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The emergence of stereotyped behaviors in *C. elegans* GREG STEPHENS, Princeton University, WILLIAM RYU, University of Toronto, WILLIAM BIALEK, Princeton University — Many organisms, including humans, engage in stereotyped behaviors and these are often attributed to a deterministic command process within the nervous system. Here we use the locomotor dynamics of the nematode *C. elegans* to suggest an alternative explanation in which stereotyped behavior emerges due to noise within a non-linear dynamical system. In previous work (*PLoS Comp Bio* **4,** e1000028 (2008)) we found that the body shapes of freely-crawling *C. elegans* are well-captured by four 'eigenworms', two of which encode the phase of a locomotory wave that generates forward and backward motion. We also used this representation to infer a non-linear dynamical model for the phase in which forward and backward crawling emerge as attractors of the deterministic dynamics. Here we show that noise induces reversals between forward and backward crawling and that the predicted reversal rate is in good agreement with experiment, with no adjustable parameters. In this model, reversals follow a stereotyped trajectory for the same reason that Brownian escape over a barrier is dominated by a narrowly defined class of trajectories. Stereotypy becomes even clearer in the dynamics with lower noise levels; the real *C. elegans* is just outside the regime where the reversal rate follows an Arrhenius dependence on the noise level. We discus the implications of our results for *C. elegans* and other organisms.

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