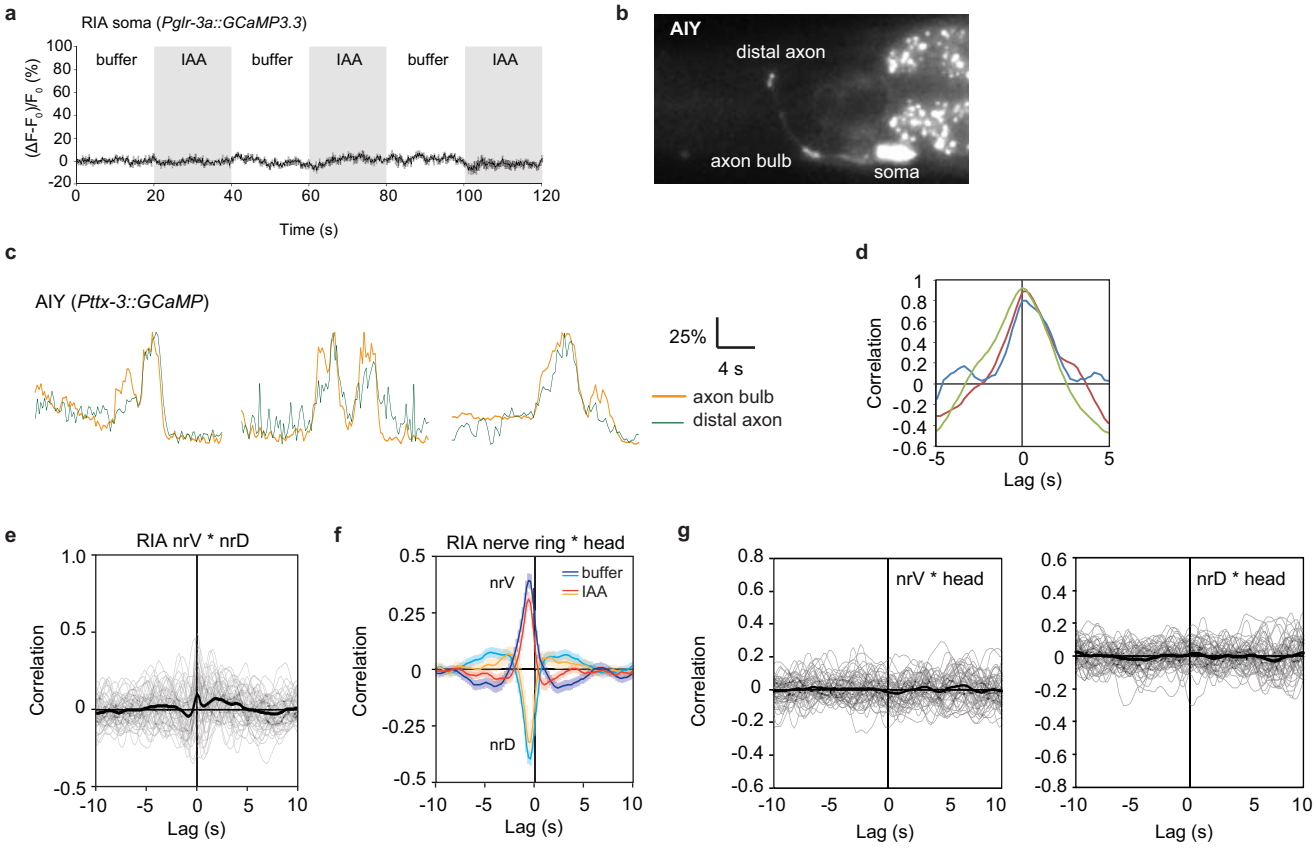
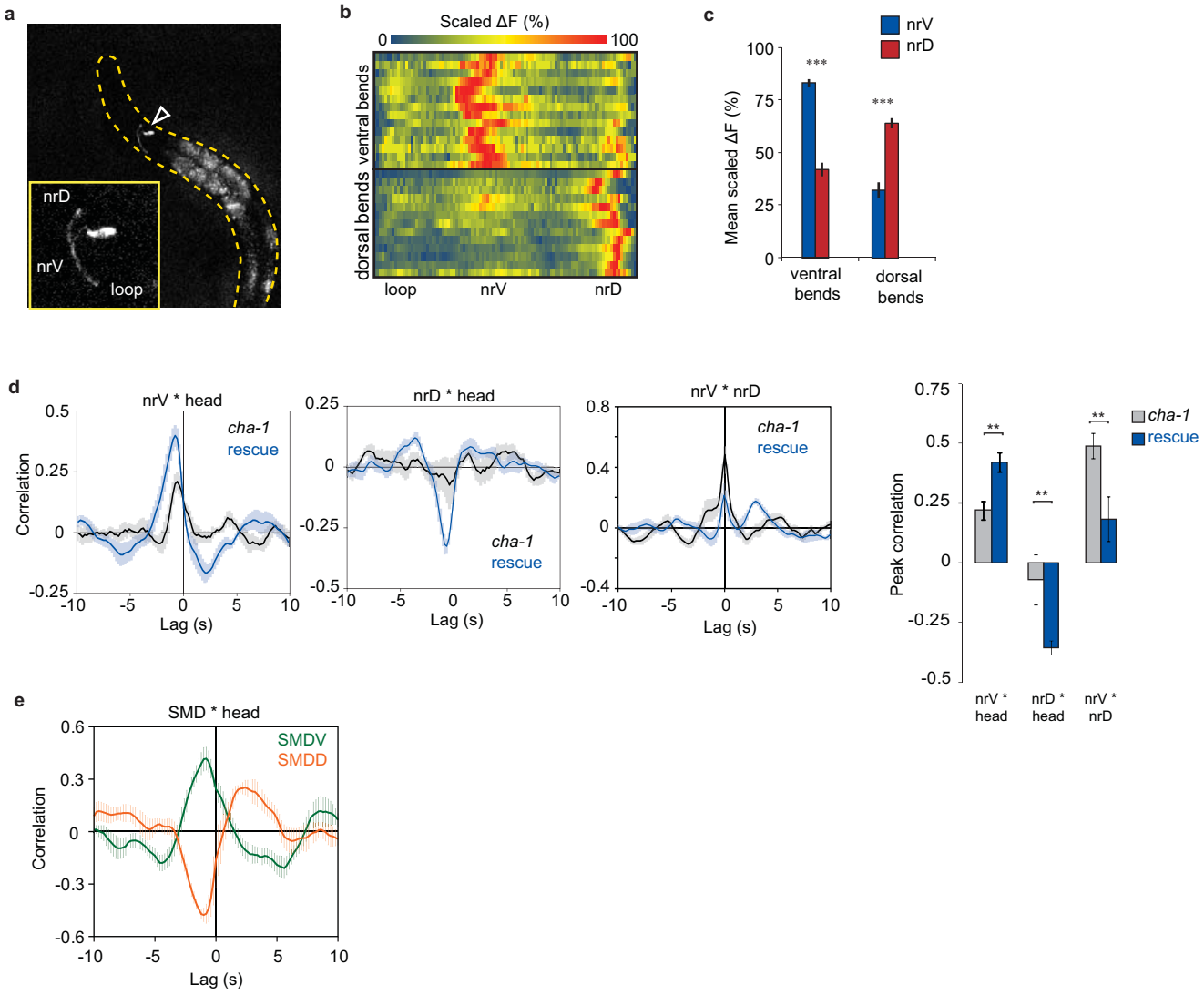
doi:10.1038/nature11081

Supplementary Figure 1



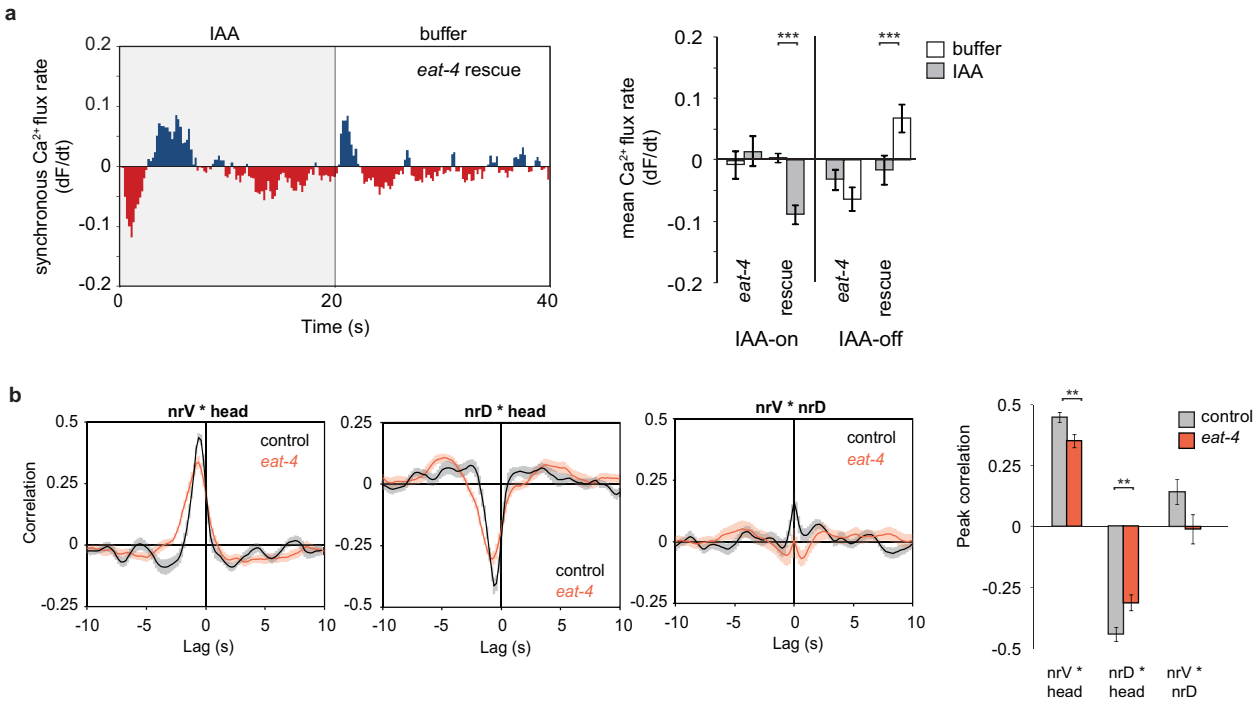
Supplementary Figure 1. AIY and RIA axonal calcium dynamics. a, Calcium recordings (mean +/- SEM) from the RIA cell body in response to IAA and buffer (n = 5). **b,** Maximum projection of a single frame from time lapse imaging in AIY (*Pttx-3::GCaMP)*. **c,** Calcium recordings from the axonal bulb and the distal tip of the AIY axon in three animals. **d,** Cross-correlation between the axon bulb and distal axon in the three recordings shown in **c**. **e,** Intracellular cross-correlation between nrV and nrD for the same data shown in Fig. 1e. **f,** Cross-correlations between nrV or nrD and head movement analyzed separately by stimulus (IAA, isoamyl alcohol). Traces are means and shading is s.e.m. **g,** Cross-correlation plots made by shifting the head movement data by one trial. Loss of correlation demonstrates that the peaks are not due to shared dependence on the stimulus. Thin lines are individual animals and heavy lines are mean values. n = 53 for **e-f**.

Supplementary Figure 2



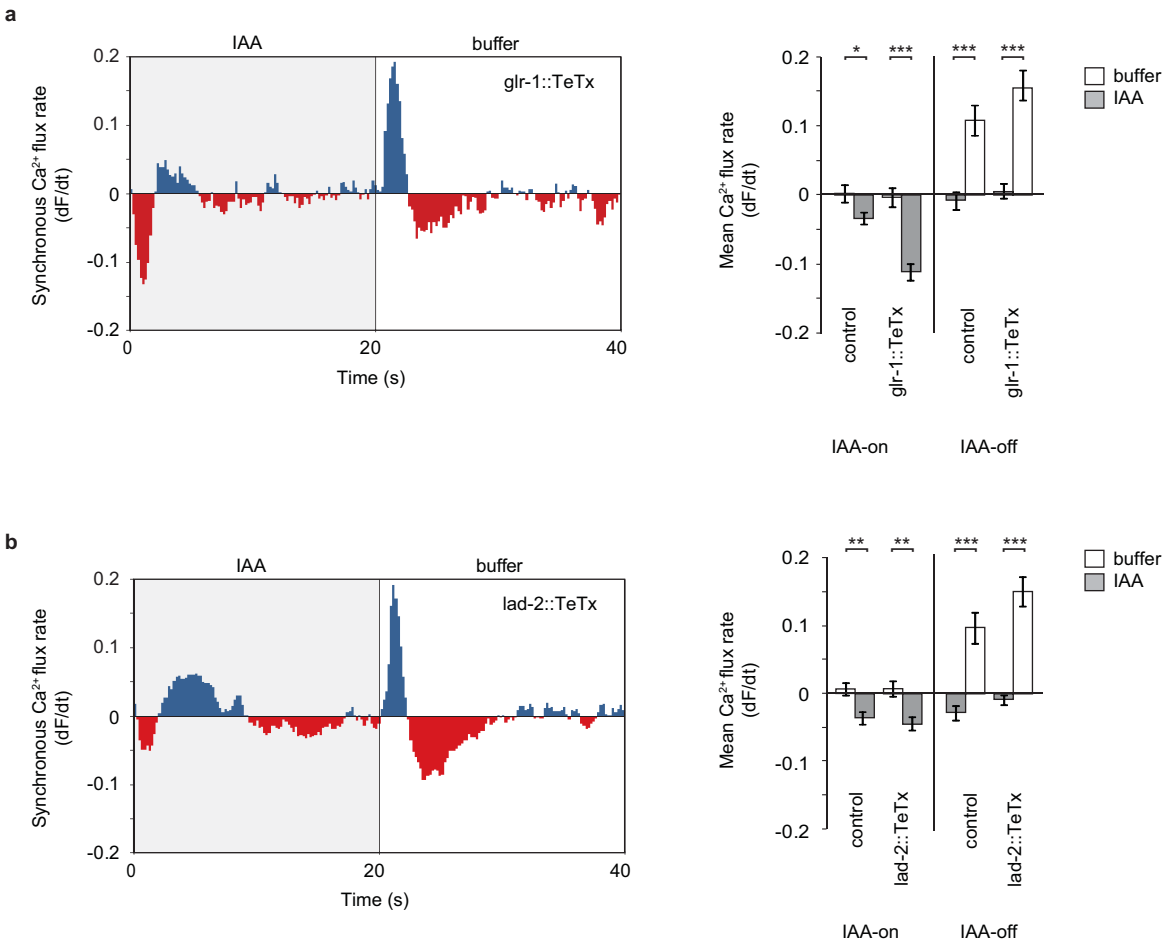
Supplementary Figure 2. RIA dynamics in freely moving animals, *cha-1* rescue, and SMD correlations with head movement. a, A RIA neuron expressing GCaMP3 in an animal freely moving on the surface of an agar pad imaged at 10x, inset indicates axonal subdomains. **b,** Fluorescence intensity profiles along a linear ROI tracing the RIA axon in animals bending dorsally or ventrally. Each row indicates result for one animal. **c,** Quantitation of traces in **b**. n ≥ 13 for each sample. **d,** Cross-correlations between nrV and head movement, nrD and head movement, and nrV and nrD in *cha-1(p1152)* mutants (n = 7) and mutants rescued with a *cha-1* cosmid transgene (n = 8). **e,** Cross-correlations between SMDV or SMDD dynamics and head movement in animals treated with 100 μM scopolamine (SMDV n = 7, SMDD n = 6). Cross-correlation plots and bar charts are mean +/- s.e.m, ***p < 0.001, **p < 0.01, ANOVA, single-tailed for rescue in **d**.

Supplementary Figure 3



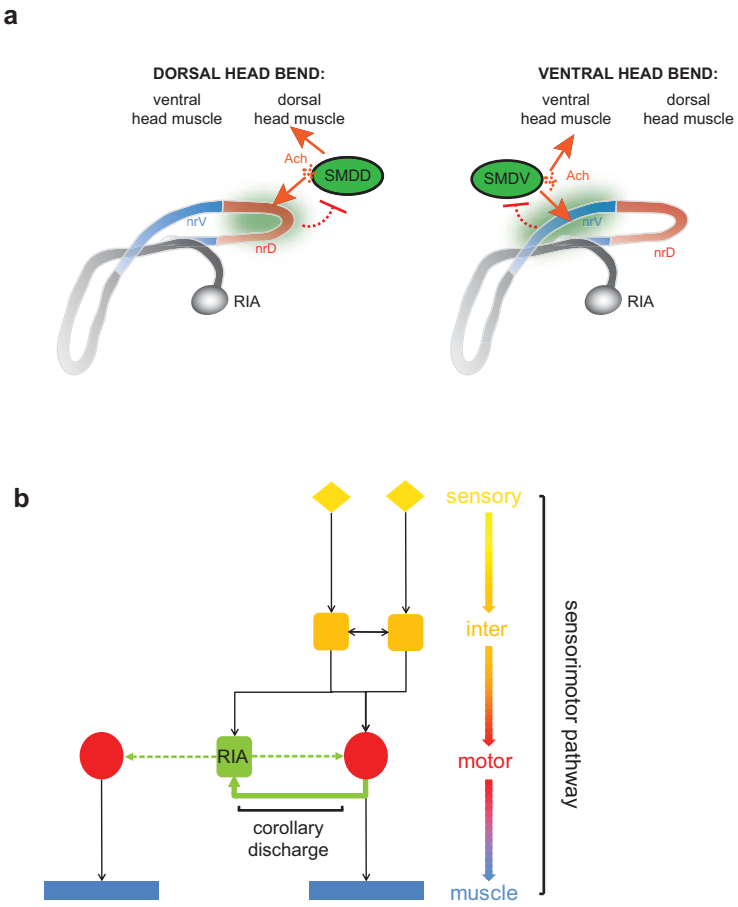
Supplementary Figure 3. Compartmentalized activity and rescue of synchronous dynamics in *eat-4* mutants. a, Rescue of synchronous responses in *eat-4(ky5)* mutants expressing an *eat-4* cDNA under its native promoter (n = 7 for each group). **b,** Cross-correlations between nrV or nrD and head movement and intracellular cross-correlation in *eat-4(ky5)* mutants (*eat-4* n = 18, control n = 19). Cross-correlation plots and bar charts are mean +/- s.e.m. ***p < 0.001, **p < 0.01, Wilcoxon signed rank in **a**, ANOVA in **b**.

Supplementary Figure 4



Supplementary Figure 4. Synchronous RIA responses in animals expressing tetanus toxin in SMDs. a-b, Response histograms as in Figure 4 showing stimulus evoked responses in animals expressing tetanus toxin in SMDD and SMDV motor neurons under either the *glr-1* (n = 18, control n = 15) or *lad*-2 (n = 17 for each group) promoter. ***p < 0.001, **p < 0.01, *p < 0.05, Wilcoxon signed rank. Bar charts are mean +/- s.e.m.

Supplementary Figure 5



Supplementary Figure 5. Summary and model of RIA dynamics and function. a, Schematic representation of the mechanism for generating motor-correlated compartmentalized calcium waves within the RIA axon and model for RIA mediating negative feedback to motor neurons to restrict head bending amplitude. **b,** Conceptual circuit diagram for the corollary discharge model of RIA function, in which integration of sensory and motor inputs can regulate locomotion through feedback to motor neurons.