
Figures and figure supplements

Sexually divergent expression of active and passive conditioned fear responses in rats

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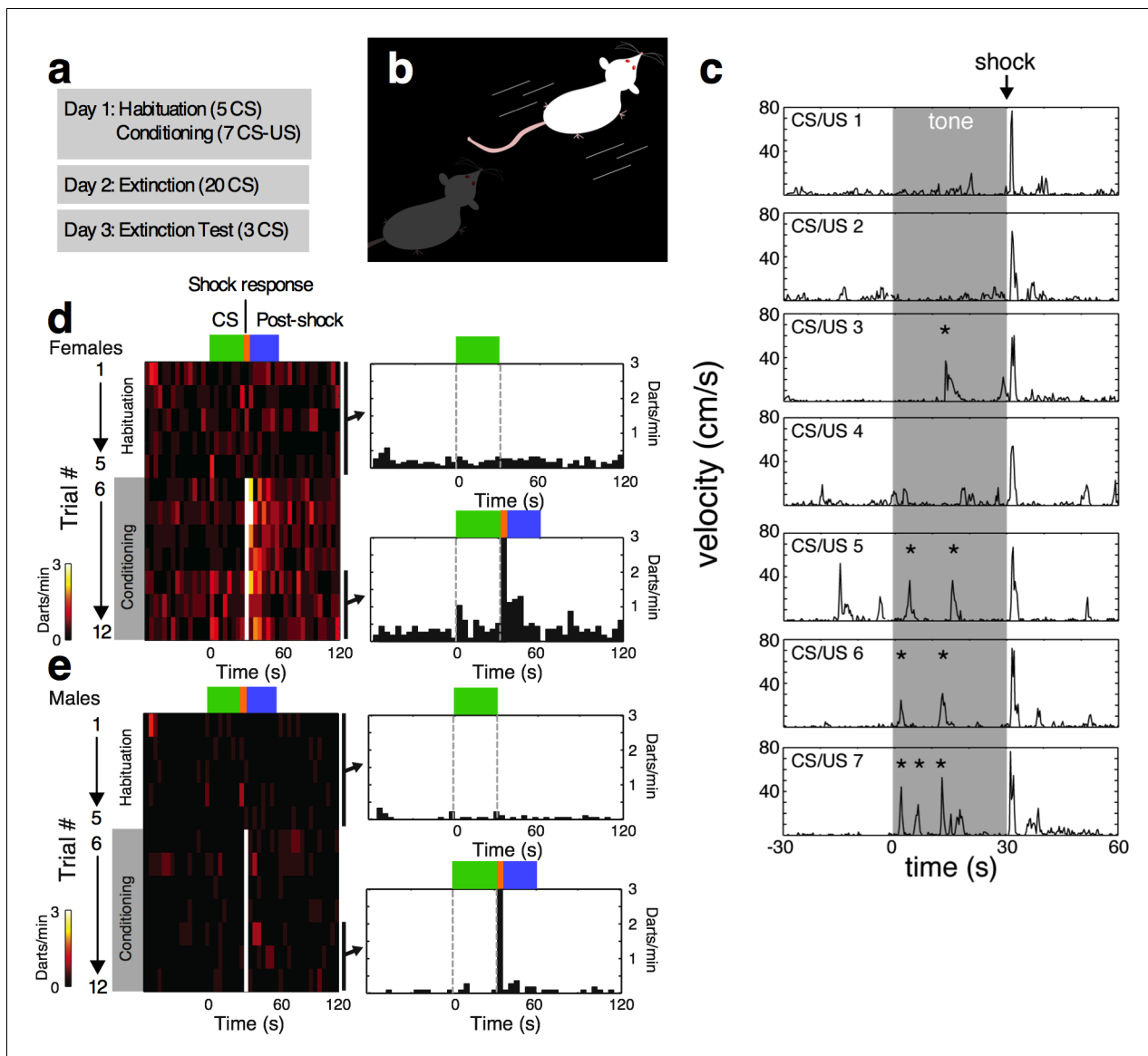


Figure 1. Darting is an active learned response to the CS that occurs primarily in female rats. (a) Experimental timeline. (b) Darts were characterized by a brief, high velocity movement across the test chamber. (c) Velocity traces from a representative animal, demonstrating increase in conditioned darting events across fear conditioning trials. Asterisks denote events that reached criterion for darting during the CS. Time 0 denotes CS onset. (d) Temporal organization of darting in all female rats. On the left is a two dimensional histogram of dart timing relative to the CS averaged over all females for 5 habituation trials and 7 conditioning trials on day 1. Trial time is on the x-axis and colored bars denote the trial epochs we defined as CS (green), shock response (orange), and post shock response (blue). Each row represents a CS trial (habituation 1–5, and conditioning 6–12), and depicts average dart rate by the color in each 4-second bin according to the color bar. On the right are histograms of the temporal organization of darts averaged over the five habituation trials (top) and the last three conditioning trials (bottom). Darts were detected and counted as described in Materials and methods. (e) Temporal organization of darting in all male rats. Panels are organized as in (d). During habituation trials, darts occurred at low rates throughout the trial in both sexes. In contrast, after conditioning only females exhibited increased darting triggered by tone onset ('CS') and sustained darting after shock delivery ('Post-shock'). Both sexes darted in response to the shock itself (Shock response). In both sexes, the first bin after the shock exceeds the limits of the y-axis.

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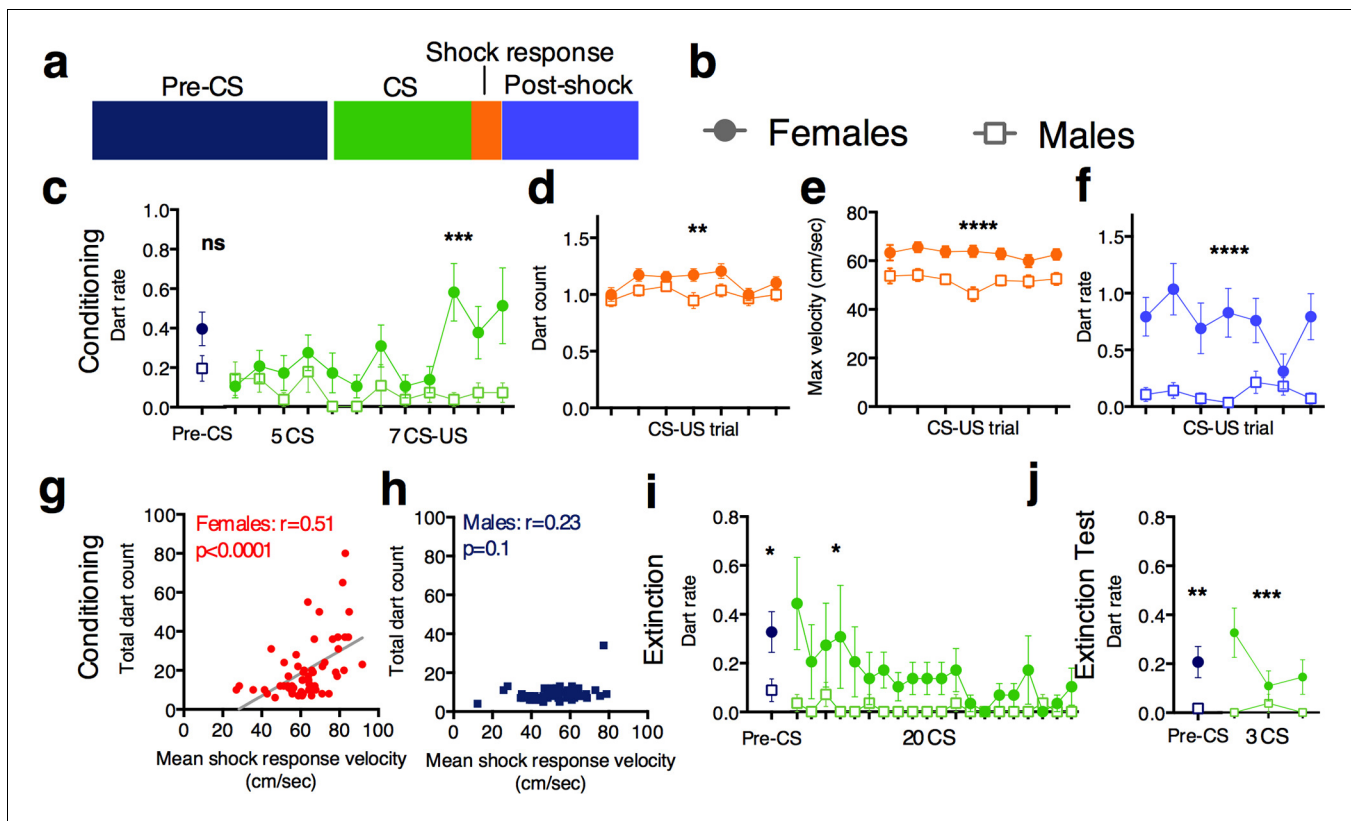


Figure 2. Sex differences in darting responses during fear conditioning and extinction. (a) The 4 fear conditioning epochs in which velocity was recorded. Graphs in c-f and i-j are color coded to match, and represent mean \pm SEM. (b) In graphs c-f and i-j, females are represented by filled circle, males by an open square. (c) Pre-CS (final 60 sec before 1st CS presentation) and CS dart rate (darts/min) during conditioning. (d) number of darts observed during 5s shock (US) response periods. (e) maximum velocity reached during 5s shock (US) response periods. (f) mean dart rate observed during 30s post-shock period. (g) and (h) Pearson's correlations of mean shock response velocity and total session dart count [note that visible male outlier was removed from analysis for being 6 SDs above mean total dart count. When included, $r=0.34$, $p<0.05$]. (i) Pre-CS and CS dart rate (darts/min) during Extinction. (j) Pre-CS and CS dart rate (darts/min) during Extinction testing. * $p<0.05$; ** $p<0.01$; *** $p<0.001$; **** $p<0.0001$ males vs. females.

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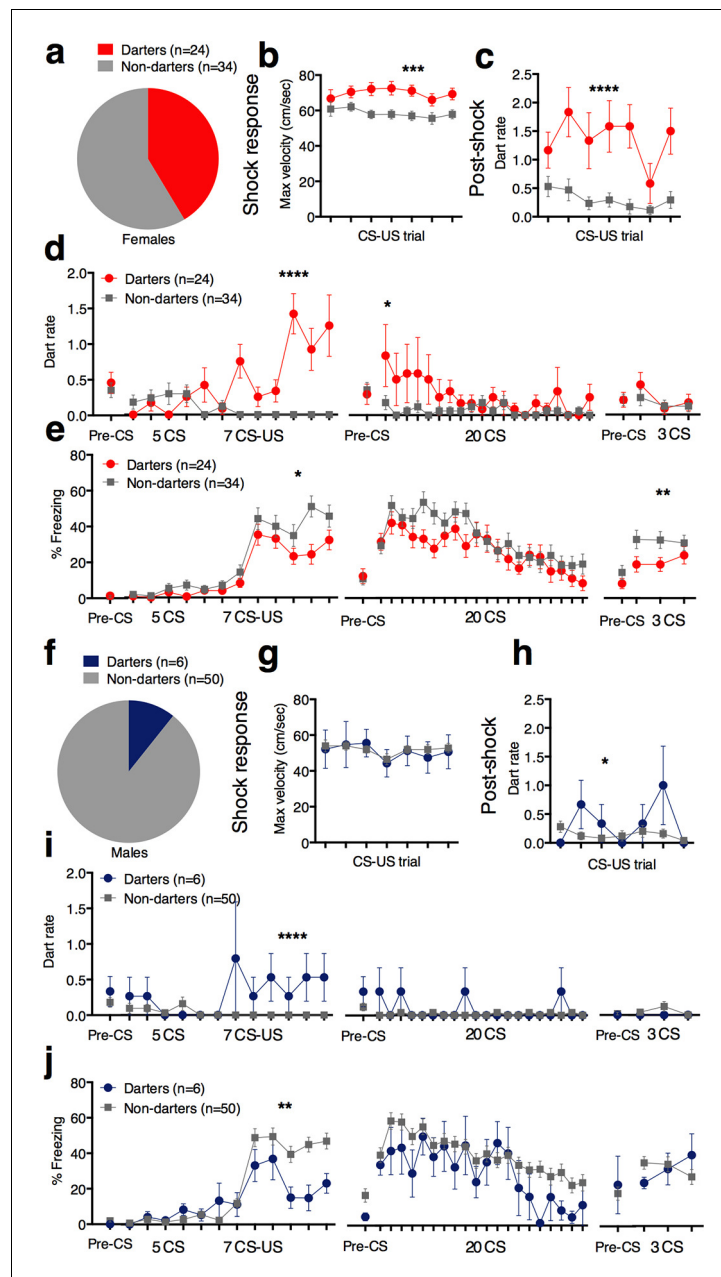


Figure 3. Darting subpopulations are greater in females and exhibit distinct behavioral patterns. (a) and (f) proportion of females and males that qualified as Darters. (b) max velocity reached during shock response period (c) mean dart rate (darts/min) observed during 30s post-shock period. (d) Pre-CS and CS dart rate (darts/min) during conditioning, extinction, and extinction test. (e) CS freezing in female Darters vs. Non-darters. (g) Shock response velocity did not differ between male Darters and Non-darters. (h) mean dart rate (darts/min) observed during 30s post-shock period. (i) Pre-CS and CS dart rate (darts/min) during conditioning, extinction, and extinction test. (j) CS freezing in male Darters vs. Non-darters. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; **** $p < 0.0001$ Darters vs. Non-darters

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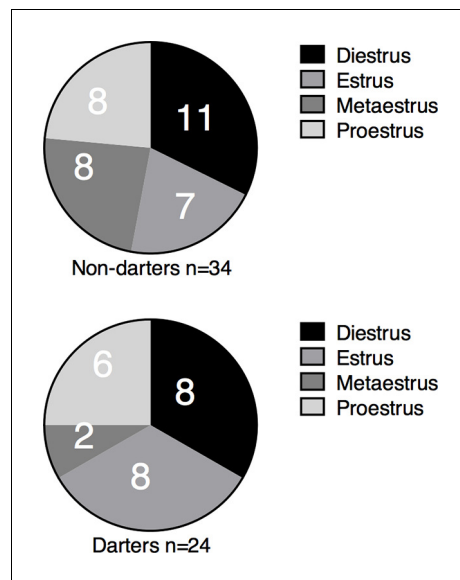


Figure 3—figure supplement 1. Distribution of animals in each estrous cycle phase did not differ between Darters and Non-darters. Chi square = 2.785, $p=0.42$.

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