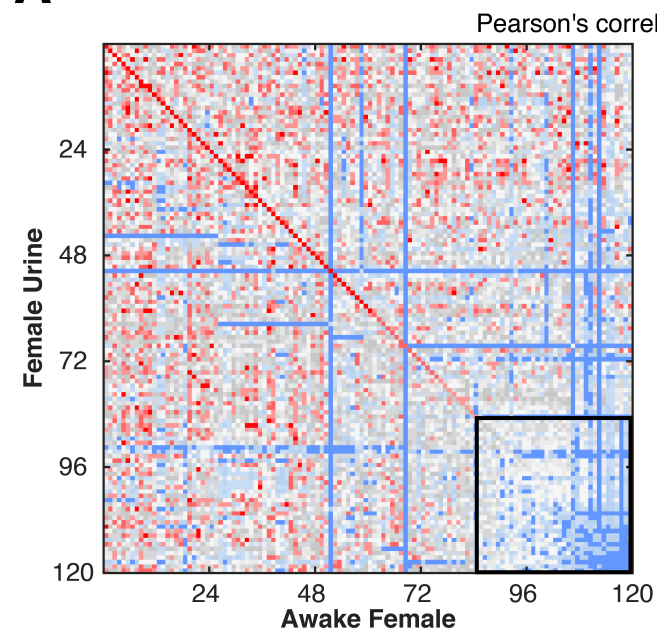


Figure S9. Syllable repertoires built from vocalization data in Chabout et al., 2015.

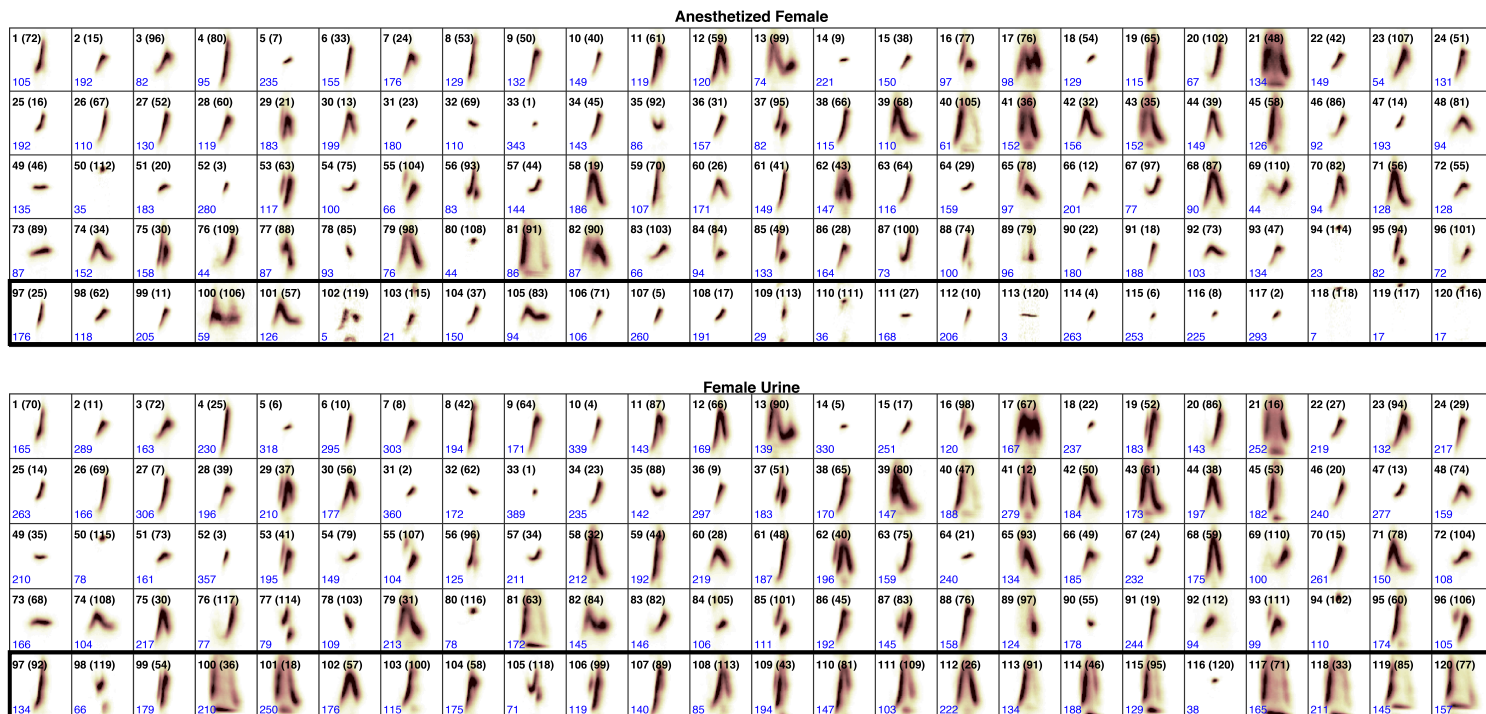
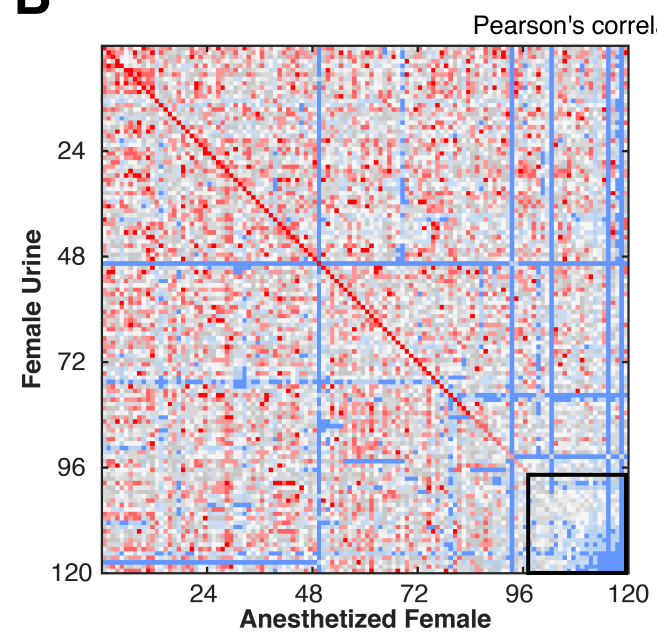
(A-C) Syllable repertoires generated from recordings of sexually-experienced B6D2F1 males vocalizing in response to same-strain: **(A)** female urine, **(B)** anesthetized female or **(C)** awake female.

Figure S10, Related to Table 1

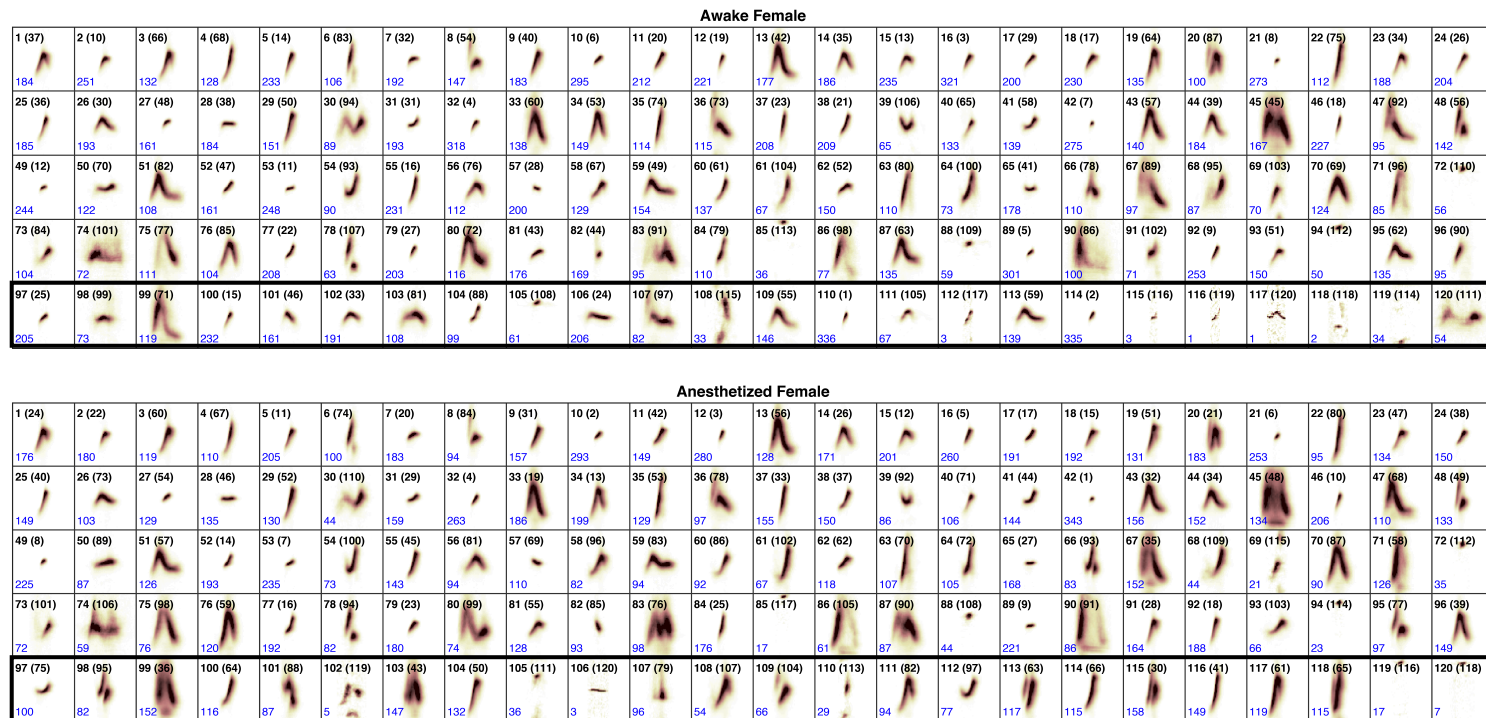
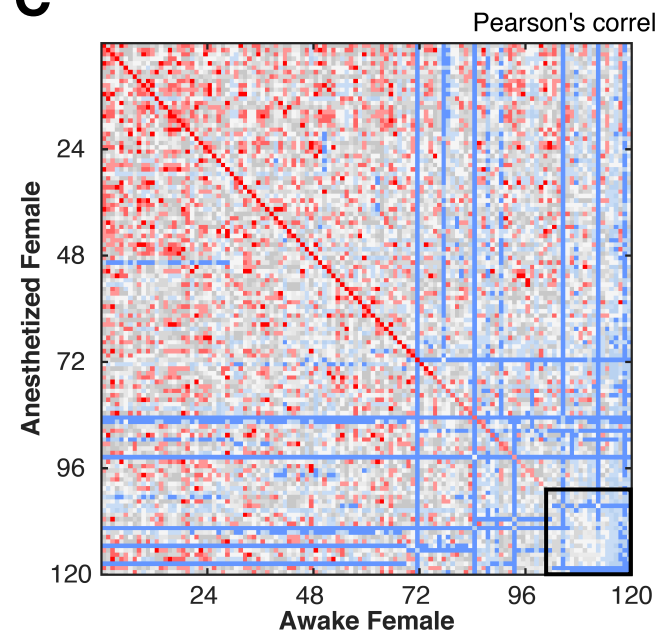
A



B



C



D

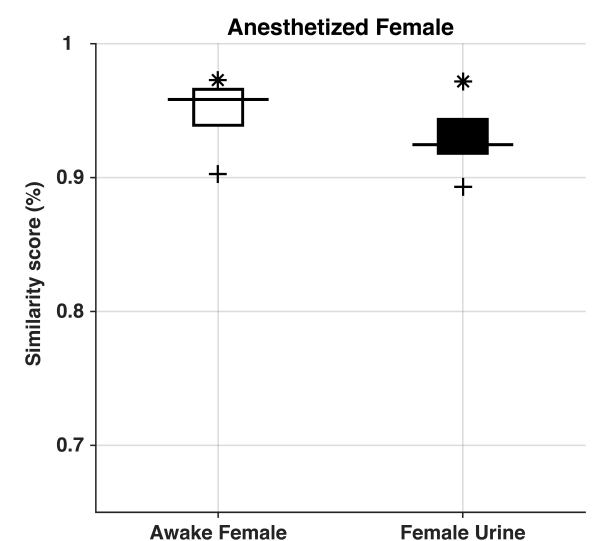
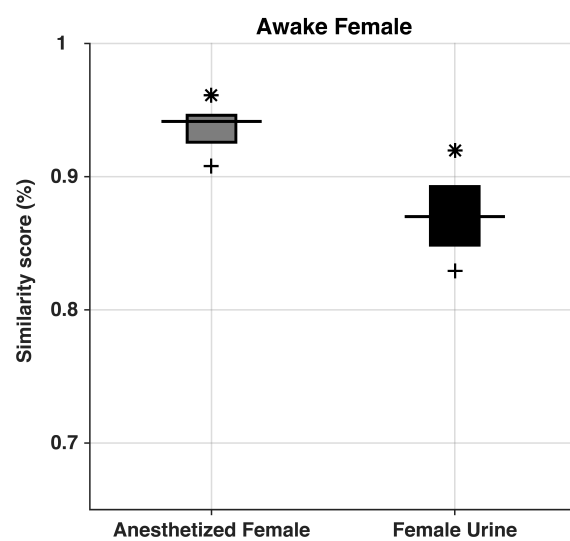
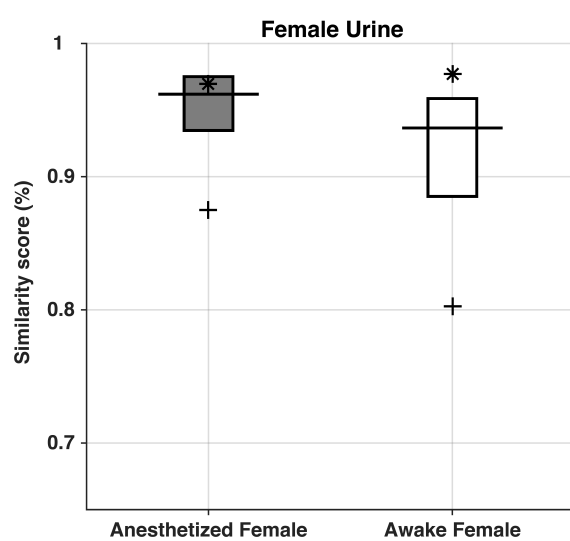


Figure S10. Cross Repertoire Similarity Matrix and Boxplot measures for vocalization data in Chabout et al., 2015.

(A-C) Similarity matrices for each pair-wise syllable repertoire comparison. **(D)** Boxplot similarity metrics with each condition serving as the reference syllable repertoire.

Figure S11, Related to Table 1

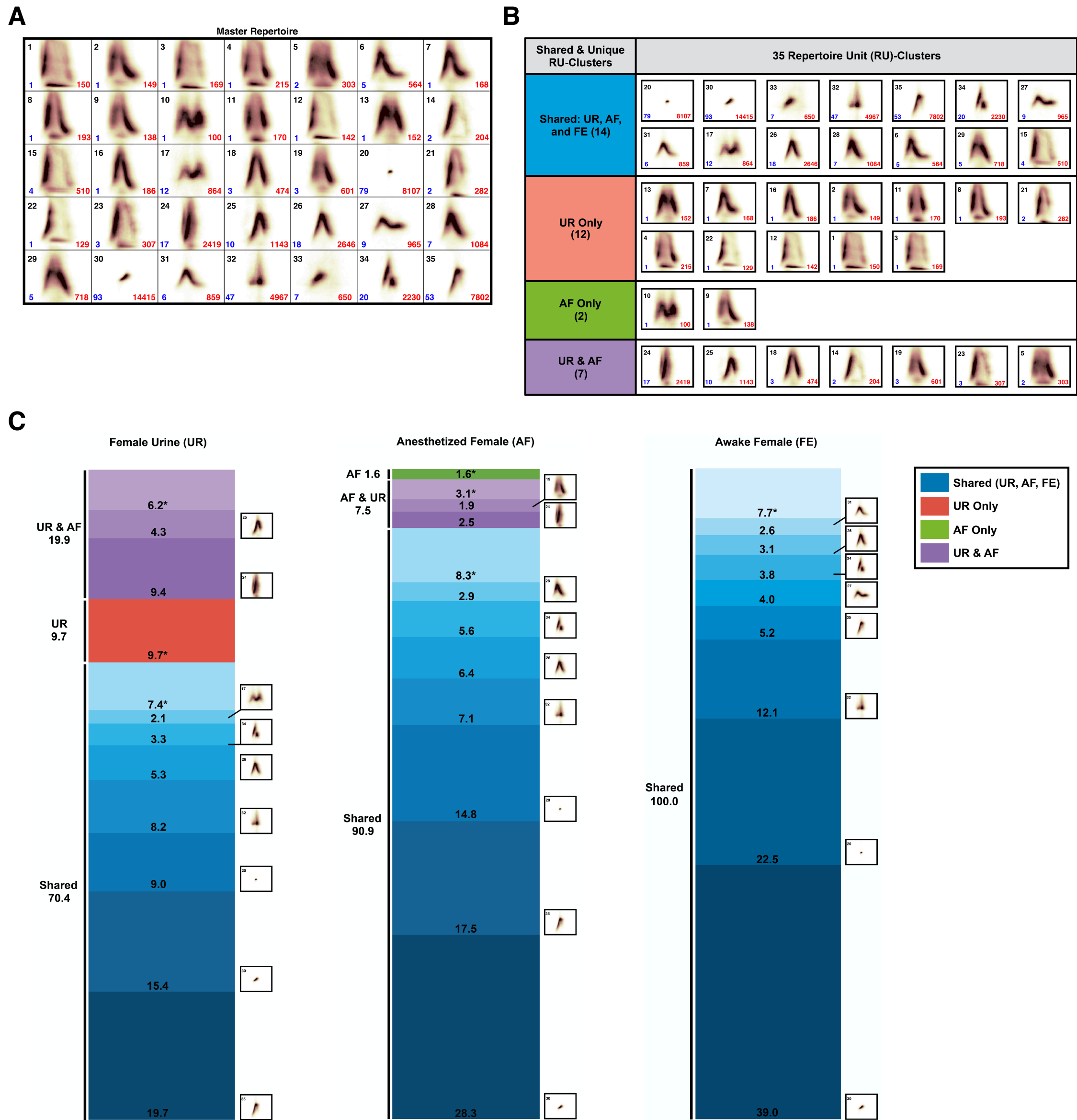


Figure S11. Master repertoire and shared and unique RU-clusters across vocalization datasets in Chabout et al., 2015.

(A) Master repertoire of 35 RU-clusters generated from a cluster analysis of the female urine (UR), anesthetized female (AF), and awake female (FE) syllable repertoires. The total number of RUs and syllables in each cluster are shown in blue and red, respectively. **(B)** Each RU-cluster was categorized as based on whether it contains RUs from each social condition (“shared”) or only from a subset of conditions (“unique”). **(C)** For each social condition, the proportion of syllables that are present within RUs, which are present within shared or unique RU-cluster categories (see **B** and legend), is shown on the left. Within each shared or unique category, the most-to-least prevalent RU-cluster types are indicated by boxes, with prevalence indicated by a gradation of dark-to-light colors. The percentage of syllables within each RU-cluster is noted within each box and the representative image for each cluster is shown on the right. *Designates the proportion of syllables that are present in RU-clusters that contain a relatively small percentage of syllables (e.g., <2.0%). The percentage of syllables in these RU-clusters are summed and no image is given. RU-cluster images can be seen in Panel **B**.