Supplemental information
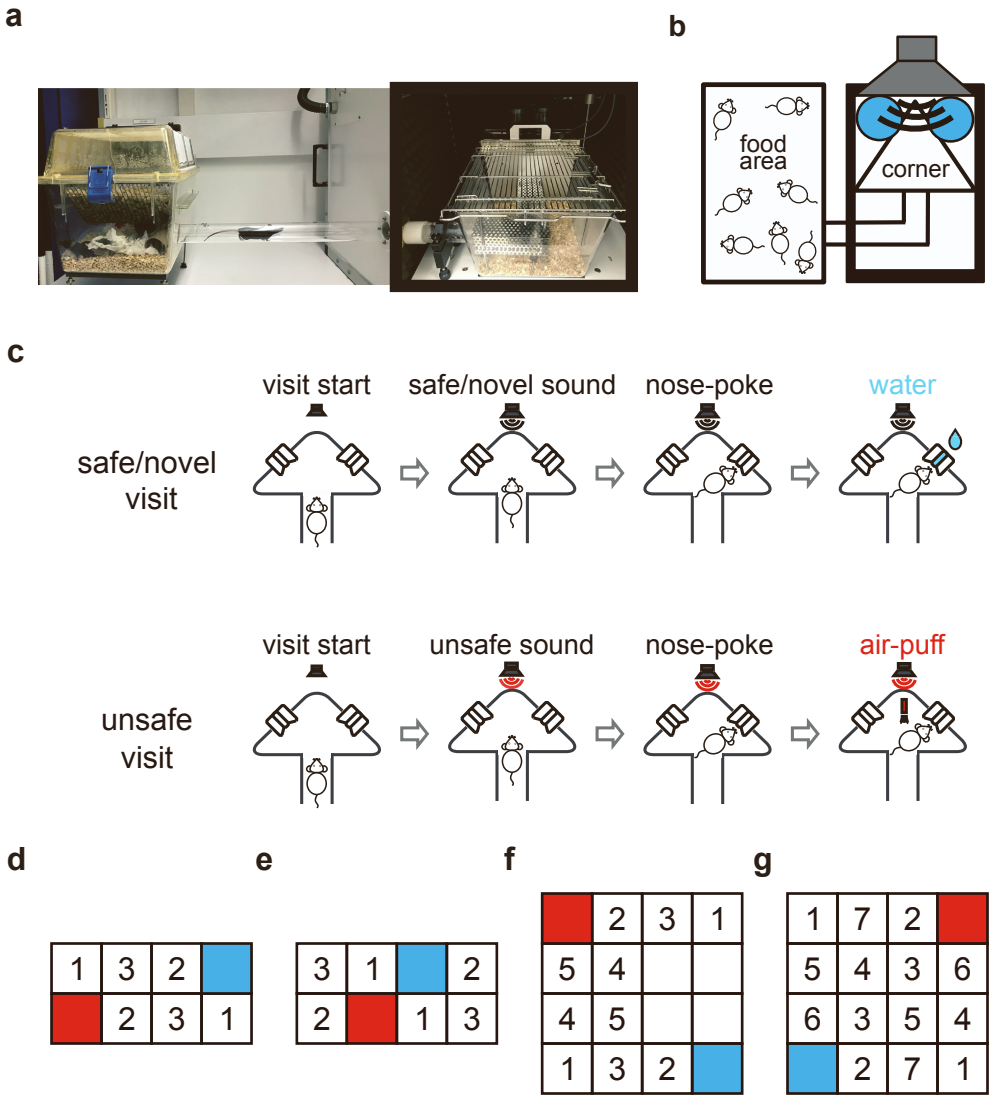
The perceptual categorization of multidimensional

stimuli is hierarchically organized

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Figure S1

a

b

food
area

corner

c

safe/novel
visit

visit start   safe/novel sound   nose-poke   water

unsafe
visit

visit start   unsafe sound   nose-poke   air-puff

d

1	3	2	
	2	3	1

e

3	1		2
2		1	3

f

	2	3	1
5	4		
4	5		
1	3	2	

g

| 1	7	2	
5	4	3	6
6	3	5	4
	2	7	1

Supplementary Fig. 1 Absolute-judgement based discrimination protocol and Audiobox apparatus.
a, Photos of the Audiobox. **b**, Schematic representation of the Audiobox. **c**, **Top**, Schema of a single safe/novel visit. Subjects initiated a visit by entering the corner. The sound stimulus was presented for the duration of each visit. Nose-poking was followed by access to water. **c**, **Bottom**, Schema of a single unsafe visit in which nose-poking was followed by an air-puff. **d-g**, The order of generalization testing. Blue and red rectangles represent safe and unsafe sounds. Numbers indicate the order of novel sounds being tested. **Related to Figure 1 and STAR Methods.**

Figure S2

a

b
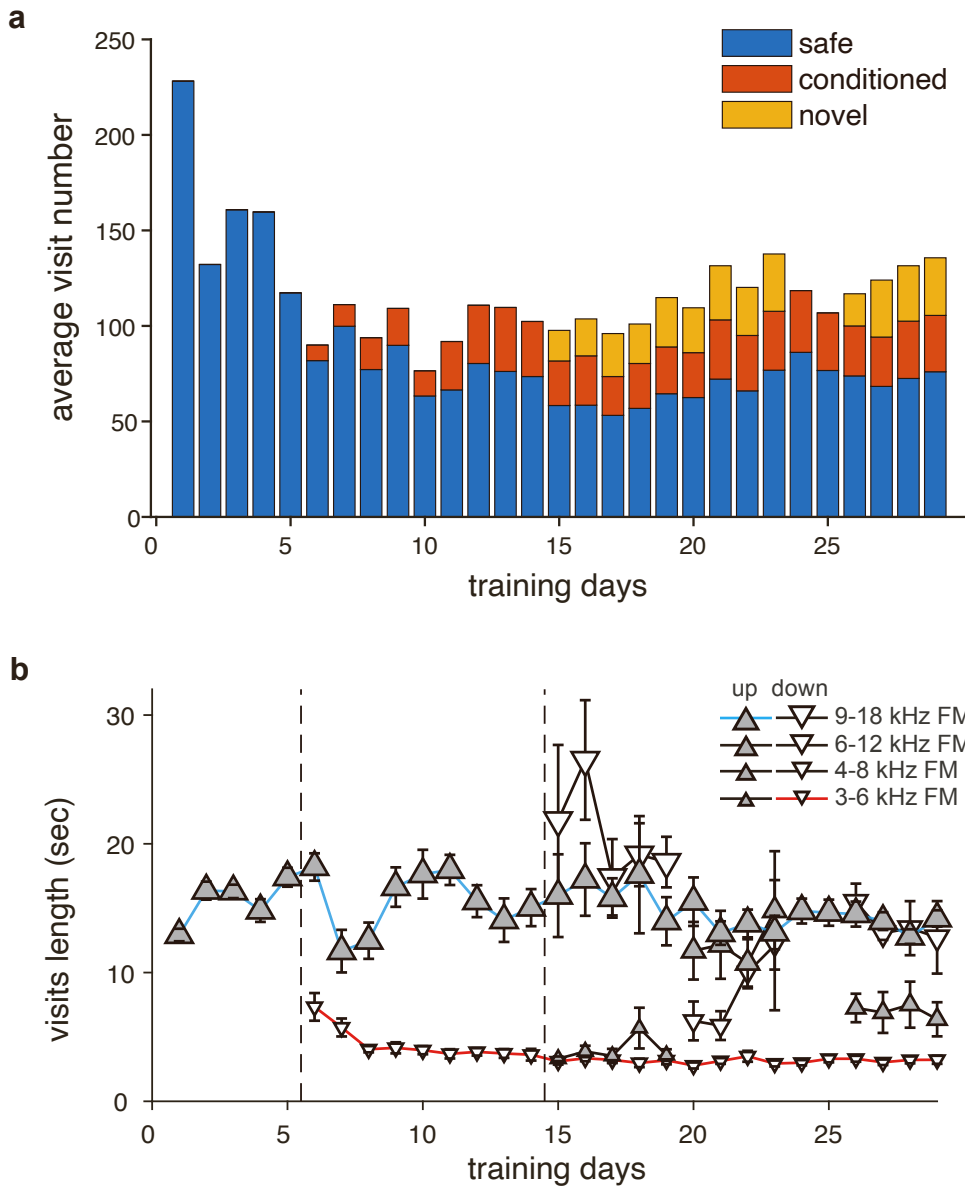
Supplementary Fig. 2 Absolute-judgement based discrimination protocol and Audiobox apparatus.
a,Average trial (visit) number per day for mice showed in Fig. 1 is shown in bar graph. Color codes the type of visit. **b**, Mean daily response for mice trained with the combination of frequency range and sweep directions shown in Fig. 1b. Performance was expressed as the duration of visits (visit length) for different types of stimuli. Error bars represent standard error. **Related to Figure 1.**

Figure S3
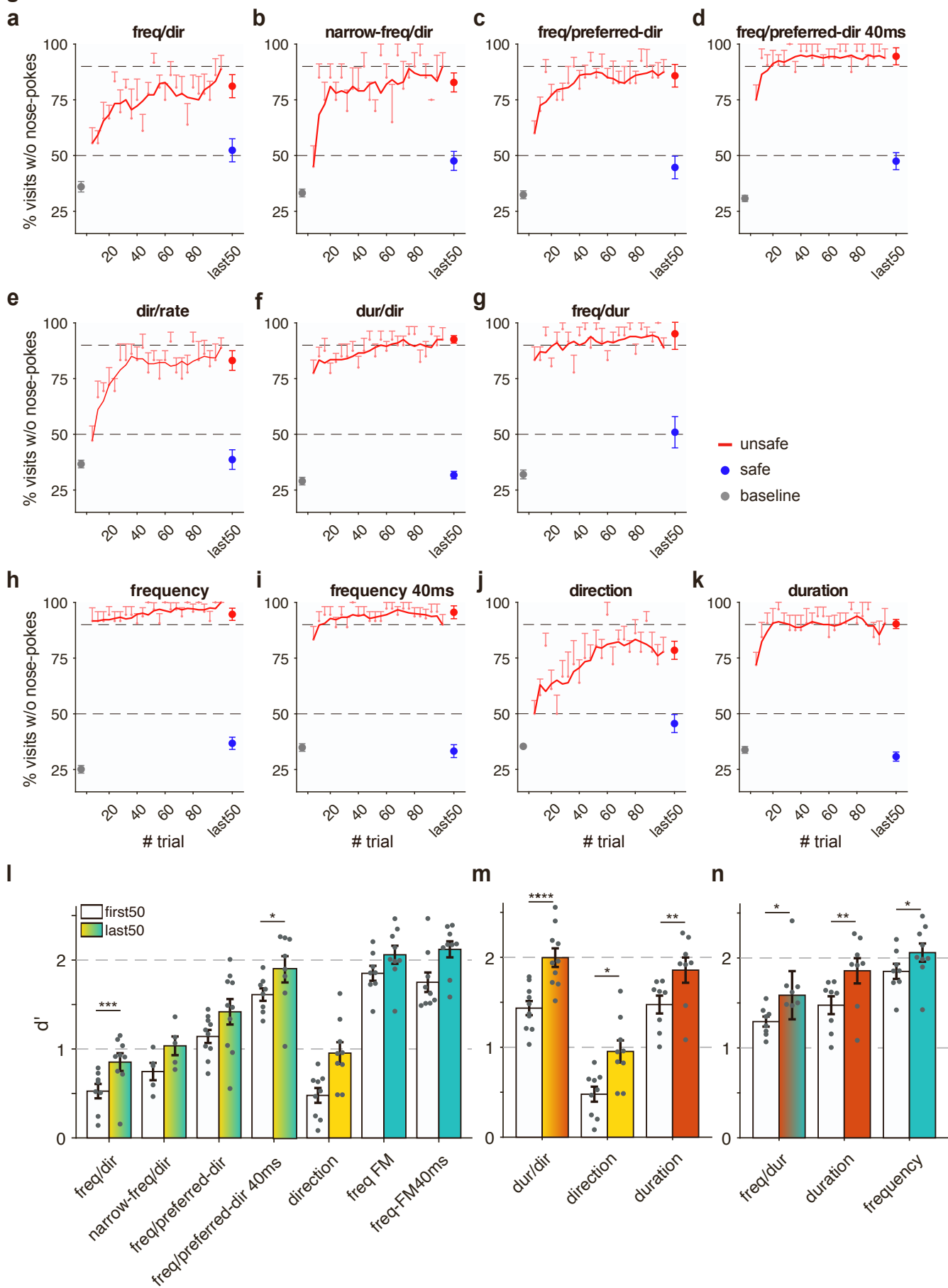
Supplementary Fig. 3 Learning curves and discrimination comparison for mice trained with FMs.

a-g, Learning curves for bi-dimensional discrimination task. Responses to the unsafe sound were calculated by averaging blocks of 4 unsafe visits starting after the first unsafe visit (red). Baseline performance (grey dot) was calculated as the mean response over the last 50 safe visits before the first unsafe visit (safe-only phase). Responses to the safe (blue dot) or unsafe (red dot) sound during the last 50 unsafe visits were plotted. Learning curves were smoothed using a 5-moving average filter. **h-k**, Learning curves for discrimination along a single dimension. **l**, d' values of individual mice trained to discriminate FM sweeps differing in the frequency range (cyan) or direction (yellow) or both dimensions (cyan and yellow). **m**, d' values of individual mice trained to discriminate FMs differing in direction (yellow) or duration (red) or both dimensions (red and yellow). **n**, d' values of individual mice trained to discriminate FMs differing in duration (red) or frequency range (cyan) or both dimensions (cyan and red). Error bars represent standard error. **Related to Figure 7.**

Figure S4
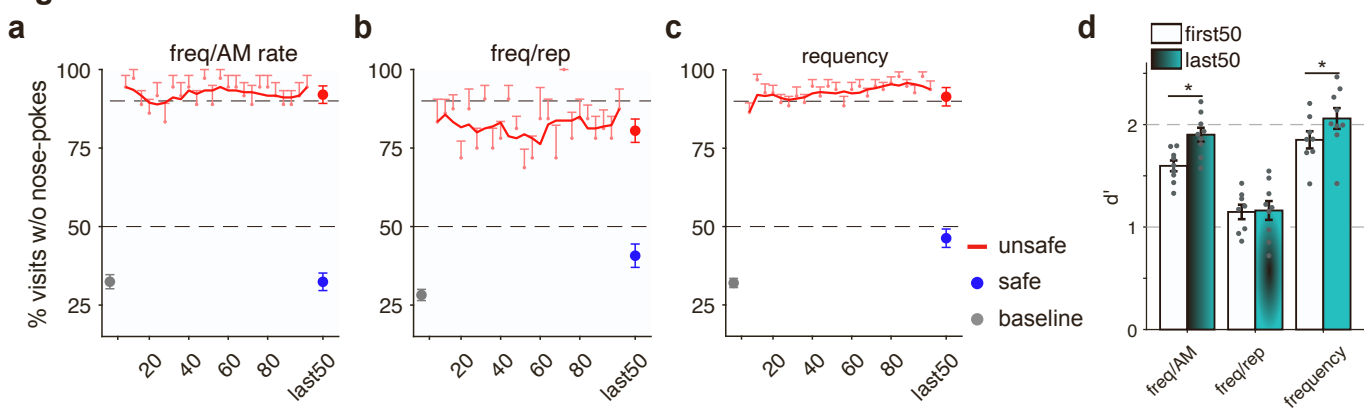
Supplementary Fig. 4 Learning curves and discrimination comparison for mice trained with periodic sounds.
a-c, Learning curves for mice trained to discriminate sounds differing carrier frequency and AM rate (**a**), tone frequency and repetition rate (**b**), or only frequency (**c**). Response to the unsafe sound was calculated by averaging blocks of 4 conditioned visits starting after the first conditioned visit (red). Baseline performance (grey dot) was calculated as the mean response over the last 50 safe visits before the first unsafe visit (safe-only phase). Average responses to the safe (blue dot) or unsafe (red dot) sounds during the last 50 unsafe visits was plotted. Learning curves were smoothed using a 5-moving average filter. **d,** d' values of individual mice trained to do uni- or bi-dimensional discrimination. Error bars represent standard error. **Related to Figure 7.**