## ~ SUPPLEMENTARY TABLES ~

**Table S1: Sample sizes.** Number of successful trials (out of 42 presented trials) and number of all unique calls recorded per stimulus and individual. The column 'stimulus type' lists the presented sound (Exp. I) or control stimulus (Exp. II).

| | | | individual | | |
|---|---|---|---|---|---|
| **Experiment** | | **stimulus type** | **A** | **B** | **C** |
| **I** | **successful trials** | **rustling** | 42 | 39 | 40 |
| | | **amplitude inversion** | 42 | 36 | 41 |
| | | **phase scramble** | 42 | 41 | 42 |
| | **unique calls recorded** | **rustling** | 2163 | 1932 | 2393 |
| | | **amplitude inversion** | 2303 | 1869 | 2361 |
| | | **phase scramble** | 2263 | 2107 | 2507 |
| **II** | **successful trials** | **silence** | 41 | 36 | 39 |
| | | **amplitude inversion** | 37 | 35 | 37 |
| | | **phase scramble** | 39 | 40 | 38 |
| | **unique calls recorded** | **silence** | 2309 | 2004 | 2065 |
| | | **amplitude inversion** | 2030 | 1922 | 1976 |
| | | **phase scramble** | 2079 | 2242 | 2119 |

**Table S2: Modelled difference in call level (in dB, REMLE) recorded at the central microphone (0°) during playback compared to silence1 in Experiment I.** These results originate from the models that were selected by the tests in **Table S3.**

| **individual** | **stimulus** | | |
|---|---|---|---|
| | **rustling** | **amplitude inversion** | **phase scramble** |
| **A** | 3.6 | 3.1 | 9.6 |
| **B** | 2.1 | 6.1 | 2.7 |
| **C** | / | / | / |

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**Table S3: Statistical results for the effect of stimulus type, experimental phase and their interactions on the call level recorded at the central microphone (0°) in Experiment I.**

| individual | effect | LLR | *df* | p |
|---|---|---|---|---|
| **A** | stimulus : phase | 35.58 | 4 | < 0.0001 |
| **B** | stimulus : phase | 18.41 | 4 | 0.0010 |
| **C** | stimulus : phase | 8.64 | 4 | 0.0707 |
| | stimulus | 2.57 | 2 | 0.2763 |
| | phase | 2.78 | 2 | 0.2489 |

**Table S4: Statistical results for the effect of experimental phase on the call level recorded at the central microphone (0°) in Experiment I.** Note that these models were computed separately for each stimulus type, as opposed to the models in **Tab. S3** which were computed for the full data set.

| stimulus | individual | effect | LLR | *df* | p |
|---|---|---|---|---|---|
| **rustling** | **A** | phase | 17.02 | 2 | 0.0002 |
| | **B** | phase | 6.69 | 2 | 0.0352 |
| | **C** | phase | 2.05 | 2 | 0.3588 |
| **amplitude inversion** | **A** | phase | 24.09 | 2 | < 0.0001 |
| | **B** | phase | 48.29 | 2 | < 0.0001 |
| | **C** | phase | 8.31 | 2 | 0.0156 |
| **phase scramble** | **A** | phase | 62.41 | 2 | < 0.0001 |
| | **B** | phase | 23.25 | 2 | < 0.0001 |
| | **C** | phase | 3.21 | 2 | 0.2005 |

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**Table S5: Modelled general increase in call level (in dB, REMLE) during playback compared to silence1 in Experiment I.** These models were computed for calls whose sonar beam was directed at the non-active loudspeakers angles (25° and 42.9°), using their call RMS level recorded at the non-active loudspeakers. The values in the table should not be subtracted from the values in **Table S2**, because they are not additive, being means. Note, however, that the values are lower than in **Table S2**, because besides the general increase in call level, bats also concentrated their scanning beam movements towards the playback source.

| **individual** | **stimulus** | | |
|---|---|---|---|
| | **rustling** | **amplitude inversion** | **phase scramble** |
| **A** | 1.5 | 3.1 | 8.6 |
| **B** | -1.9 | 4.9 | 1.3 |
| **C** | / | / | / |

**Table S6: Modelled difference between the call levels (in dB, REMLE) recorded at the central microphone (0°) and the peripheral microphones (25°), separately for silence1 and playback phase in Experiment I.** Note that the difference was higher during the playback phase in individuals A and B, showing that the beam movements were more often aimed at the playback loudspeaker during the playback than during pre-playback silence. These results originate from the models that were selected by the tests in **Table S6**.

| **phase** | **individual** | **stimulus** | | |
|---|---|---|---|---|
| | | **rustling** | **amplitude inversion** | **phase scramble** |
| **silence1** | **A** | 1.1 | 0.8 | 0.4 |
| | **B** | -0.2 | 0.3 | 0.3 |
| | **C** | 0.6 | 1.3 | 1.3 |
| **playback** | **A** | 1.7 | 1.7 | 2.8 |
| | **B** | 0.9 | 1.4 | 1.4 |
| | **C** | 0.6 | 1.3 | 1.3 |

**Table S7: Statistical results for the microphone angle, experimental phase, presented stimulus type and their interactions in Experiment I.** Recordings from the central microphones (0°) and the surrounding peripheral microphones (25°) were included in the modelled dataset.

| individual | effect | LLR | *df* | p |
|---|---|---|---|---|
| **A** | angle : phase : stimulus | 17.00 | 4 | 0.0019 |
| **B** | angle : phase : stimulus | 4.56 | 4 | 0.3353 |
| | angle : stimulus | 6.91 | 2 | 0.0315 |
| | angle : phase | 33.48 | 2 | < 0.0001 |
| | phase : stimulus | 23.10 | 4 | 0.0001 |
| **C** | angle : phase : stimulus | 2.16 | 4 | 0.7064 |
| | angle : stimulus | 15.62 | 2 | 0.0004 |
| | angle : phase | 0.48 | 2 | 0.7829 |
| | phase : stimulus | 9.72 | 4 | 0.0454 |

**Table S8: Statistical results for the microphone angle, presented stimulus type, loudspeaker position and their interactions computed separately for the silence1 and playback phase of Experiment 1.** Note that stimulus effect and its interactions did not play a role in the model during the silence1 phase, but only during the playback phase. Significant angle:loudspeaker interactions are a result of different call levels recorded at each microphones, probably due to preferred scanning directions of the bats (see **Fig. S2**). These interactions were present irrespective of experimental phase or individual tested. The threefold interactions angle:stimulus:loudspeaker did not have a significant effect and are therefore not shown in the table.

| **experimental phase** | **individual** | **effect** | **LLR** | ***df*** | **p** |
|---|---|---|---|---|---|
| **silence1** | **A** | angle : stimulus | 1.37 | 2 | 0.5046 |
| | | stimulus : loudspeaker | 7.19 | 4 | 0.1260 |
| | | stimulus | 2.77 | 2 | 0.2498 |
| | | angle : loudspeaker | 195.23 | 2 | < 0.0001 |
| | **B** | angle : stimulus | 1.45 | 2 | 0.4833 |
| | | stimulus : loudspeaker | 1.79 | 4 | 0.7750 |
| | | stimulus | 0.06 | 2 | 0.9685 |
| | | angle : loudspeaker | 121.42 | 2 | < 0.0001 |
| | **C** | angle : stimulus | 1.17 | 2 | 0.5568 |
| | | stimulus : loudspeaker | 9.57 | 4 | *0.0482 |
| | | stimulus | 1.67 | 2 | 0.4331 |
| | | angle : loudspeaker | 121.97 | 2 | < 0.0001 |
| **playback** | **A** | angle : stimulus | 16.39 | 2 | 0.0003 |
| | | stimulus : loudspeaker | 3.31 | 4 | 0.5071 |
| | | angle : loudspeaker | 171.92 | 2 | < 0.0001 |
| | **B** | angle : stimulus | 8.31 | 2 | 0.0157 |
| | | stimulus : loudspeaker | 3.58 | 4 | 0.4652 |
| | | angle : loudspeaker | 104.44 | 2 | < 0.0001 |
| | **C** | angle : stimulus | 5.45 | 2 | 0.0655 |
| | | stimulus : loudspeaker | 14.43 | 4 | 0.0060 |
| | | angle : loudspeaker | 123.69 | 2 | < 0.0001 |

* This interaction term had a high *p*-value and was not supported by the AIC.

**Table S9: Statistical results for the microphone angle, experimental phase, presented stimulus type and their interactions in Experiment I.** These results were calculated for a subset of the data including only recordings of the three microphones located next to the loudspeakers (i.e. microphones 3, 5, and 6). For each playback, the microphone next to the active playback loudspeaker had an angle of 0°, while the other two microphones were either located at 25° and 42.9° (if stimuli were played from the left or right loudspeaker) or were both located at 25° (if stimuli were played from the middle loudspeaker).

| **individual** | **effect** | **LLR** | ***df*** | **p** |
|---|---|---|---|---|
| **A** | angle : phase : stimulus | 88.75 | 8 | < 0.0001 |
| **B** | angle : phase : stimulus | 35.79 | 8 | < 0.0001 |
| **C** | angle : phase : stimulus | 7.31 | 8 | 0.5040 |
| | angle : stimulus | 11.98 | 4 | 0.0175 |
| | angle : phase | 15.37 | 4 | 0.0040 |
| | phase : stimulus | 6.85 | 4 | 0.1442 |

**Table S10: Modelled difference in call level (in dB, REMLE) between the playback microphone (0°) and the other two microphones at the silent loudspeakers (at 25° or 42.9°) in Experiment I.** Note that this difference is higher during the playback phase than the silence1 phase for those playbacks where individuals A and B directed their calls towards the playback.

| **phase** | **difference re. angle** | **individual** | **stimulus** | | |
|---|---|---|---|---|---|
| | | | **rustling** | **amplitude inversion** | **phase scramble** |
| **silence1** | **25°** | **A** | 0.7 | 0.8 | 0.1 |
| | | **B** | -0.9 | 0.1 | 0.2 |
| | | **C** | -0.4 | -0.4 | -0.4 |
| | **42.9°** | **A** | 1.6 | 0.8 | 0.5 |
| | | **B** | -0.5 | 0.5 | -0.2 |
| | | **C** | -0.2 | -0.2 | -0.2 |
| **playback** | **25°** | **A** | 0.8 | 1.4 | 2.4 |
| | | **B** | 0.2 | 1.9 | 0.8 |
| | | **C** | 0.2 | 0.2 | 0.2 |
| | **42.9°** | **A** | 2.5 | 3.2 | 7.0 |
| | | **B** | 1.5 | 5.3 | 1.0 |
| | | **C** | -0.7 | -0.7 | -0.7 |

**Table S11: Statistical results for microphone angle, presented stimulus type and their interaction computed separately for the silence1 and playback phase of Experiment 1.** These results were calculated using a subset of the data (i.e., only recordings of the three microphones located next to the loudspeakers were included).

| experimental phase | individual | effect | LLR | *df* | p |
|---|---|---|---|---|---|
| **silence1** | **A** | angle : stimulus | 9.80 | 4 | *0.0440 |
| | | stimulus | 2.05 | 2 | 0.3586 |
| | | angle | 30.54 | 2 | < 0.0001 |
| | **B** | angle : stimulus | 12.40 | 4 | *0.0146 |
| | | stimulus | 0.01 | 2 | 0.9962 |
| | | angle | 1.47 | 2 | 0.4788 |
| | **C** | angle : stimulus | 1.07 | 4 | 0.8987 |
| | | stimulus | 1.57 | 2 | 0.4567 |
| | | angle | 6.36 | 2 | 0.0415 |
| **playback** | **A** | angle : stimulus | 91.69 | 4 | < 0.0001 |
| | **B** | angle : stimulus | 80.70 | 4 | < 0.0001 |
| | **C** | angle : stimulus | 1.37 | 4 | 0.8497 |
| | | stimulus | 2.74 | 2 | 0.2537 |
| | | angle | 28.46 | 2 | < 0.0001 |

* These interactions had a high *p*-value and were not supported by the AIC.

**Table S12: Statistical results for the effects of stimulus type, experimental phase and their interaction on the proportion of identified sonar beam directions aimed at the playback loudspeaker in Experiment I.** In individuals A and B, we found no significant effect of stimulus (not shown). Only a significant effect of phase or its interaction shows that there was a response to the playback.

| individual | effect | LLR | *df* | p |
|---|---|---|---|---|
| **A** | stimulus : phase | 8.09 | 4 | 0.0885 |
| | phase | 24.34 | 2 | < 0.0001 |
| **B** | stimulus : phase | 8.25 | 4 | 0.0827 |
| | phase | 14.15 | 2 | 0.0008 |
| **C** | stimulus : phase | 8.86 | 4 | 0.0648 |
| | phase | 0.34 | 2 | 0.8431 |
| | stimulus | 9.80 | 2 | 0.0074 |

Both phase and stimulus had three levels, resulting in $df$=4 ( (3-1) × (3-1) ) for interactions and $df$=2 (3-1) for isolated effects.

**Table S13: Modelled proportion of identified sonar beam directions aimed at the playback loudspeaker (MLE) in Experiment I.** Note that 0.33 indicates that the sonar beam was aimed equally often at the three loudspeakers, whereas higher values show the preference for the playback loudspeaker (c.f. Fig. 4). Preferences for the playback loudspeaker were found for individuals A and B during the playback phase.

| phase | individual | Stimulus | | |
|---|---|---|---|---|
| | | **rustling** | **amplitude inversion** | **phase scramble** |
| **silence1** | **A** | 0.39 | 0.37 | 0.28 |
| | **B** | 0.33 | 0.29 | 0.35 |
| | **C** | 0.21 | 0.34 | 0.34 |
| **playback** | **A** | 0.46 | 0.37 | 0.52 |
| | **B** | 0.33 | 0.60 | 0.35 |
| | **C** | 0.21 | 0.34 | 0.34 |

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**Table S14: Statistical results for the effect of experimental phase, condition (rustling vs. control sound) and their interaction on the call level recorded at the playback microphones in Experiment II.** If no interaction was found, the effect of experimental phase and condition were analysed separately.

| Stimuli | individual | effect | LLR | *df* | p |
|---|---|---|---|---|---|
| **rustling vs. silence** | **A** | phase : condition | 40.53 | 2 | < 0.0001 |
| | **B** | phase : condition | 47.39 | 2 | < 0.0001 |
| | **C** | phase : condition | 3.42 | 2 | 0.1809 |
| | | phase | 2.29 | 2 | 0.3183 |
| | | condition | 5.43 | 1 | 0.0198 |
| **rustling vs. amplitude inversion** | **A** | phase : condition | 8.99 | 2 | 0.0112 |
| | **B** | phase : condition | 17.76 | 2 | 0.0001 |
| | **C** | phase : condition | 4.38 | 2 | 0.1118 |
| | | phase | 0.68 | 2 | 0.7103 |
| | | condition | 4.91 | 1 | 0.0267 |
| **rustling vs. phase scramble** | **A** | phase : condition | 30.94 | 2 | < 0.0001 |
| | **B** | phase : condition | 3.61 | 2 | 0.1648 |
| | | phase | 26.77 | 2 | < 0.0001 |
| | | condition | 4.25 | 1 | 0.0392 |
| | **C** | phase : condition | 0.29 | 2 | 0.8641 |
| | | phase | 0.36 | 2 | 0.8367 |
| | | condition | 2.18 | 1 | 0.1401 |

**Table S15: Modelled difference in call level (in dB, REMLE) at the rustling-loudspeaker compared to the control-loudspeaker during the playback phase of Experiment II.**

| **Individual** | **control stimulus** | | |
|---|---|---|---|
| | **silence** | **amplitude inversion** | **phase scramble** |
| **A** | 2.7 | -0.5 | -2.7 |
| **B** | 2.8 | -2.4 | -0.4 |
| **C** | -0.5 | -0.4 | / |

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**Table S16: Modelled proportion of identified sonar beam directions aimed at the rustling-loudspeaker (MLE) in Experiment II.** Only identified sonar beam directions aimed at either of the two playback loudspeakers were used for estimating the proportions. Therefore, 0.5 indicates that bats scanned the playback and control loudspeaker equally, whereas higher values indicate that the sonar beam was more often aimed at the rustling loudspeaker (c.f. Fig. 6). This was found for individuals A and B during the playbacks of rustling with silence, showing a clear reaction to insect-generated sound.

| **Phase** | **individual** | **control stimulus** | | |
|---|---|---|---|---|
| | | **silence** | **amplitude inversion** | **phase scramble** |
| **silence1** | **A** | 0.48 | 0.52 | 0.42 |
| | **B** | 0.44 | 0.37 | 0.46 |
| | **C** | 0.47 | 0.48 | 0.48 |
| **playback** | **A** | 0.66 | 0.52 | 0.42 |
| | **B** | 0.73 | 0.32 | 0.46 |
| | **C** | 0.47 | 0.48 | 0.48 |

## ~ SUPPLEMENTARY FIGURES ~

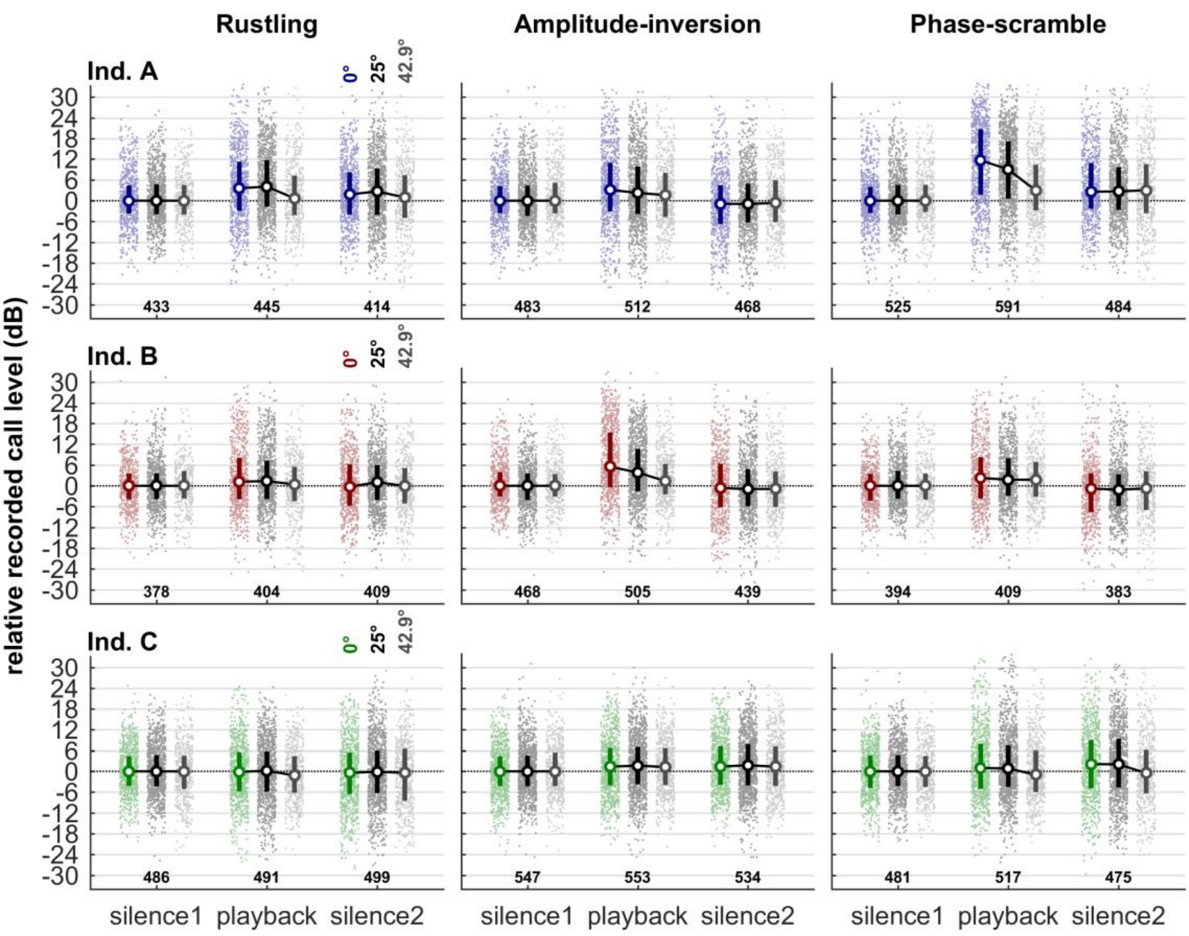


**Fig. S1: Relative call levels in Experiment I (Single Playbacks)** recorded only on the three central microphones (i.e. 3, 5, and 6). Displayed is the data for three individual bats (**A-C**) and for three different playback types (left to right: moth rustling, amplitude-inverted control, phase-scrambled control). Call levels are expressed relative to the mean level of all calls recorded at the same microphone during the silence1 phase. Each panel displays the median (± quartiles) of all calls (dots) recorded on the microphone beside the active playback speaker (0°) and the microphones at 25° and 42.9° angle around this speaker, separately for the three 3-s long phases of an experimental trial (silence1, playback, silence2). Small numbers at the bottom report the total number of unique echolocation calls recorded during the respective phase. The horizontal dotted line at 0 dB indicates no chance in call level relative to the silence1-phase. Experimental phase, microphone angle, and stimulus type and/or their interactions significantly influenced the recorded call level (see results and **Tables S8-S10** for detailed statistics). Note that the considerable variation in call level is caused by the bats' continuous sonar beam scanning on top of sonar beam focusing, which was controlled for by a longitudinal random factors structure.

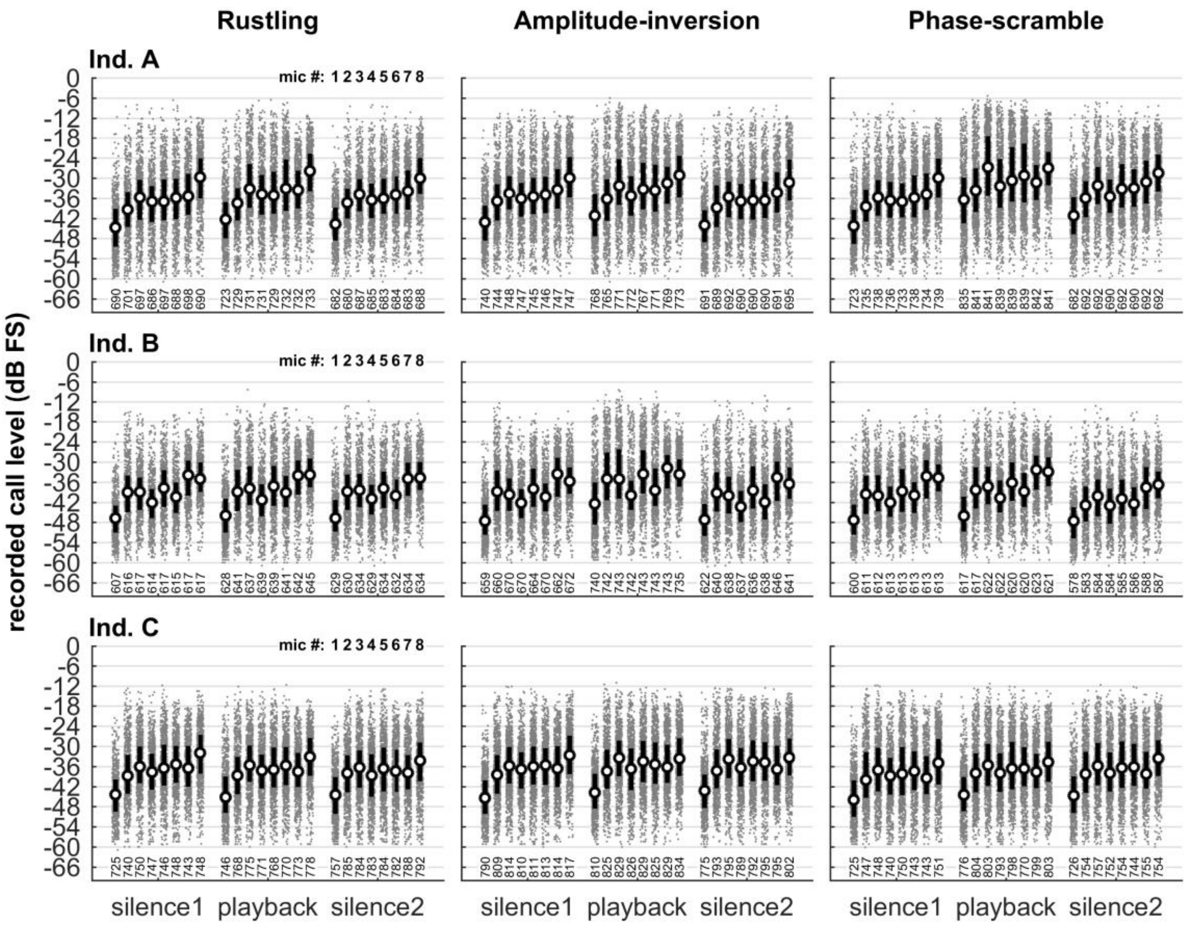


**Fig. S2: Recorded call levels in Experiment I (Single Playbacks)** at each microphone (1-8), for three individual bats (**A-C**) and for three different playback types (left to right: moth rustling, amplitude-inverted control, phase-scrambled control). Each panel displays the median (± quartiles) of all calls (dots) recorded on each microphone, separately for the three 3-s long phases of an experimental trial (silence1, playback, silence2). Small numbers at the bottom report the total number of unique echolocation calls recorded on each microphone during the respective phase. Note that, despite the calibration, there is still considerable variation in recorded call level between the microphones as well as between the bats, potentially caused by preferred scanning directions of the bats.

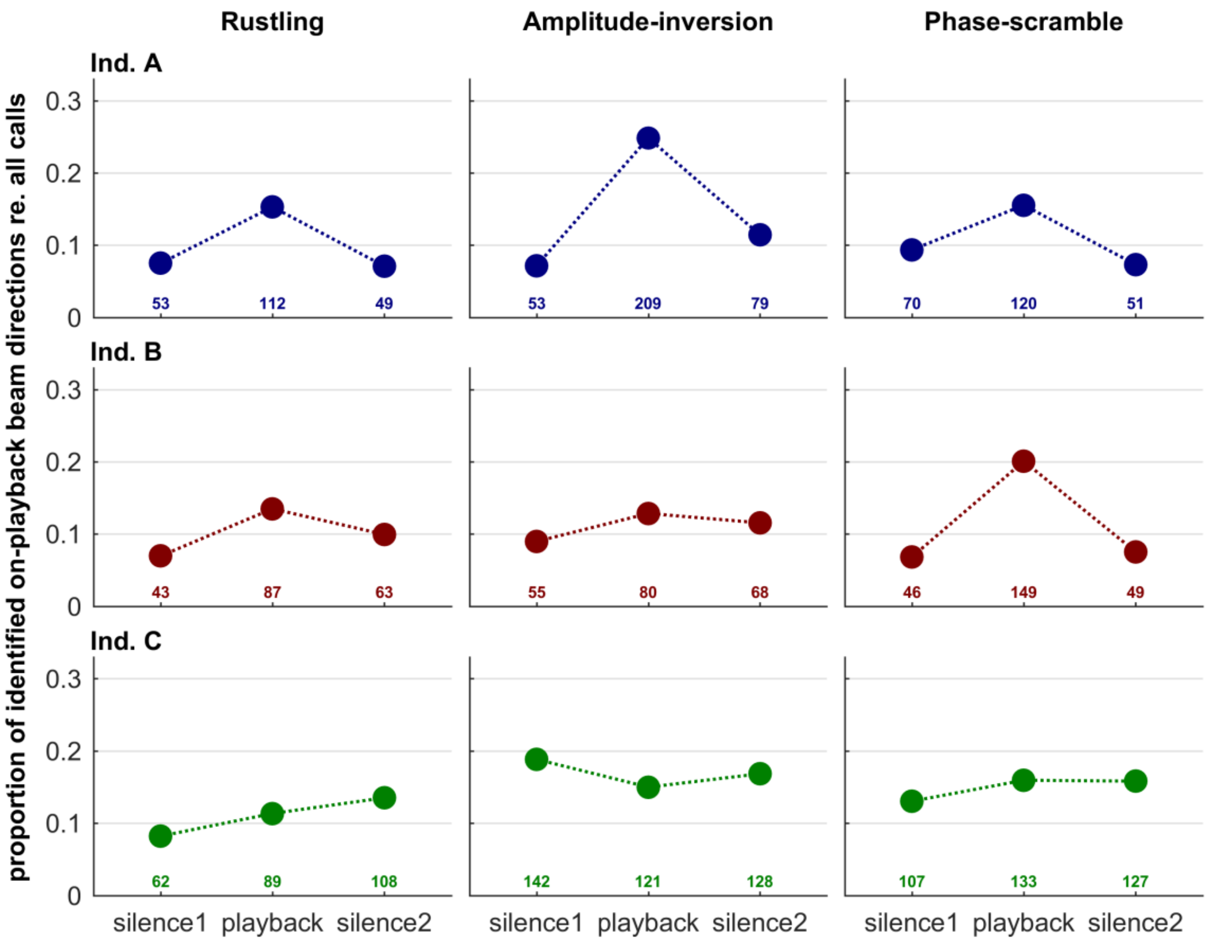


**Fig. S3: Sonar beam direction in Experiment I (Single Playbacks)** for three individual bats (**A-C**) and for three different playback types (left to right: moth rustling, amplitude-inverted control, phase-scrambled control). Each panel shows the proportion of identified sonar beam directions aimed at the playback, relative to the total number of all identified sonar beam directions, separately for each of the three 3-s long phases of an experimental trial (silence1, playback, silence2). Small numbers at the bottom indicate the number of identified beam directions that were aimed at the playback during the respective phase.

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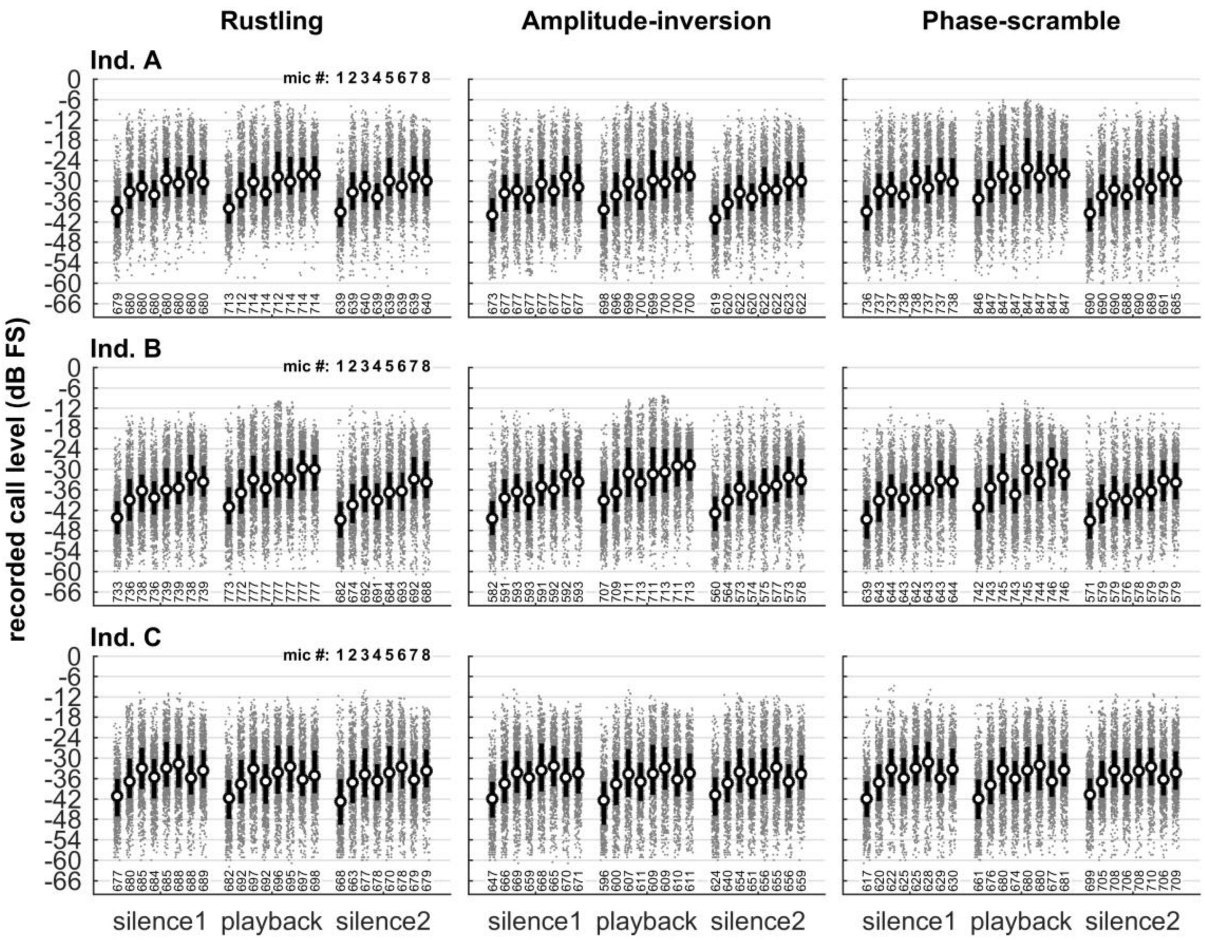


**Fig. S4: Recorded call levels in Experiment II (Paired Playbacks)** at each microphone (1-8), for three individual bats (**A-C**) and for three different playback types (left to right: moth rustling, amplitude-inverted control, phase-scrambled control). Each panel displays the median (± quartiles) of all calls (dots) recorded on each microphone, separately for the three 3-s long phases of an experimental trial (silence1, playback, silence2). Small numbers at the bottom report the total number of unique echolocation calls recorded on each microphone during the respective phase. Note that, despite the calibration, there is still considerable variation in recorded call level between the microphones as well as between the bats, potentially caused by preferred scanning directions of the bats.

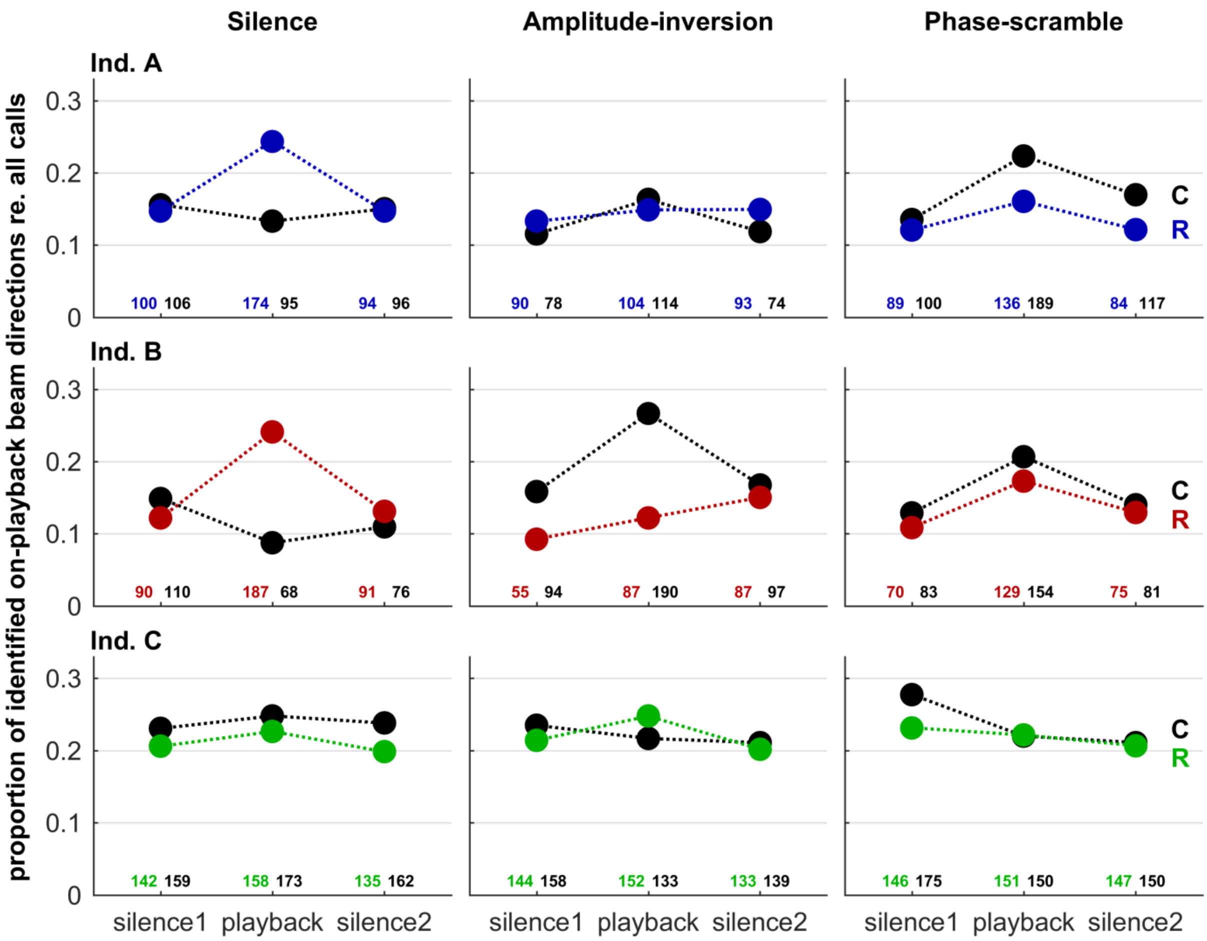


**Fig. S5: Sonar beam direction in Experiment II (Paired Playbacks).** For the three bats (individuals **A-C**) the proportion of identified sonar beam directions are shown with each column displaying the results for one of the three paired playback types: The sound of a moth rustling on leaves was either paired with silence (left), or with the amplitude-inverted (middle) or phase-scrambled (right) control version of a different rustling sound. Each panel shows the proportion of identified beam directions that were aimed at the rustling (coloured, R) and control playback (black, C), relative to the total number of identified beam directions, separately for each of the three 3-s long phases of an experimental trial (silence1, playback, silence2). Only two loudspeakers, the left and right one, were included in this analysis. Small numbers at the bottom indicate the number of unique directed calls that were focused on the two playbacks during the respective phase.