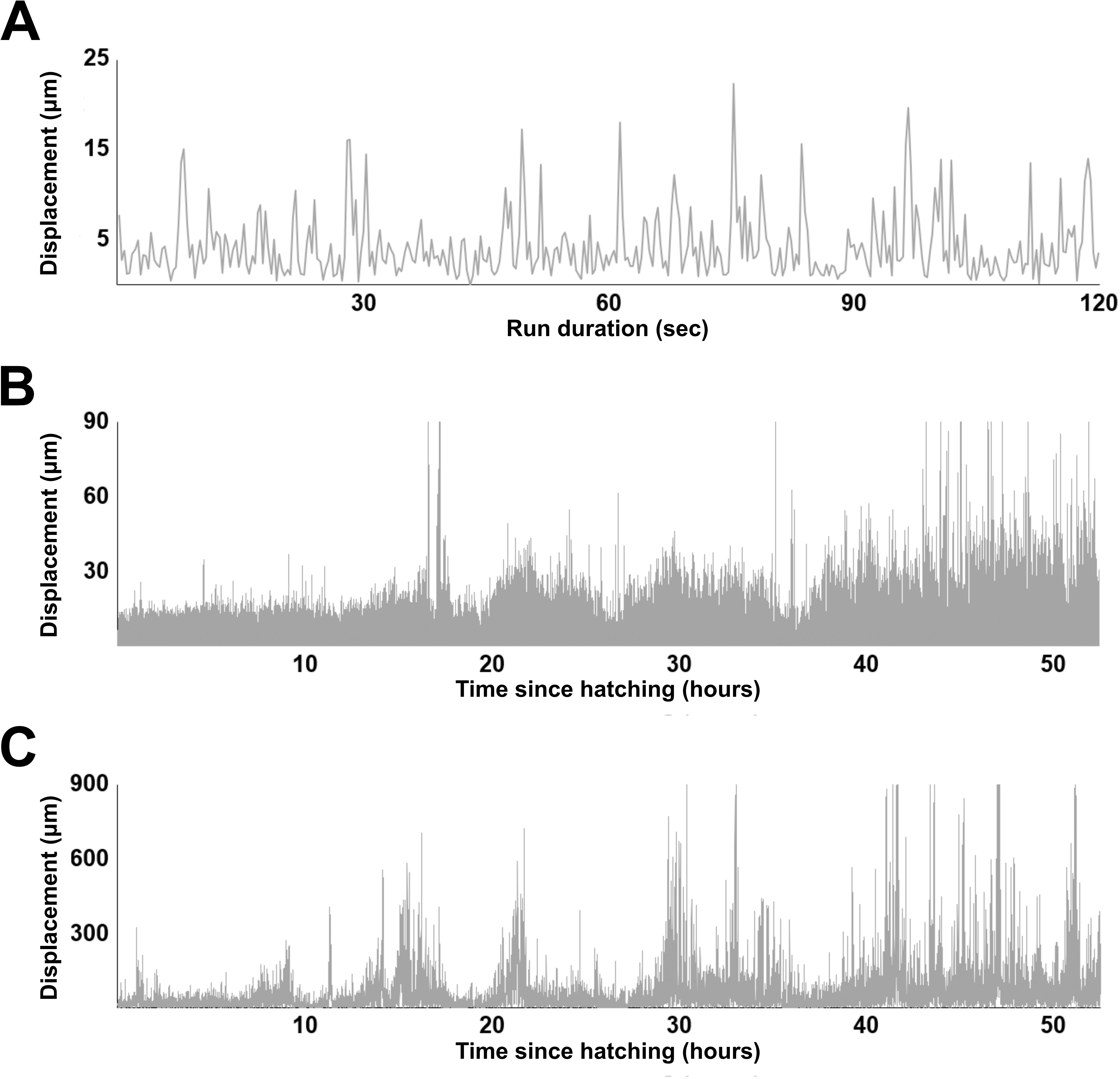
A
25
15
5
Displacement (µm)
30
60
90
120
Run duration (sec)
B
90
60
30
Displacement (µm)
10
20
30
40
50
Time since hatching (hours)
C
900
600
300
Displacement (µm)
10
20
30
40
50
Time since hatching (hours)

Figure S1. Variability of exploratory behavior.
(A) A plot of 2 minutes (360 frames) of exploratory movement of the same animal as shown in Figure 1B. Note the average displacements of ~4-5 μm and that high displacement values (~15-20 μm) approximately correspond to the upper margin of much of the plot in Figure 1B. **(B)** Activity profile over the entire ~50 hours of recording of a different animal than the one shown in Figure 1B. Temporal pattern of displacements in this individual somewhat obscures periods of reduced activity corresponding to lethargus. **(C)** 30-fold reduced frame sampling still results in a noisy activity profile (this is the same animal as shown in Figure 1B), necessitating smoothing.

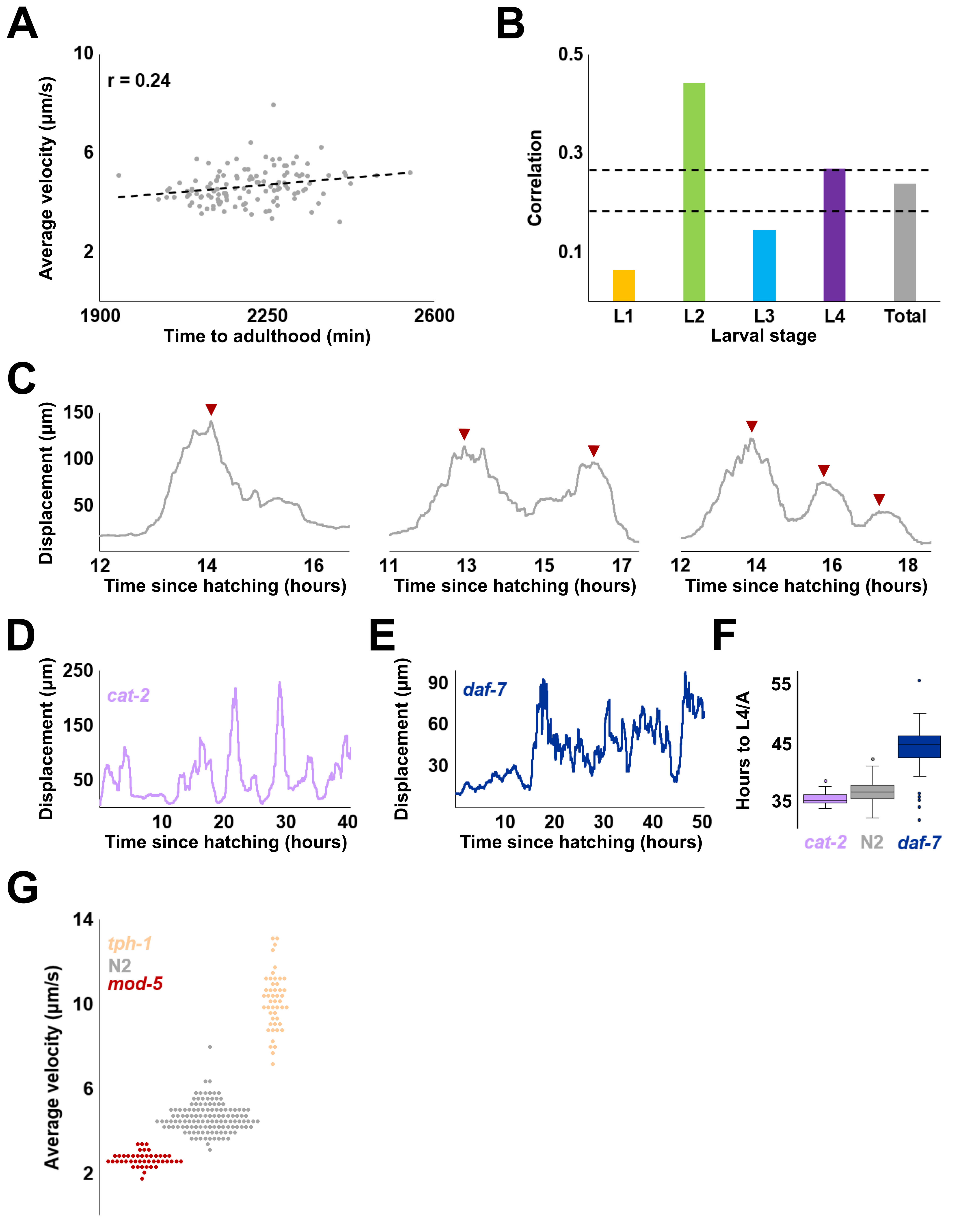
A
r = 0.24
Average velocity (µm/s)
Time to adulthood (min)
B
Correlation
Larval stage
L1
L2
L3
L4
Total
C
Displacement (µm)
Time since hatching (hours)
D
cat-2
Displacement (µm)
Time since hatching (hours)
E
daf-7
Displacement (µm)
Time since hatching (hours)
F
Hours to L4/A
cat-2
N2
daf-7
G
tph-1
N2
mod-5
Average velocity (µm/s)

Figure S2. Relationship between locomotor activity and rate of development.
(A) Correlation between total developmental time and locomotor activity (sum of displacements divided by time) for 125 wild type N2 worms. **(B)** Correlation between activity (sum of displacements divided by time) and stage duration for each larval stage; “total” shows the same value as in (A). Dashed lines denote two and three standard deviations above the expected correlation between two random sets of 125 uncorrelated variables. **(C)** Representative activity profiles of individuals representing 1 peak, 2 peak, and 3 peak (marked with arrowheads) categories. **(D)** Representative activity profile of *cat-2(e1112)* mutant individual. **(E)** Representative activity profile of *daf-7(e1372)* mutant individual. Note that inferring the L2/L3 boundary is particularly challenging. **(F)** Duration of development (*i.e.*, time to L4/adult transition) for *cat-2* (N=52) and *daf-7* (N=46) mutants compared to wild type N2 (N=125). **(G)** Total activity (sum of displacements divided by total time of development; this is equivalent to average velocity) for *tph-1*, N2, and *mod-5* animals. Each dot is one individual. Averaged activity profiles of these strains are shown in Figure 2D.

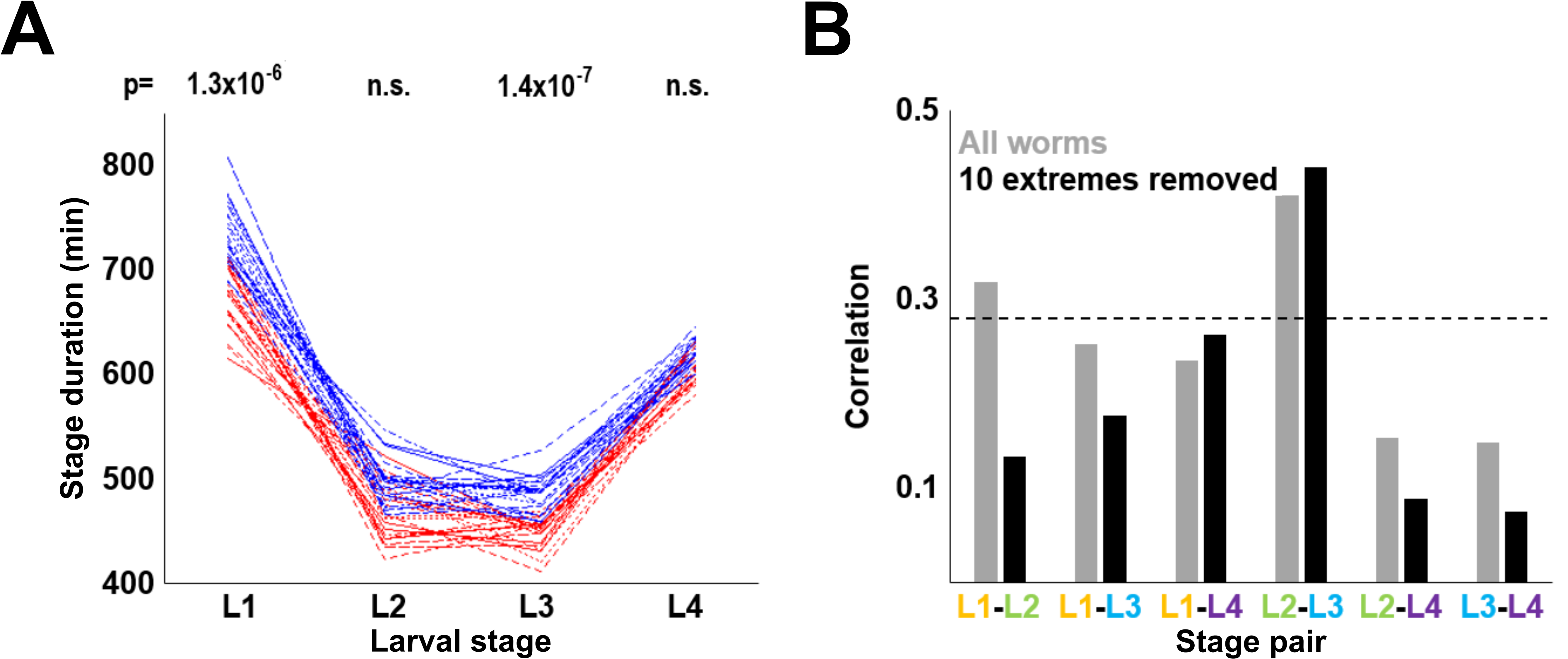
A
p=
1.3x10-6
n.s.
1.4x10-7
n.s.
800
700
600
500
400
Stage duration (min)
L1
L2
L3
L4
Larval stage
B
All worms
10 extremes removed
0.5
0.3
0.1
Correlation
L1-L2
L1-L3
L1-L4
L2-L3
L2-L4
L3-L4
Stage pair

Figure S3. Sensitivity of analyses in Figure 3 to extreme values.
(A) Stage durations of the 21st-41st fastest vs 21st-41st slowest worms to reach adulthood. p-values shown above each stage are results of the Kolmogorov-Smirnov test comparing durations of that stage for the 20 fastest and 20 slowest developing worms. **(B)** Pairwise correlations of stage durations of empirical N2 data including all 125 (in grey) or 115 (in black) individuals. To obtain the set of 115 from the set of 125, 10 individuals showing greatest deviations from population average developmental time were removed. Dashed line (0.27) denotes three standard deviations above zero, which is the expected correlation of two sets of random variables (N=125).

Durations of L1, L2, L3, L4 stages are t_1, t_2, t_3, t_4 respectively. $T = t_1 + t_2 + t_3 + t_4$. These quantities fluctuate about average values,

$$t_i = a_i + x_i, \;\; i = 1, 2, 3, 4. \tag{1}$$

Here $a_i > 0$ are defined as

$$a_i = \langle \, t_i \, \rangle \,, \tag{2}$$

and the brackets $\langle \; \rangle$ stand for averaging. $|x_i| \ll a_i$ are fluctuations. By definition, $\langle \, x_i \, \rangle = 0$.

Similarly, with the definitions $a = a_1 + a_2 + a_3 + a_4$ and $x = x_1 + x_2 + x_3 + x_4$, we find

$$T = a + x, \;\; \langle \, T \, \rangle = a, \;\; \langle \, x \, \rangle = 0. \tag{3}$$

Define

$$c_i^2 = \frac{\langle \, x_i^2 \, \rangle}{a_i^2}, \;\; c^2 = \frac{\langle \, x^2 \, \rangle}{a^2}, \;\; s_i = \frac{\langle \, x_i x \, \rangle}{c c_i a a_i}. \tag{4}$$

Here s_i are the correlation coefficients between the time of the i-th stage and the total time. Consider now the following quantities

$$\frac{t_i}{T} = \frac{a_i + x_i}{a + x}. \tag{5}$$

We would like to evaluate

$$r_i^2 = \frac{\left\langle \left(\frac{t_i}{T}\right)^2 \right\rangle - \left\langle \, \frac{t_i}{T} \, \right\rangle^2}{\left\langle \, \frac{t_i}{T} \, \right\rangle^2} = \frac{\left\langle \left(\frac{t_i}{T}\right)^2 \right\rangle}{\left\langle \, \frac{t_i}{T} \, \right\rangle^2} - 1. \tag{6}$$

in the lowest order of perturbation theory in x_i.

First we observe that

$$\frac{t_i}{T} = \frac{a_i + x_i}{a + x} \approx \frac{a_1}{a} + \frac{x_i a - x a_i}{a^2} + \frac{a_i x^2 - a x x_i}{a^3} + \ldots. \tag{7}$$

Averaging we find

$$\left\langle \, \frac{t_i}{T} \, \right\rangle \approx \frac{a_i}{a} + \frac{a_i a^2 c^2 - a^2 \, a_i \, c \, c_i \, s_i}{a^3}. \tag{8}$$

Now we expand

$$\left(\frac{t_i}{T}\right)^2 = \frac{a_i^2}{a^2} + \frac{2\left(x_i a_i a - x a_i^2\right)}{a^2} + \frac{3a_i^2 x^2 - 4 a a_i x x_i + a^2 x_i^2}{a^4} + \ldots. \tag{9}$$

Averaging this, we find

$$\left\langle \left(\frac{t_i}{T}\right)^2 \right\rangle \approx \frac{a_i^2}{a^2} + \frac{3a_i^2 a^2 c^2 - 4a^2 a_i^2 c c_i s_i + a^2 a_i^2 c_i^2}{a^4}. \tag{10}$$

Finally, calculating the ratio and expanding, we find

$$r_i^2 = c^2 + c_i^2 - 2 \, c \, c_i \, s_i. \tag{11}$$

Figure S4. Analytical derivation of the relationship between variation of absolute and fractional stage duration.