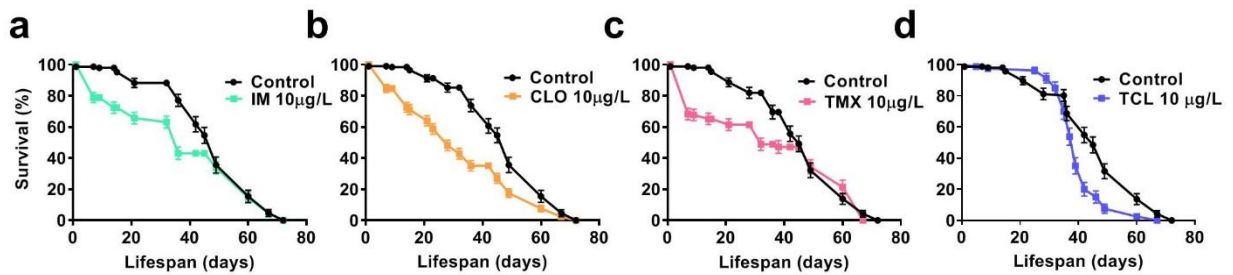
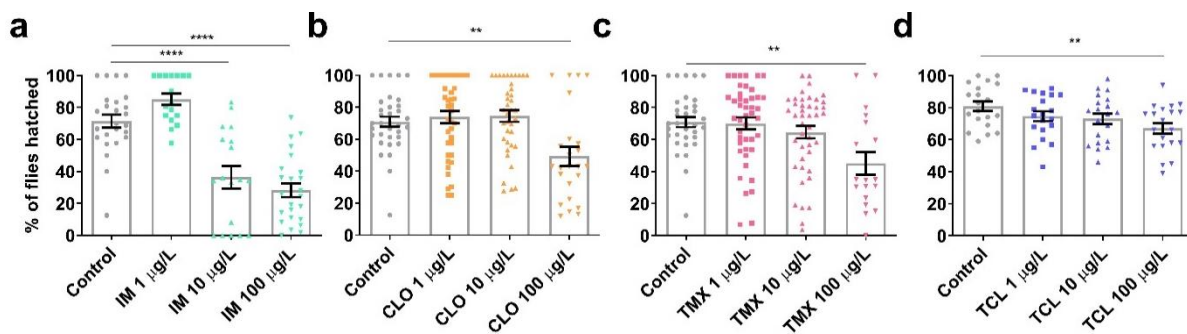


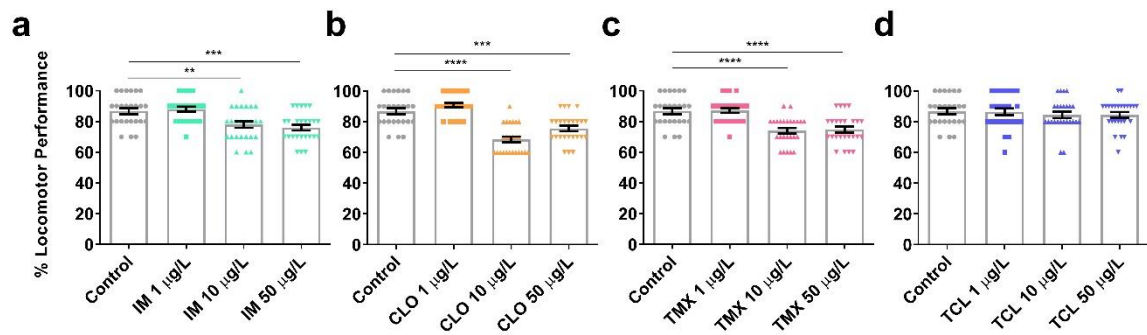
## Extended Data



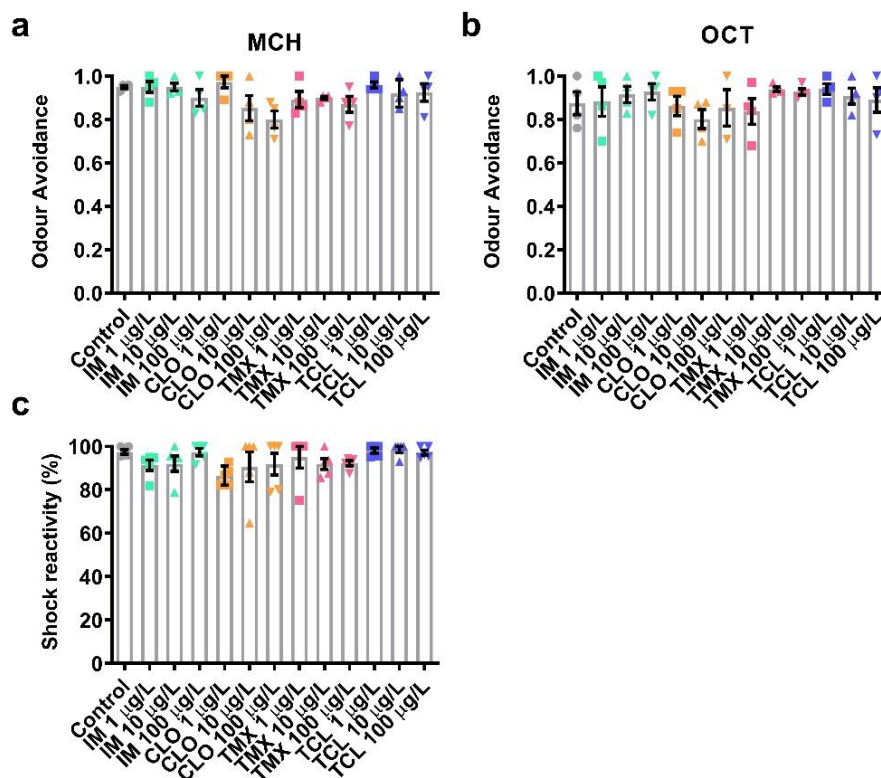
**Extended data Fig. 1| Field relevant concentrations of neonicotinoids reduced longevity.** Compared to the median lifespan for control flies (49 days) flies exposed to 10 µg/L of **a**, IM (36 days, ( $\chi^2_1=8.3, p=0.004$ ), **b**, CLO (28 days, ( $\chi^2_1=41.0, p < 0.001$ ), **c**, TMX (36 days, ( $\chi^2_1=5.8, p=0.016$ ) and **d**, TCL (39 days, ( $\chi^2_1=18.5, p < 0.001$ ) had shorter lives.  $n=100$  flies for each group.



**Extended data Fig. 2| Field-relevant concentrations of neonicotinoids reduce viability.** The viability of offspring of flies exposed to 1, 10 or 100 µg/L of **a**, IM ( $F_{3,80} = 31.7, p \leq 0.001$ ), **b**, CLO ( $F_{3,132} = 6.9, p < 0.001$ ), **c**, TMX ( $F_{3,135} = 5.4, p = 0.002$ ) and **d**, TCL ( $F_{3,76} = 3.8, p = 0.014$ ),  $n=10$  groups of 10 once mated female flies for each treatment. Viability was measured by counting the number of eggs laid by 10 once mated female in 24 h period and then counting the % of those eggs that completed development, eclosing viable adults ~15-18 days later.



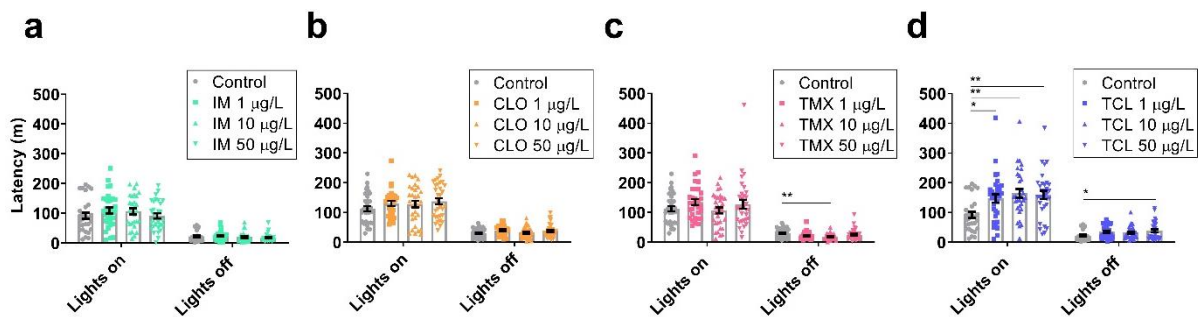
**Extended data Fig. 3| Field relevant concentrations of neonicotinoids reduce locomotor performance.** Locomotor performance was measured using the negative geotaxis climbing assay, flies exposed to 10 or 50  $\mu\text{g/L}$  of the banned neonicotinoids: **a**, IM ( $F_{3,96} = 9.9$ ,  $p < 0.001$ ), **b**, CLO ( $F_{3,96} = 32.0$ ,  $p < 0.001$ ), **c**, TMX ( $F_{3,96} = 15.8$ ,  $p < 0.001$ ) significantly reduced climbing performance, while the non-banned neonicotinoid **d** TCL ( $F_{3,96} = 0.4$ ,  $p = 0.762$ ) did not affect locomotion.  $n=25$  flies for each treatment group.



**Extended data Fig. 4| Field relevant concentrations of neonicotinoids do not disrupt olfaction or shock reactivity.** Sensory controls for olfactory-shock conditioning memory assays (Fig. 1) show 1, 10 and 100  $\mu\text{g/L}$  of IM, CLO, TMX and TCL did not affect **a**, odour avoidance of 4-methylcyclohexanol (MCH) ( $\chi^2_{12} = 19.5$ ,  $p = 0.076$ ), or **b**, 3-octanol (OCT) ( $\chi^2_{12} = 10.0$ ,  $p = 0.674$ ) and **c**, shock reactivity ( $\chi^2_{12} = 22.6$ ,  $p = 0.031$ ). Each data point represents a group of  $\sim 50$  flies, tested together,  $n=4$  for each group.

**Extended data Table 1| Field relevant concentrations of neonicotinoids increase the proportion of the population (%) exhibiting arrhythmicity compared to controls**

|         | IM  | CLO | TMX | TCL |
|---------|-----|-----|-----|-----|
| 1 µg/L  | 8%  | 11% | 10% | 1%  |
| 10 µg/L | 19% | 19% | 23% | 4%  |
| 50 µg/L | 27% | 36% | 65% | 0%  |



**Extended data Fig. 5| Field relevant concentrations of thiacloprid increase daytime sleep latency.** The mean latency in minutes (m) before sleep was initiated after lights on or lights off, for flies exposed to 1, 10 or 50 µg/L of **a**, IM, day ( $F_{3,114}=0.9$ ,  $p=0.441$ ) and night ( $F_{3,114}=0.9$ ,  $p=0.468$ ), **b**, CLO, day ( $F_{3,120}=1.1$ ,  $p=0.333$ ) and night ( $F_{3,120}=2.0$ ,  $p=0.124$ ), **c**, TMX, day ( $F_{3,124}=1.3$ ,  $p=0.264$ ) and night ( $F_{3,124}=4.3$ ,  $p=0.007$ ) or **d**, TCL, day ( $F_{3,120}=5.6$ ,  $p=0.001$ ) and night ( $F_{3,120}=2.7$ ,  $p=0.50$ ). Each datapoint represents a single fly,  $n=28-32$  flies per treatment.