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Drosophila courtship: Male hybrid vigor after crossing isogenic lines?

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1. Introduction

In many models of sexual selection it is assumed that attractive traits are passed on from father to son and thus also help the mother attain fitness benefits, since her sons would be more likely to father even more offspring. In *Drosophila simulans*, male attractiveness is heritable through the patriline: attractive fathers sire attractive sons, while unattractive fathers sire unattractive sons (Taylor et al., 2007). However, Pischedda et al. had previously concluded that "male fitness was not inherited by sons" in *Drosophila melanogaster*. In an attempt to further elucidate the evolutionary and neurobiological underpinnings of sexual signaling during courtship, we set out to test the attractiveness of recently published isogenic fly lines. It has been reported that these 40 lines exhibit considerable variability in copulation latencies and frequencies (Ayroles et al., 2009). We started by measuring copulation latencies and frequencies of a selected subset of these lines in standard courtship wheels against a Canton S tester female. The selected lines were the five lines with the highest (lowest, respectively) copulation latencies from experiments using large, food-containing vials with Oregon/Samarkand tester females. To identify the lines best suited for crossing, the copulation latencies were plotted against the copulation frequencies and four lines which were clearly separable on both variables were chosen for crossbreeding. In all cases, the male offspring from the reciprocal crosses were more attractive than the less attractive parent(s). Some offspring exceeded even the more attractive parent in attractiveness. This evidence demonstrates that the fathers from an unattractive *D. melanogaster* population can sire attractive sons. The results also suggest a form of hybrid vigor which can render offspring more attractive than same-sex members from both their patri- and their matriline.

5. Conclusions

Reproducibility of our experiments was higher for copulation latencies than for copulation frequencies.
In all experiments where we crossed isogenic lines and tested the male F1 hybrids against a CS tester female, the hybrid males were at least as attractive as the most attractive parental strain, if not substantially more attractive. Thus, the experiments failed to falsify the hypothesis that a hybrid vigor effect influences male attractiveness when highly isogenic strains of *D. melanogaster* are crossed.

Courtship Wheels

Methods: All flies were collected under CO_2 anaesthesia. For the crosses female virgins were housed together with the respective males for 3-4 days at 25°. All flies for the experiments were collected and housed together in food vials for 3-4 days before testing them. Flies were put individually into the chambers of the courtship wheel, every male with a Canton S tester female of the same age. They were observed for 60 minutes and the copulation latency and frequency were recorded.

2. Attractive and unattractive males

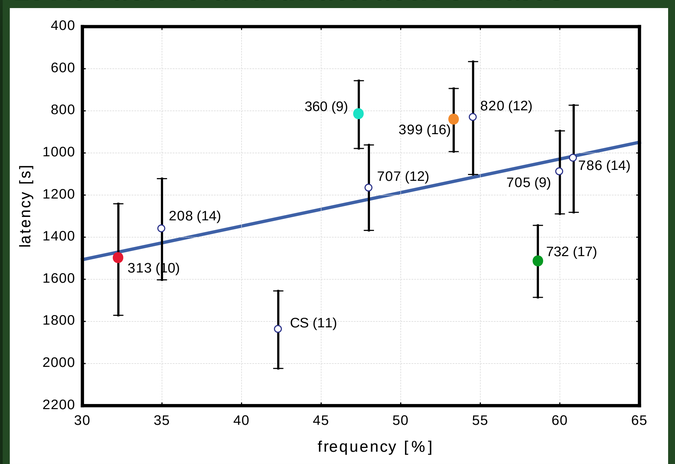

Fig. 1: *Relationship of latency and frequency scores for male offspring of selected lines. Based on these data the lines for the subsequent crossing experiments were chosen.*
were chosen.

3. Reproducibility

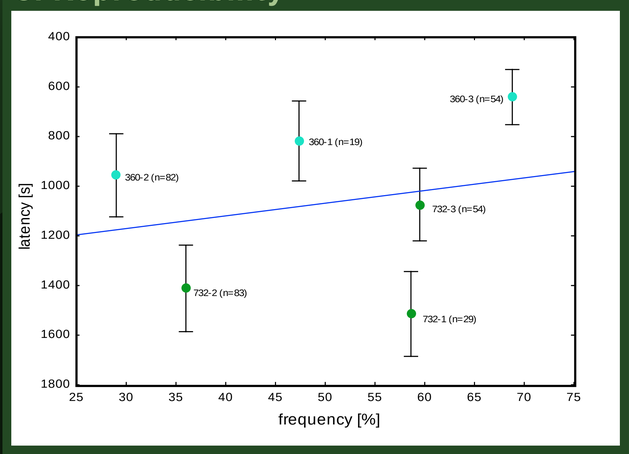

Fig. 2: *Relationship of latency and frequency scores from for male offspring of the lines 360 and 732. The experiment was repeated three times.*
360-1/732-1: data from experiment #1 (see Fig. 1)
360-2/732-2: data from experiment #2
360-3/732-3: data from experiment #3 (done in blind)

4. Unattractive fathers can sire attractive sons

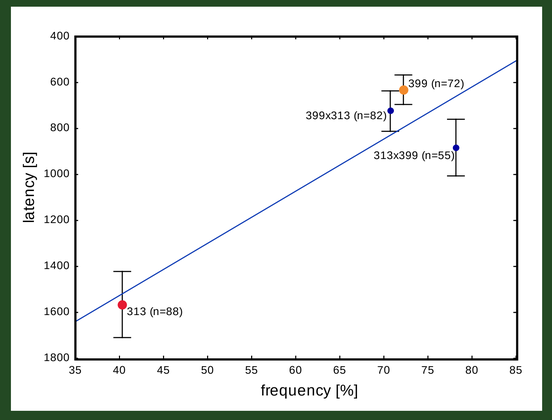

Fig. 4: *Relationship of latency and frequency scores for male offspring of reciprocal crossbreeds and the parent lines (313 and 399).*
313x399: offspring of 313 females and 399 males
399x313: offspring of 399 females and 313 males

5. Hybrid vigor?

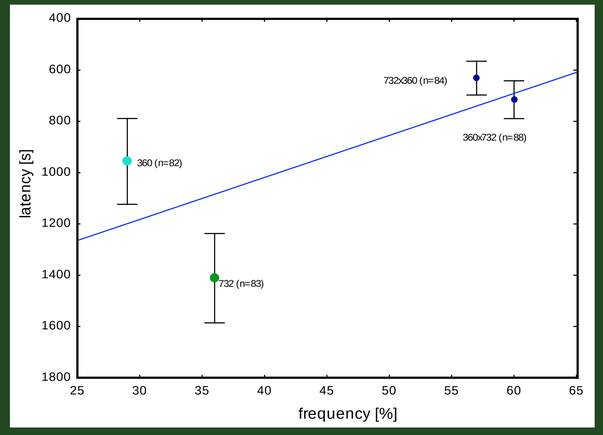

Fig. 3: *Relationship of latency and frequency scores for male offspring of reciprocal crossbreeds and the parent lines (360 and 732).*
360x732: offspring of 360 females and 732 males
732x360: offspring of 732 females and 360 males

References:
Ayroles JF, Carbone MA, Stone EA, Jordan KW, Lyman RF, Magwire MM, Rollmann SM, Dun-can LH, Lawrence F, Anholt RR, Mackay TF (2009): Systems genetics of complex traits in Drosophila melanogaster. Nat Genet. 41(3):299-307
Taylor ML, Wedell N, Hosken DJ. (2007): The heritability of attractiveness. Curr Biol. 17(22):R959-60
Pischedda A, Chippindale AK (2006): Intralocus Sexual Conflict Diminishes the Benefits of Sexual Selection. PLoS Biol 4(11): e356

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