ESM (Electronic Supplementary Material)

Supplementary Note 1: Results for Melanin as an FA Character

Melanin colour has a mean very near zero (n = 52, mean melanin per side = 1.85 x 104 pixels or 6.64 mm^2, mean left minus right = 169 pixels or 60.87 μm^2, SD = 4,181 pixels or 1,505.31 μm^2) and fluctuates with no fixed directional effect (27 males with slightly more melanin on right side, and 25 with more on left side; left and right sides did not differ statistically in amount of colour: Shapiro-Wilk, W = 0.96, P = 0.16). Thus, like orange colour, melanin is a statistical FA character. However, there was no female preference for melanin, and no male display bias in relation to melanin (Table S1, Fig. S1).

Supplementary Table S1. Multivariate regression (standard least squares; n = 53 males, r^2 = 0.38, $F_{[5,46]}$ = 5.57, P < 0.001) with female preference score as the independent variable and male traits as factors. P < 0.05 is highlighted in bold.

Traits	Sum of square	*F*	*P*
Body length	22.50	7.97	**0.007**
Orange colour quantity	30.58	10.83	**0.002**
Orange asymmetry	0.67	0.24	0.629
Melanin colour quantity	0.16	0.06	0.813
Melanin asymmetry	0.63	0.22	0.638
Number of sigmoid displays	1.04	0.37	0.547
Percent ‘best side’ displays	0.36	0.13	0.724

Supplementary Figure S1. Asymmetry in melanin colour and display behaviour of males. **(a)** F_1 males with live female ($n = 53$; $y = -0.25x - 0.04$; $r^2 = 0.06$; $P = 0.07$). **(b)** F_2 males with live female ($n = 31$; $y = -0.44x - 0.10$; $r^2 = 0.001$; $P = 0.88$). **(c)** F_2 males with model female ($n = 55$; $y = 0.09x + 0.07$; $r^2 = 0.003$; $P = 0.69$).

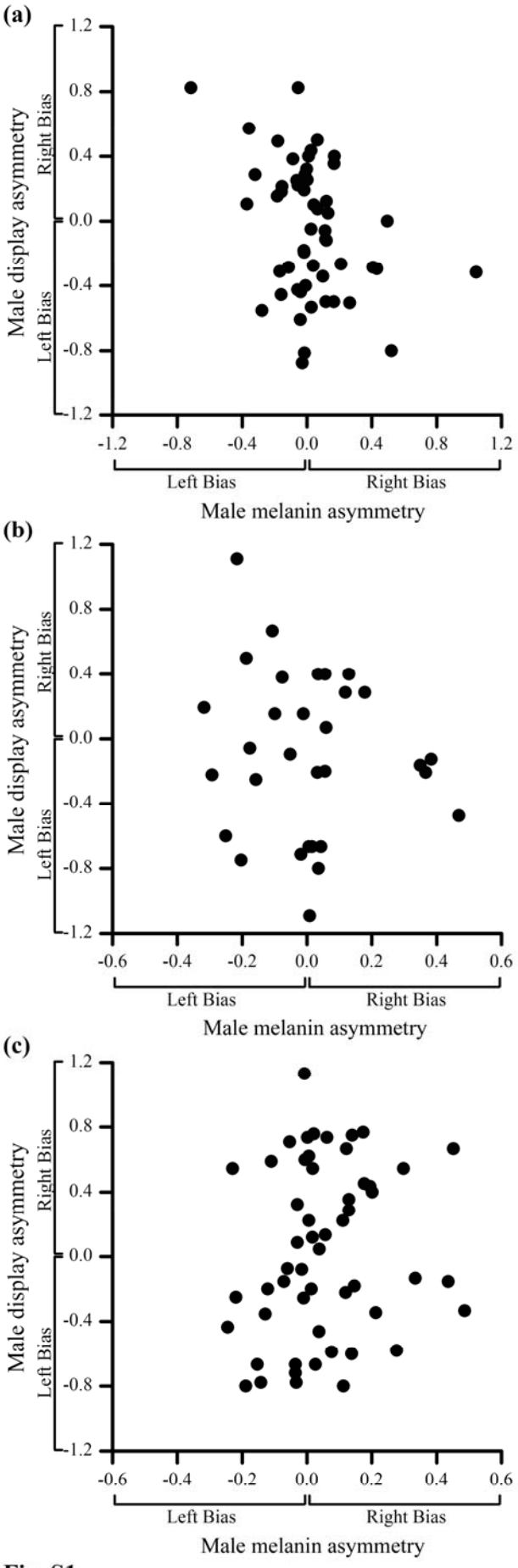
(a)
Male display asymmetry
Right Bias
Left Bias
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-1.2 -0.8 -0.4 0.0 0.4 0.8 1.2
Left Bias
Right Bias
Male melanin asymmetry
(b)
Male display asymmetry
Right Bias
Left Bias
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-0.6 -0.4 -0.2 0.0 0.2 0.4 0.6
Left Bias
Right Bias
Male melanin asymmetry
(c)
Male display asymmetry
Right Bias
Left Bias
1.2
0.8
0.4
0.0
-0.4
-0.8
-1.2
-0.6 -0.4 -0.2 0.0 0.2 0.4 0.6
Left Bias
Right Bias
Male melanin asymmetry

Fig. S1

Supplementary Table S2. Pearson's correlation among three potential indicators of male genetic quality (orange colour quantity, body size, and orange asymmetry)

Variables	Orange Colour Quantity	Body Size	Orange Asymmetry
Orange Colour Quantity	1.000	0.203	**-0.407****
Body Size		1.000	**-0.359****
Orange Asymmetry			1.000

**P< 0.01 is highlighted in bold; orange asymmetry was arcsine-transformed; orange colour quantity is the total from both body sides.

Supplementary Table S3. The results of linear regressions between father (F1 males; n = 26) and offspring (F2 males; n = 91) in orange and melanin colour pigmentation, ornamental FA, and display biases. Heritability can be estimated as 2bXY, in which bXY refers to the slope of the regression. S.E. refers to standard error. $P < 0.05$ is highlighted in bold.

Traits	b_{XY}	S.E.	F	P
1. Orange colour				
Total quantity	0.36	0.16	4.91	**0.03**
Asymmetry				
a. Side	-0.07	0.10	0.48	0.49
b. Level of asymmetry	-0.06	0.09	0.44	0.51
Display biasing behaviour (live female test)	0.08	0.28	0.08	0.78
2. Melanin Colour				
Total quantity	0.01	0.18	0.004	0.95
Asymmetry				
a. Side	0.01	0.11	0.01	0.91
b. Level of asymmetry	-0.05	0.10	0.27	0.60
Display biasing behaviour (live female test)	-0.14	0.38	0.14	0.72

Supplementary Table S4. Female orientation versus male side presented when males perform sigmoid displays and when they do not. Female orientation was counted only when females were 'attentive' (i.e., oriented towards the test male in the preference zone). χ^2 values were calculated under the null hypothesis that females randomly choose the same or opposite side to that displayed by the male. F_1 is the first generation of males, and F_2 is their male progeny tested with different females.

	Male side displayed (%)			
	Sigmoid display		No display	
Female side displayed	Right	Left	Right	Left
F_1				
Right	29	26	23	23
Left	21	25	27	27
χ^2 (*P*)	0.41 (0.52)		0.00 (0.99)	
F_2				
Right	31	24	31	26
Left	20	25	25	18
χ^2 (*P*)	1.44 (0.23)		0.04 (0.84)	

Supplementary Figure S2. Mean percentage of orange 'best-side' displays by F_1 males across trials (see Methods). **(a)** All males (n = 53; Spearman correlation: r = -0.0085, P = 0.9658). **(b)** Asymmetric males (n = 16; r = 0.0631, P = 0.7496).

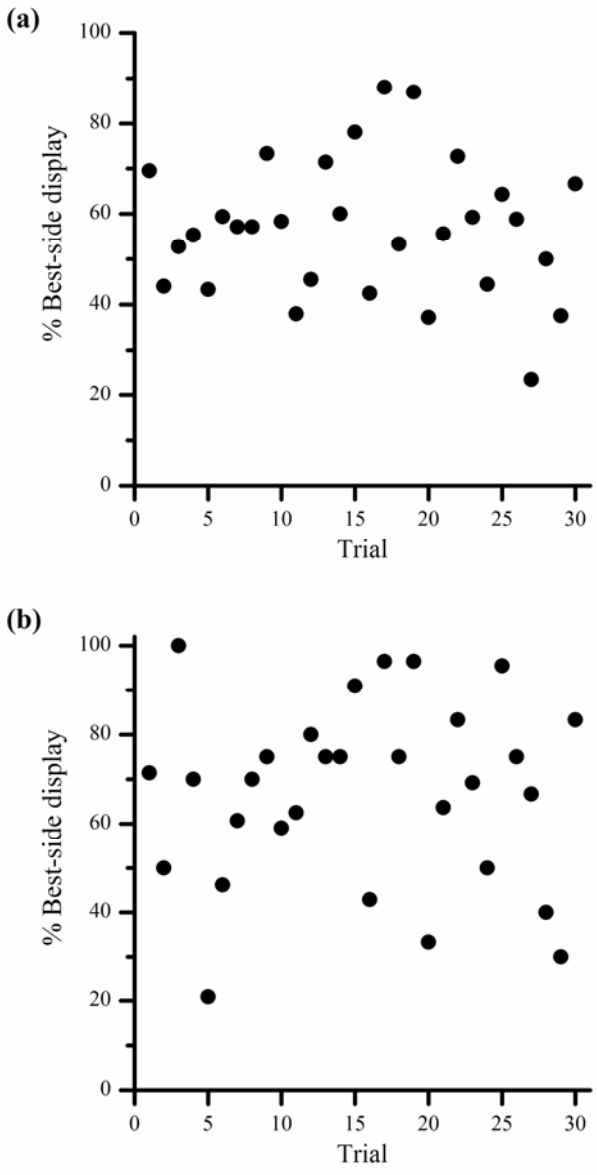

Fig. S2