**Figure 1—source data 1. Statistics**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Panel** | **Comparison**  | **Mean & SEM** | **Test** | **Statistic** | **p-value** | **Correction** |
| E | Effect of optogenetics on contrast task (N = 5 mice) | 17 ms: 75 ± 3%33 ms: 76 ± 4%50 ms: 74 ± 4%66 ms: 77 ± 6%100 ms: 82 ± 4% 133 ms: 91 ± 3%No opto: 89 ± 3% | One-way repeated measures ANOVA,Post-hoc Tukey-Kramer | Main: F(6) = 5.16 | Main: 0.005 \*\*17 vs. no: 0.027 \*33 vs. no: 0.06250 vs. no: 0.022 \*66 vs. no: 0.095 100 vs. no: 0.551133 vs. no: 0.999 | Main: Bonferroni for 3 tasks |
| Inflection point - Contrast | 99 ± 8 ms (SD) | Bootstrap (n = 1000) |  |  |  |
| Effect of optogenetics on orientation task (N = 6 mice) | 33 ms: 61 ± 2%66 ms: 62 ± 3%100 ms: 60 ± 3%133 ms: 65 ± 4%166 ms: 67 ± 3% 200 ms: 70 ± 3%No opto: 73 ± 2% | One-way repeated measures ANOVA,Post-hoc Tukey-Kramer | Main: F(6) = 3.55 | Main: 0.027 \*33 vs. no: 0.034 \*66 vs. no: 0.051100 vs. no: 0.021 \*133 vs. no: 0.322166 vs. no: 0.566200 vs. no: 0.975 | Main: Bonferroni for 3 tasks |
| Inflection point - Orientation | 156 ± 35 ms (SD) | Bootstrap |  |  |  |
| Effect of optogenetics on phase task (N= 6 mice) | 33 ms: 60 ± 4%66 ms: 52 ± 4%100 ms: 64 ± 2%133 ms: 63 ± 6%166 ms: 69 ± 3% 200 ms: 71 ± 3%No opto: 73 ± 2% | One-way repeated measures ANOVA, Post-hoc Tukey-Kramer | Main: F(6) = 5.03 | Main: 0.003\*\*33 vs. no: 0.11566 vs. no: 0.001 \*\*100 vs. no: 0.435133 vs. no: 0.702166 vs. no: 0.976200 vs. no: 0.999 | Main: Bonferroni for 3 tasks |
| Inflection point – Phase | 134 ± 30 ms (SD) | Bootstrap |  |  |  |

**Figure 1—figure supplement 2**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Panel** | **Comparison**  | **Mean & SEM** | **Test** | **Test Statistic** | **p-value** | **Correction** |
| G,inset | Firing rate for laser on vs. laser off (170 units from 3 GAD2Cre mice) | Off: 13.6 ± 1.0 sp/sOn: 3.3 ± 0.7 sp/s | LME: *rate ~ opto + (1|unit) + (opto|session)* | F(1, 338) = 55.58 | < 0.001 \*\*\* | none |

**Figure 1—figure supplement 3**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Panel** | **Comparison**  | **Mean & SEM** | **Test** | **Test Statistic** | **p-value** | **Correction** |
| E | Evoked firing rate for laser on vs. laser off (109 units from 4 WT mice) | Off: 10.0 ± 0.9 sp/sOn: 9.6 ± 0.9 sp/s | LME: *rate ~ opto + (1|unit) + (opto|session)* | F(1, 402) = 16.83 | < 0.001 \*\*\* | none |

**Figure 1—figure supplement 4**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Panel** | **Comparison**  | **Mean & SEM** | **Test** | **Statistic** | **p-value** | **Correction** |
| B | Contrast - Hits |  17 ms: 58 ± 5 % 33 ms: 59 ± 6 % 50 ms: 58 ± 4 % 67 ms: 60 ± 5 %100 ms: 67 ± 4 %133 ms: 75 ± 3 %No opto: 78 ± 4 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect: F = 9.10 | Main: 0.00011 \*\*\* 17 vs. no: 0.00018 \*\*\* 33 vs. no: 0.00024 \*\*\* 50 vs. no: 0.00013 \*\*\* 67 vs. no: 0.00057 \*\*\*100 vs. no: 0.045 \*133 vs. no: 0.88 | Main: Bonferroni for 3 tasks |
| Contrast - Errors |  17 ms: 20 ± 3 % 33 ms: 18 ± 3% 50 ms: 20 ± 4 % 67 ms: 19 ± 5 %100 ms: 15 ± 3 %133 ms: 8 ± 4 %No opto: 10 ± 3 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect:F = 4.23 | Main: 0.016 \* 17 vs. no: 0.022 \* 33 vs. no: 0.063 50 vs. no: 0.018 \* 67 vs. no: 0.055100 vs. no: 0.33133 vs. no: 0.99 | Main: Bonferroni for 3 tasks |
| Contrast - Misses |  17 ms: 22 ± 6 % 33 ms: 23 ± 6 % 50 ms: 22 ± 3 % 67 ms: 21 ± 5 %100 ms: 17 ± 4 %133 ms: 17 ± 6 %No opto: 12 ± 3 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect:F = 2.51 | Main: 0.15 17 vs. no: 0.045 \* 33 vs. no: 0.021 \* 50 vs. no: 0.040 \* 67 vs. no: 0.060100 vs. no: 0.48133 vs. no: 0.51 | Main: Bonferroni for 3 tasks |
| Orientation - Hits |  17 ms: 37 ± 7 % 33 ms: 36 ± 7 % 50 ms: 39 ± 6 % 67 ms: 38 ± 8 %100 ms: 43 ± 7 %133 ms: 45 ± 8 %No opto: 51 ± 2 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect:F = 2.98 | Main: 0.055 17 vs. no: 0.014 \* 33 vs. no: 0.011 \* 50 vs. no: 0.040 \* 67 vs. no: 0.025 \*100 vs. no: 0.28133 vs. no: 0.62 | Main: Bonferroni for 3 tasks |
| Orientation - Errors |  17 ms: 23 ± 5 % 33 ms: 22 ± 3 % 50 ms: 26 ± 2 % 67 ms: 22 ± 4 %100 ms: 21 ± 2 %133 ms: 20 ± 3 %No opto: 19 ± 2 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect:F = 1.33 | Main: 0.81 17 vs. no: 0.45 33 vs. no: 0.74 50 vs. no: 0.080 67 vs. no: 0.84100 vs. no: 0.90133 vs. no: 1.00 | Main: Bonferroni for 3 tasks |
| Orientation - Misses |  17 ms: 40 ± 12 % 33 ms: 42 ± 9 % 50 ms: 35 ± 7 % 67 ms: 41 ± 10 %100 ms: 36 ± 8 %133 ms: 35 ± 10 %No opto: 31 ± 4 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect:F = 1.00 | Main: 1.00 17 vs. no: 0.37 33 vs. no: 0.22 50 vs. no: 0.91 67 vs. no: 0.29100 vs. no: 0.83133 vs. no: 0.90 | Main: Bonferroni for 3 tasks |
|  | Phase - Hits |  17 ms: 32 ± 6 % 33 ms: 28 ± 5 % 50 ms: 38 ± 7 % 67 ms: 37 ± 6 %100 ms: 45 ± 8 %133 ms: 49 ± 7 %No opto: 49 ± 3 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect:F = 6.1 | Main: 0.00050 17 vs. no: 0.0037 \*\* 33 vs. no: 0.00050 \*\*\* 50 vs. no: 0.12 67 vs. no: 0.081100 vs. no: 0.90133 vs. no: 1.00 | Main: Bonferroni for 3 tasks |
|  | Phase - Errors |  17 ms: 23 ± 5 % 33 ms: 28 ± 6 % 50 ms: 24 ± 3 % 67 ms: 23 ± 6 %100 ms: 21 ± 2 %133 ms: 20 ± 4 %No opto: 18 ± 2 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect:F = 1.7 | Main: 0.47 17 vs. no: 0.67 33 vs. no: 0.029 50 vs. no: 0.47 67 vs. no: 0.56100 vs. no: 0.89133 vs. no: 0.98 | Main: Bonferroni for 3 tasks |
|  | Phase - Misses |  17 ms: 46 ± 10 % 33 ms: 43 ± 10 % 50 ms: 38 ± 9 % 67 ms: 40 ± 9 %100 ms: 34 ± 10 %133 ms: 31 ± 10 %No opto: 33 ± 4 % | One-way repeated measures ANOVA, Post-hoc Dunnett | Main effect:F = 2.2 | Main: 0.20 17 vs. no: 0.091 33 vs. no: 0.24 50 vs. no: 0.82 67 vs. no: 0.65100 vs. no: 1.00133 vs. no: 1.00 | Main: Bonferroni for 3 tasks |

**Figure 1—figure supplement 5**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Panel** | **Comparison**  | **Mean & SEM** | **Test** | **Statistic** | **p-value** | **Correction** |
| C | Effect of optogenetics on maximum lick rate (N = 8 mice) | 17 ms: 7.4 ± 0.4 l/s33 ms: 7.5 ± 0.6 l/s50 ms: 7.9 ± 0.5 l/s67 ms: 7.3 ± 0.5 l/s100 ms: 7.2 ± 0.4 l/s133 ms: 7.3 ± 0.6 l/s166 ms: 7.2 ± 0.6 l/s200 ms: 7.5 ± 0.6 l/sNo opto: 6.9 ± 0.4 l/s | One-way repeated measures ANOVA, Post-hoc Tukey-Kramer | Main effect:F(8) = 1.37 | Main: 0.23517 vs. no: 0.55233 vs. no: 0.85250 vs. no: 0.09166 vs. no: 0.946100 vs. no: 0.988133 vs. no: 0.940166 vs no: 0.999 200 vs no: 0.799 | None |
| D | Effect of optogenetics on reaction times in contrast task (N = 5 mice) | 17 ms: 756 ± 100 ms33 ms: 745 ± 82 ms50 ms: 749 ± 87 ms66 ms: 684 ± 67 ms100 ms: 705 ± 54 ms133 ms: 695 ± 44 msNo opto: 632 ± 27 ms | One-way repeated measures ANOVA, Post-hoc Tukey-Kramer | Main effect: F(6) = 1.74 | Main: 0.46917 vs. no: 0.18033 vs. no: 0.24650 vs. no: 0.22566 vs. no: 0.926100 vs. no: 0.730133 vs. no: 0.905 | Main: Bonferroni for 3 tasks |
| Effect of optogenetics on reaction times in orientation task (N = 6 mice) | 33 ms: 800 ± 70 ms66 ms: 763 ± 51 ms100 ms: 789 ± 46 ms133 ms: 798 ± 74 ms166 ms: 773 ± 63 ms200 ms: 771 ± 58 msNo opto: 710 ± 57 ms | One-way repeated measures ANOVA, Post-hoc Tukey-Kramer | Main effect: F(6) = 1.75 | Main: 0.43733 vs. no: 0.11866 vs. no: 0.666100 vs. No: 0,190133 vs. no: 0.131166 vs. no: 0.340200 vs. no: 0.365 | Main: Bonferroni for 3 tasks |
| Effect of optogenetics on reaction times in phase task (N = 6 mice) | 33 ms: 808 ± 84 ms66 ms: 823 ± 59 ms100 ms: 831 ± 69 ms133 ms: 817 ± 61 ms166 ms: 801 ± 43 ms200 ms: 808 ± 52 msNo opto: 691 ± 55 ms | One-way repeated measures ANOVA, Post-hoc Tukey-Kramer | Main effect: F(6) = 3.06 | Main: 0.05633 vs. no: 0.06866 vs. no: 0.028\*100 vs. no: 0.016\*133 vs. no: 0.040\*166 vs. no: 0.103200 vs. no: 0.069 | Main: Bonferroni for 3 tasks |