

***Caenorhabditis elegans* exhibit a coupling between the
defecation motor program and directed locomotion.**

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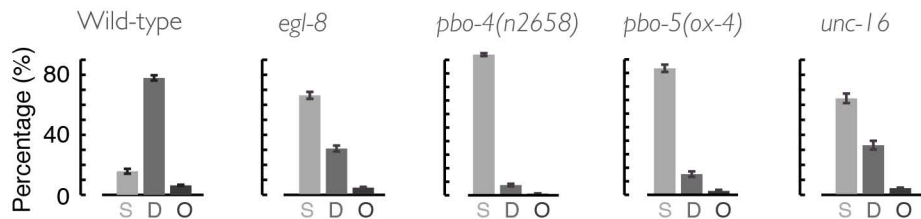
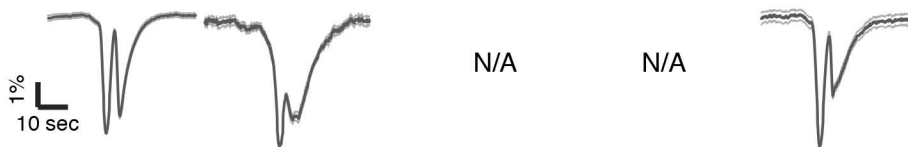
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SUPPLEMENTARY FIGURES AND FIGURE LEGENDS

S - single trough

D - double trough

O - other

Body length
(two Bocs)

N/A

N/A

aBoc

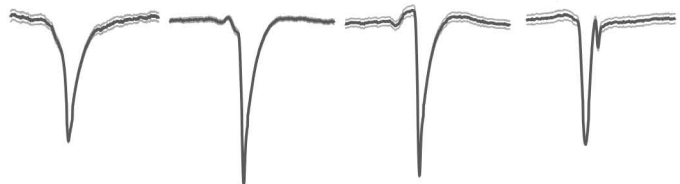
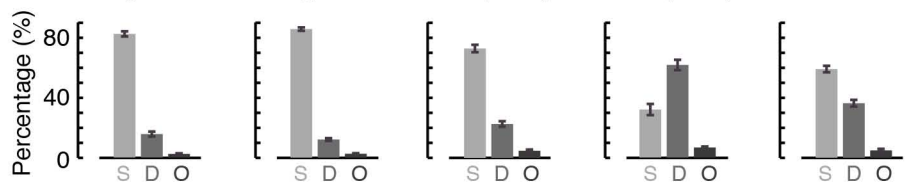
aBoc

aBoc

pBoc

Body length
(one Boc)

N/A

*egl-3**egl-21**unc-31(e928)**unc-31(e169)**aex-5*Body length
(two Bocs)

N/A

N/A

N/A



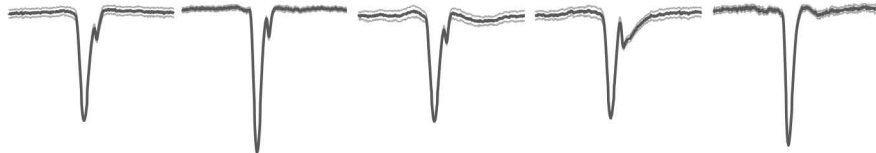
pBoc

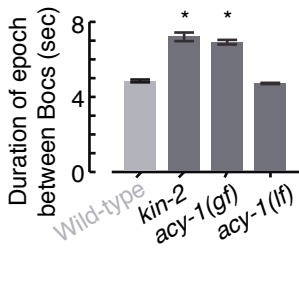
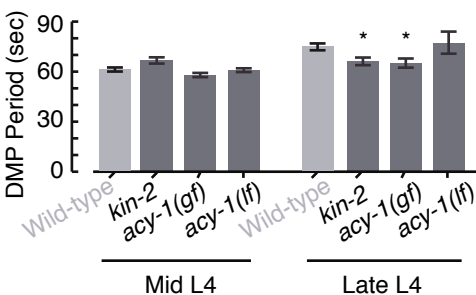
pBoc

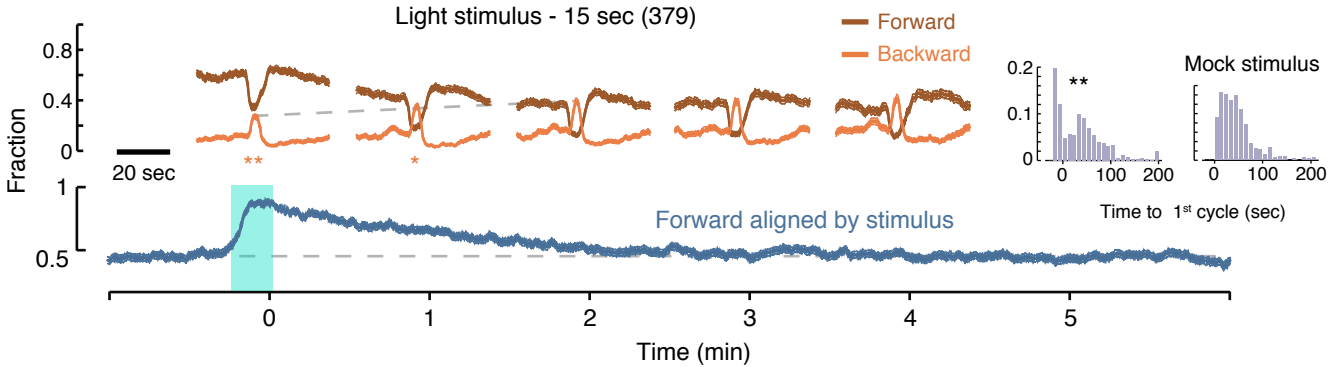
pBoc

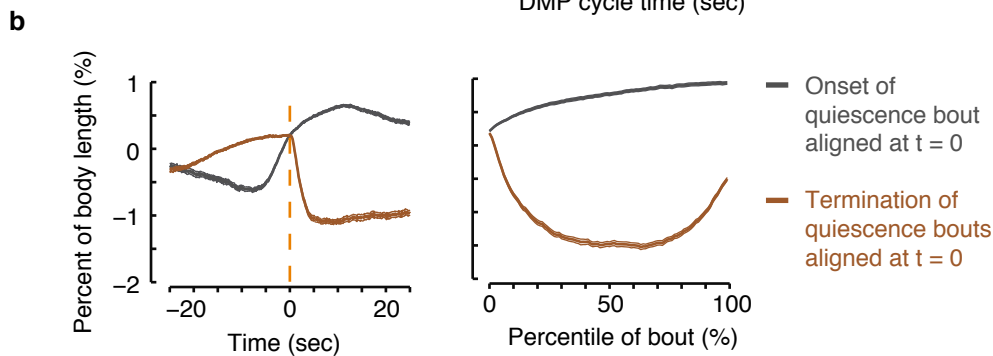
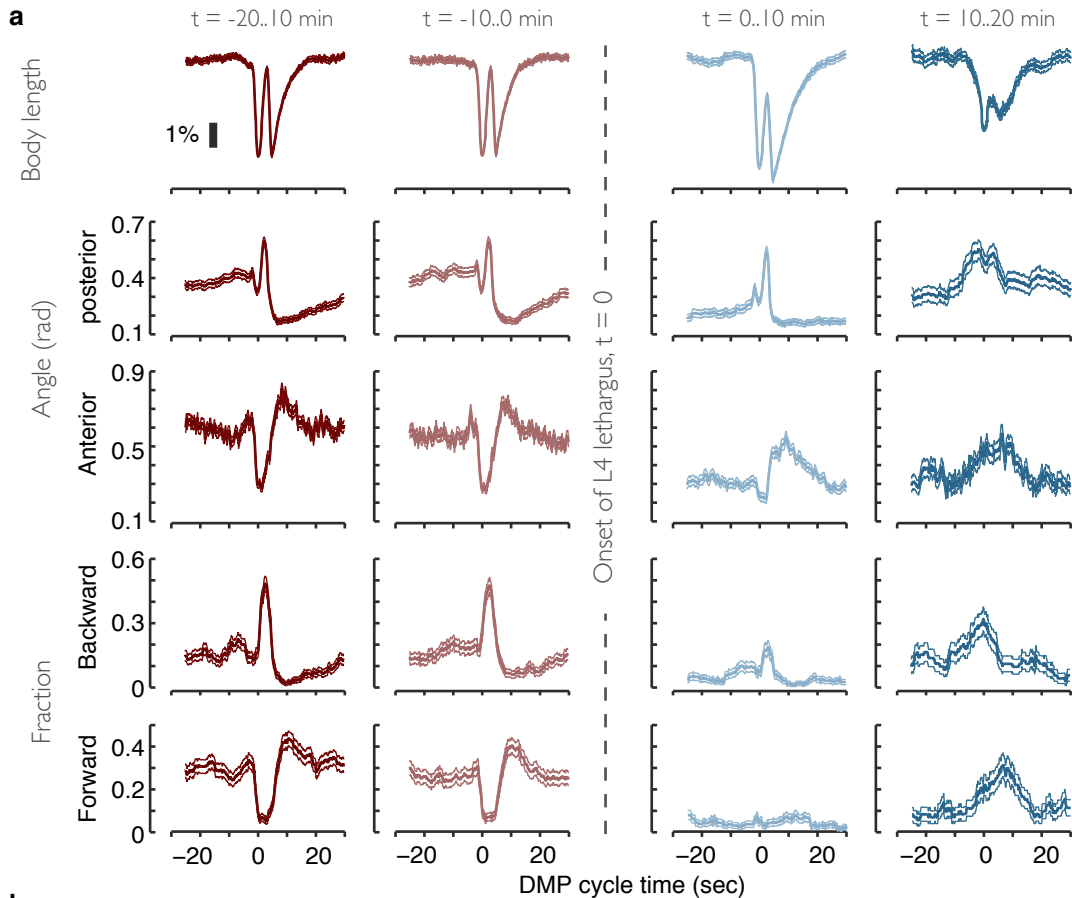
pBoc

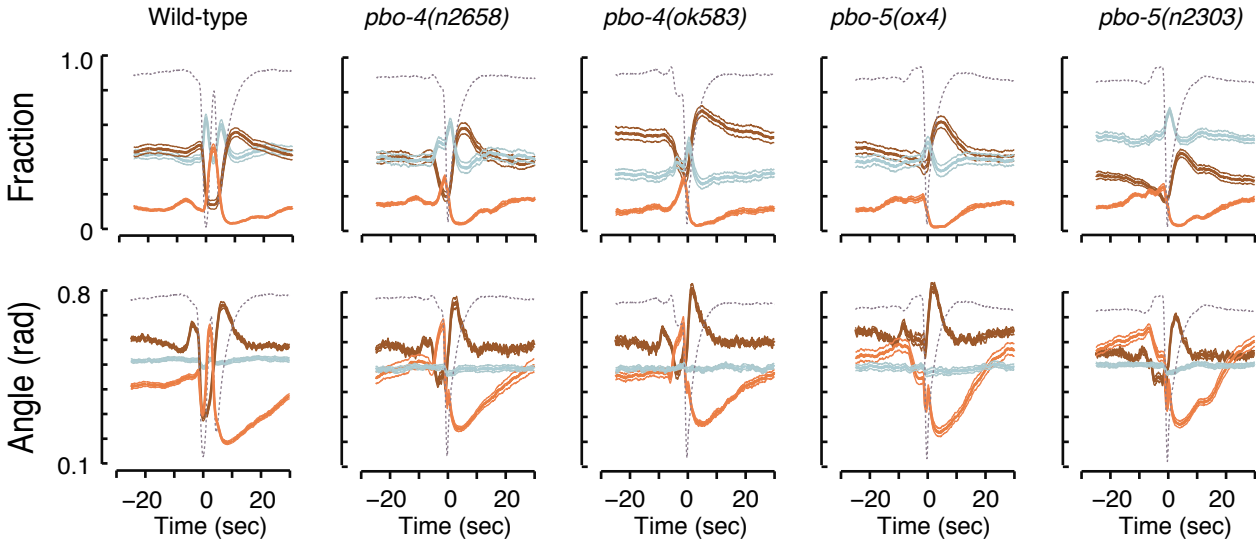
pBoc

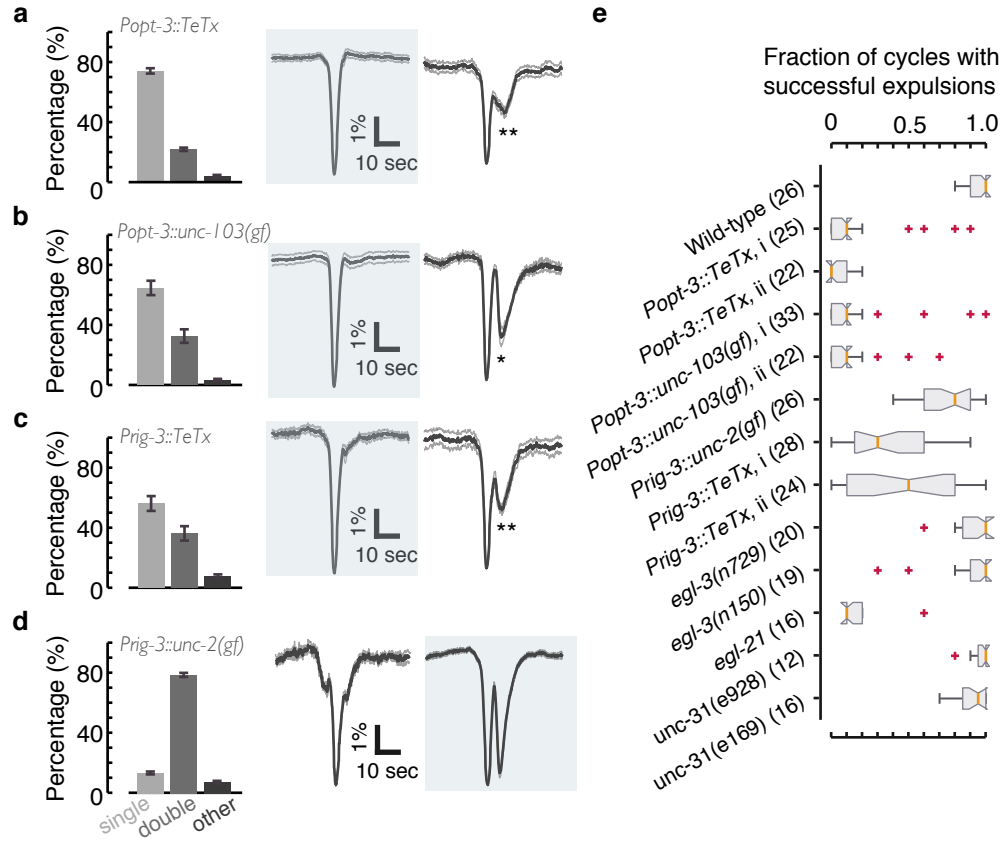
Body length
(one Boc)











Reversals CDF (a.u.)

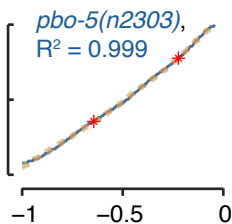
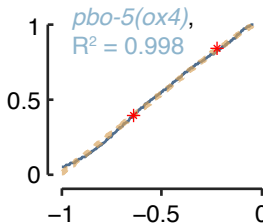
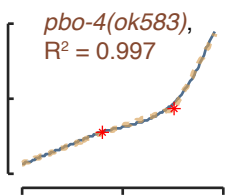
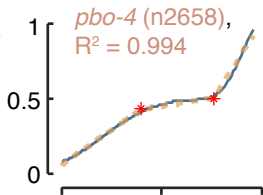
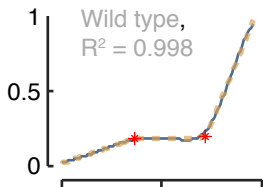


Figure S1. Body contractions and detected cycles in DMP deficient mutants. Same as Fig. 1B-C for strains with known DMP defects and for *egl-3* and *egl-21* mutants. From left to right: N(wild-type) = 28, N(*egl-8*) = 9, N(*pbo-4*) = 11, N(*pbo-5*) = 13, N(*unc-16*) = 10, N(*egl-3*) = 10, N(*egl-21*) = 10, N(*unc-31(e928)*) = 14, N(*unc-31(e169)*) = 9, and N(*aex-5*) = 11 animals. Wild-type data was reproduced from Fig. 1B-C for convenience. When single or double contractions were detected at a frequency lower than 15% the resulting mean body-length could have been significantly affected by experimental noise. Here, these cases are denoted as "N/A".

Figure S2. Timing of DMP cycles in mutants with altered PKA activity. The periods between DMP cycles (left) and the durations of epochs between Bocs within a cycle (right) for mutants in which PKA activity was altered. Wild-type data was reproduced from Fig. 1. N(*kin-2*) = 15, N(*acy-1(gf)*) = 15, and N(*acy-1(lf)*) = 13. Error bars depict mean $\pm$ s.e.m and single asterisks denote significant differences from wild-type ($p < 0.05$).

Figure S3. The DMP and the DAMP co-reset. Same as Fig. 3b, but for a stimulus of 20mW blue light ($\lambda = 475 \pm 15$ nm), initiated at $t = -15$ sec and terminated at $t = 0$. As opposed to the mechanical stimulus, blue light either induced a DMP cycle during the stimulus or delayed it for approximately one period ($t = 60$ sec). Forward locomotion propensity aligned by the stimulus (bottom) was reproduced from ⁷¹.

Figure S4. The DMP and the DAMP co-terminate. (a) The body-lengths, anterior and posterior angles, and forward and backward locomotion of wild-type L4 lethargus during 10 minute period leading to and immediately after the onset of L4 lethargus. During the

first 10 minutes after the onset of lethargus, Bocs and DAMP posture dynamics were detected, DAMP backward motion was weakly evoked, and DAMP forward motion was not evoked. During the next 10 minute period, body contraction, posture dynamics, and locomotion dynamics were mostly associated with transitions from quiescence to motion, indicating that the DMP and the DAMP co-terminated. In all panels N = 28 animals and thin lines depict $\pm$ s.e.m. **(b)** The body-lengths of wild-type L4 lethargus larvae were aligned at the onset of bouts of quiescence (grey) or motion (brown). The data was plotted as a function of time (left) and of progression through the bout, i.e., time normalized by the duration of the bout (right). Thin lines depict $\pm$ s.e.m.

Figure S5. The dynamics of locomotion and posture during the DAMP of *pbo-4* and *pbo-5* mutants. Data was plotted in the same manner as in Fig. 2a, b. Top row: the likelihood of observing forward locomotion, backward locomotion, and dwelling during a DMP cycle. Bottom row: the mean magnitude of anterior, posterior, and mid-body angles (see methods). Locomotion and angle data were aligned at the trough of the pBoc (t = 0) before averaging. Wild-type data were reproduced from Fig. 2 for convenience. Thin lines depict mean $\pm$ s.e.m and double asterisks denote significant differences from wild-type ($p < 0.01$).

Figure S6. (a) Left: the fractions of detected single, double, and multiple body-length troughs during the L4 stage of *Popt-3::TeTx* transgenics. Middle/right: the mean body length of *Popt-3::TeTx* transgenics during single- and double-trough events, respectively. N = 11 animals and error bars or thin lines depict mean $\pm$ s.e.m. **(b-d)** The same as panel **(a)** for *Popt-3::unc-103(gf)* (N=11), *Prig-3::TeTx* (N=9), and *Prig-3::unc-2(gf)*

(N=10), respectively. Double asterisks denote a significant difference from wild-type ($p < 0.01$). (e) The fractions of DMP cycles with successful expulsions in the above described transgenics and in mutants with broad defects in peptidergic signaling. Box plot depicts outliers (red crosses), 75% and 25% quantiles (grey boxes), medians (orange lines), and remaining non-outlier data (dark lines).

Figure S7. Proton signaling affects the shaping of DAMP dynamics. Piecewise linear fits to the scaled cumulative propensities of backward motion during the 25 seconds preceding the aBoc. Data is shown for of wild-type animals, *pbo-4* mutants, and *pbo-5* mutants. Comparisons of the resulting slopes are presented in Fig. 7b.

Supplementary movie M1. An example defecation cycle. Red arrows denote the timing of the pBoc and the aBoc. During the pBoc the posterior body-wall muscles contract symmetrically and relaxes asymmetrically as backward motion is initiated. Backward motion is terminated upon the initiation of the aBoc, after which forward locomotion is ensues. The movie is slowed down two fold with respect to real time.