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HEAD POSTURE, BODY POSTURE AND GAZE MOVEMENTS IN THE RESTING AND FLYING FRUITFLY DROSOPHILA

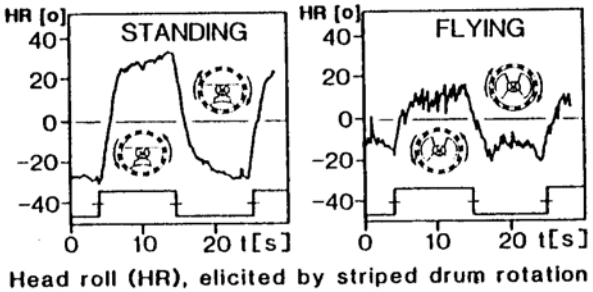
R. Hengstenberg,
Max-Planck-Institut f. biol. Kybernetik, Spemannstr. 38, D-7400 Tübingen

Postural movements of *Drosophila* which affect the alignment of Ihe eyes with the visual surroundings have been studied by macro-videography.
Drosophila, like other diptera, can turn its head in all directions: yaw ±25°, pitch ±35°, roll ±120°. In flight, the head is pitched downwards by 23.0°±7.5°SD. This compensates, at least partly, the increased elevation of the body axis during flight (walking: 15.0°±4.2°SD, flying: 45.5°±13.0°SD; Götz KG unpubl.). In flight, The body angle varies inversely with the flight speed (CT David, 1978, Physiol Entomol 3„ 191), but it is not yet known whether the endogeneous body pitch correction of the head varies accordingly.

At rest, flies hold their head still, but when walking or flying, the head is moved spontaneously and incessantly in a seemingly random fashion by a few degrees in varying directions. In flight, *Drosophila* flicks its head about twice per second horizontally through 10°-15° usually accompanied by twitches in wingbeat and hindleg posture that probably correspond to the rapid turns frequently observed in free flight.

Since flies do not respond to gravity in flight (R. Tengstenberg & N. Bayer 1988, Verh Dtsch Zool Ges 81, 203), *Drosophila* can be mounted in arbitrary orientations in the center of a striped drum to elicit head/eye movements in different directions. When the pattern (λ=24° I - 300 cd/m^2 , m = 0.95) is moving back and forth (±120°) at constant angular velocity (w_p =24°/s), *Drosophila* turns its head in the same direction, reducing the apparent pattern velocity on the eyes. The response strength is measured by the velocity gain ($G = w_h/w$) while The head turns through its neutral position. This procedure eliminates saturation iffectt with increasing head excursions, and the feedback influence of neck sense Organs. In contrast to *Calliphora (*R. Hengstenberg et al 1986, Proc R Soc 221, 455), *Drosophila* responds vigorously to pattern motion when resting: the response gain for yaw, pitch and roll, respectively, is G_y = 0.75±0.11 SD, G_p = 0.83±0.05, G_r =0.82.±0.06. In flight, the corresponding response gains are smaller, possibly due to the superpositon of spontaneous head movements: G_y = 0.73± 0.05 SD, G_p = 0.65± 0.08, G_r = 0.58±0.05. There is no significant difference between male and female flies, and none between females of the wildtype strains Berlin, Oregon R and Canton S.

Self-motion may have several deleterious effects on vision: motion blurring of the retinal image, misplacement of a target on the retina, and misalignment of a target with the retinal coordinates. Gaze-stabilizing eye or head movements reduce all these disturbances simultaneously and thus ensure best visual perception.



Head roll (HR), elicited by striped drum rotation