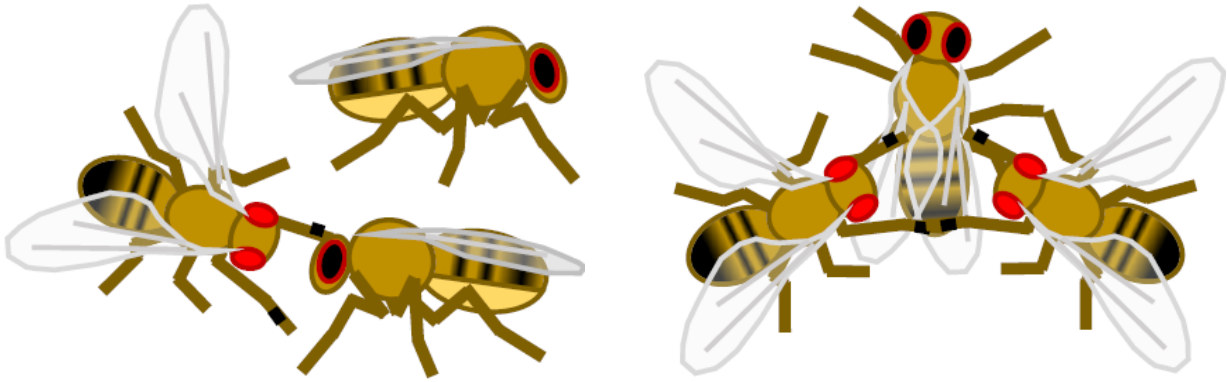
Journal Club

朱培雯 陈洁 王林

2022.04.28

Mating preference in *Drosophila*

- The influencing factors and basic overview of mating preference—Zhu Peiwen
- Study on courtship preference in male flies—Wang Lin
- The mate choice in female flies—Chen Jie



The influencing factors and basic overview of mating preference

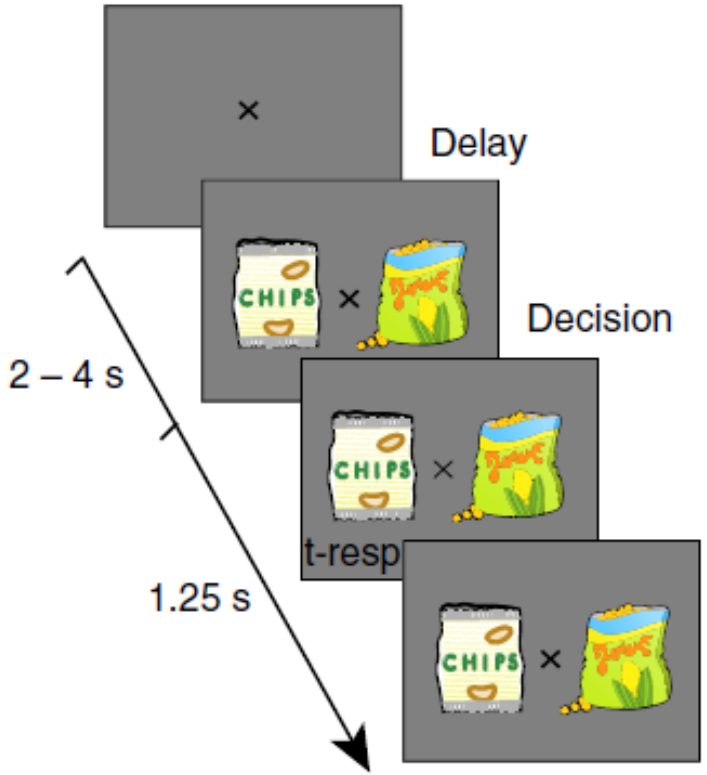
朱培雯

2022.04.28

Preference among people

图源：https://cn.bing.com

Preference among people



nature COMMUNICATIONS

ARTICLE

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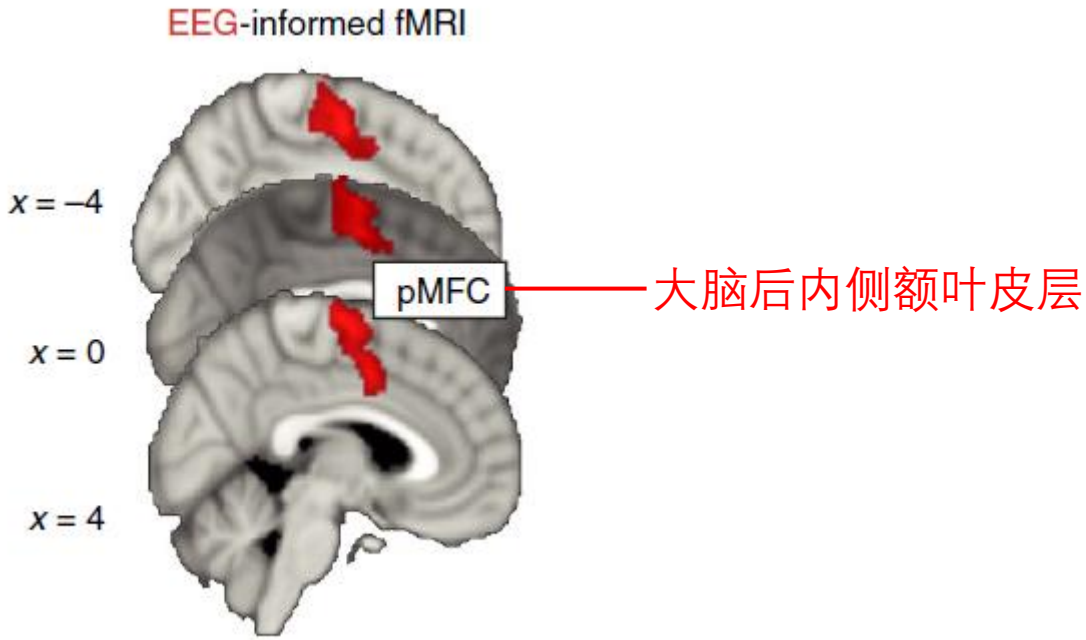
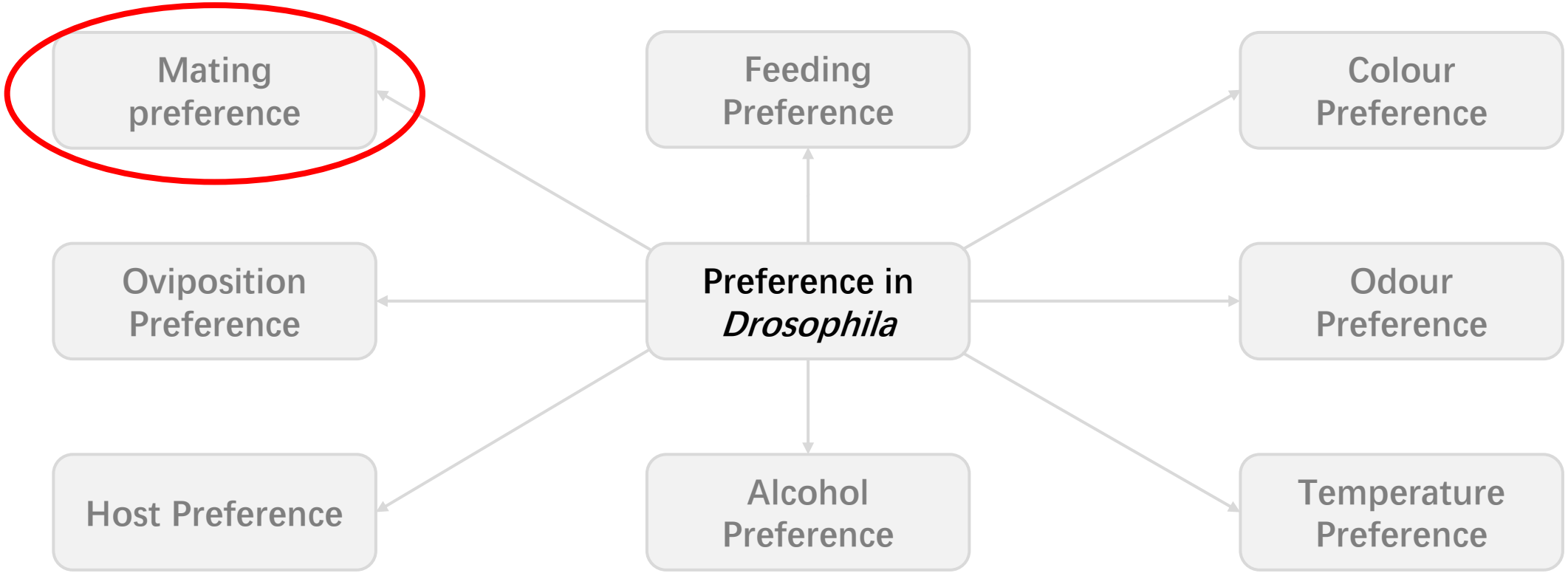
Neural correlates of evidence accumulation during value-based decisions revealed via simultaneous EEG-fMRI

M. Andrea Pisauro[1], Elsa Fouragnan[1,2], Chris Retzler[1,3] & Marios G. Philiastides[1]



(M. Andrea Pisauro, Marios G. Philiastides, et al. Nature Communications, 2017)



RESULTS BY YEAR

1,957 results

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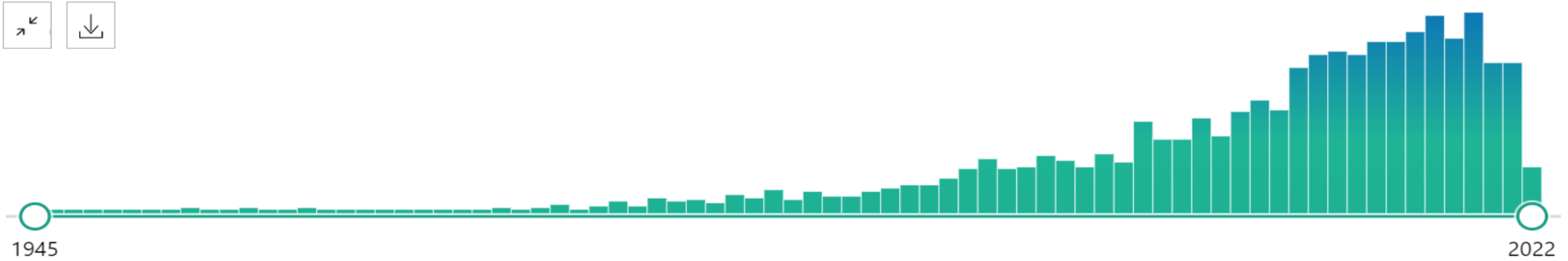
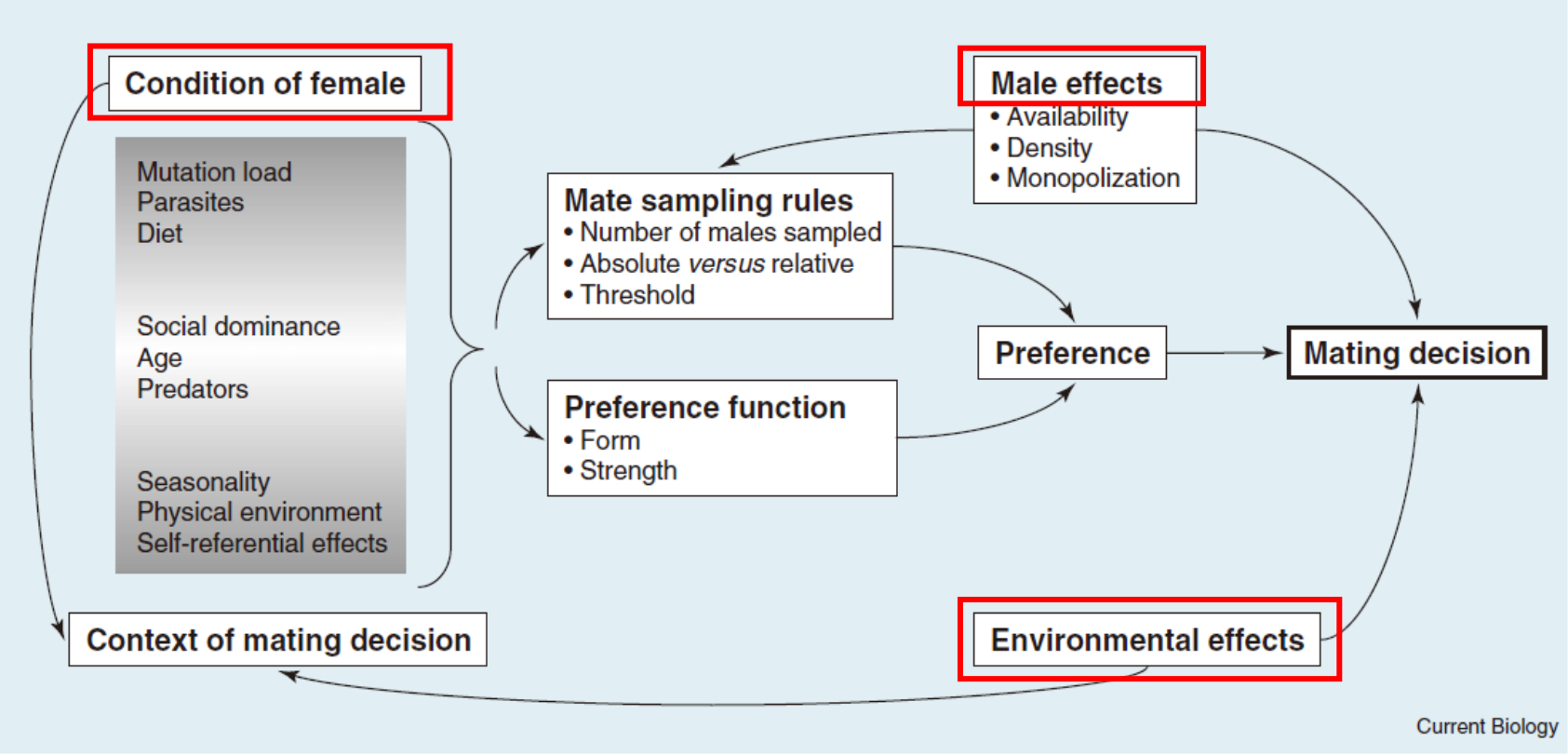
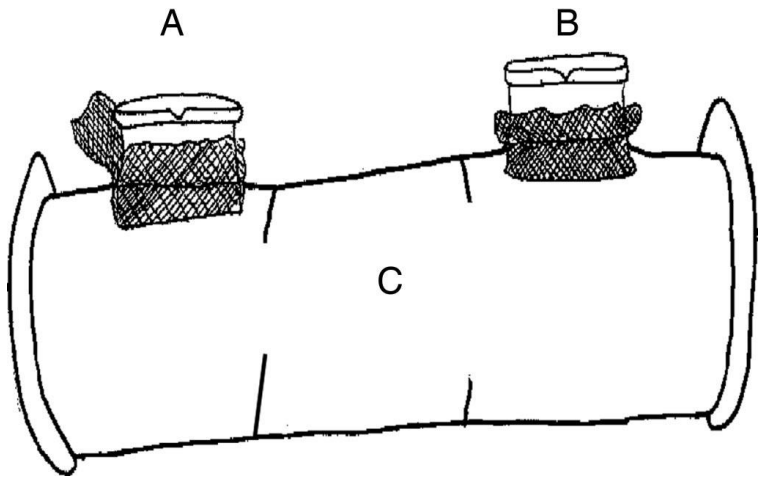


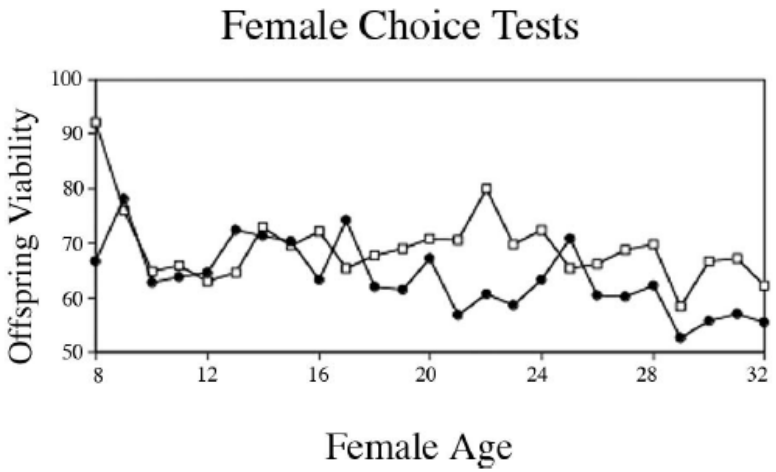
Mate preference, which is the attraction of an animal to another with particular phenotypic characteristics, underlies mate choice and is a condition-dependent trait, meaning that discrimination between potential mates depends upon the internal physiology of the choosing animal.

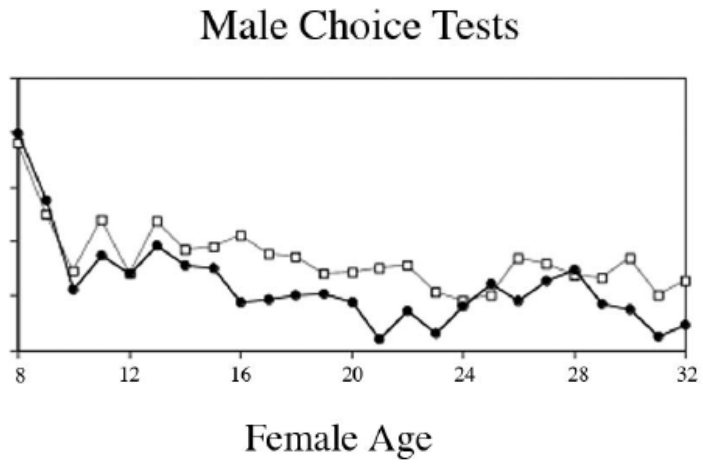


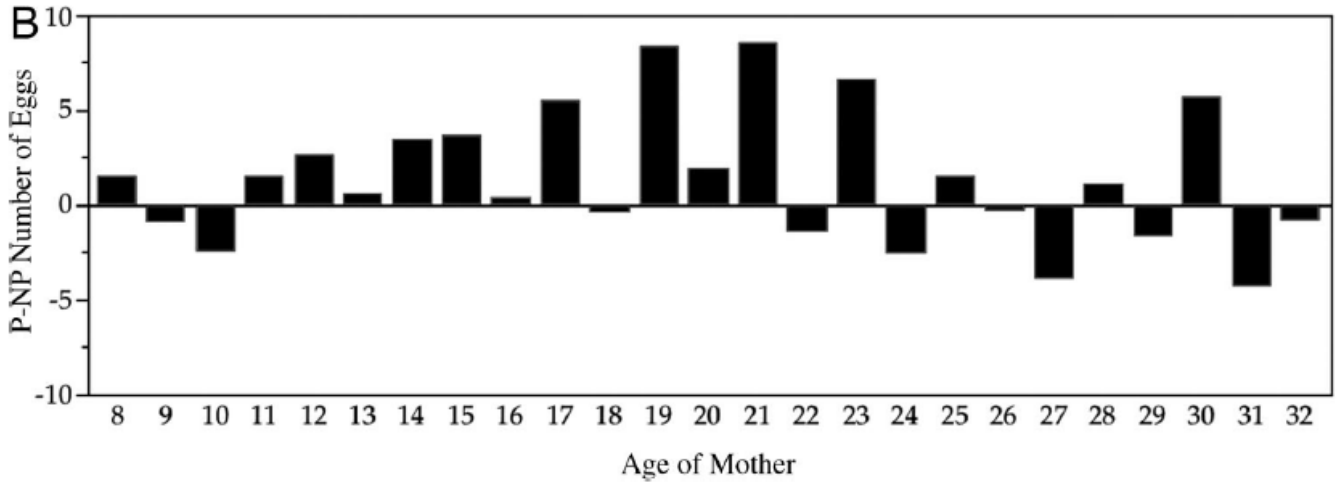
(Cotton, Pomiankowski, et al. Current Biology, 2006)

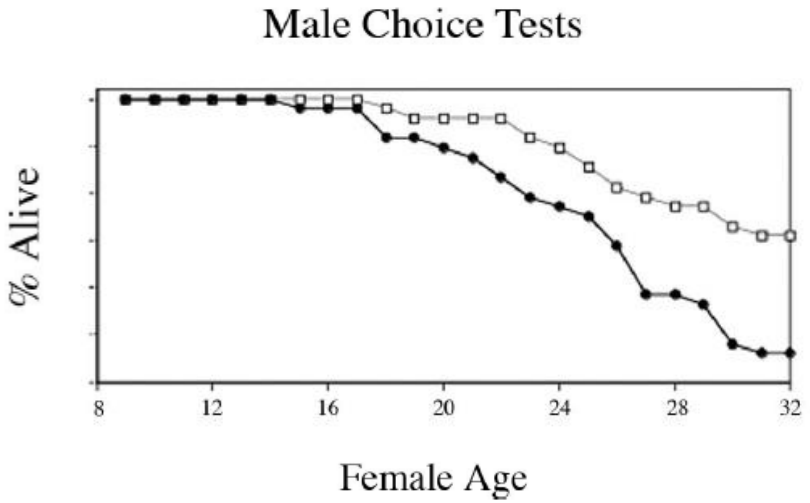
Experimental constraints on mate preferences decrease offspring viability and fitness of mated pairs





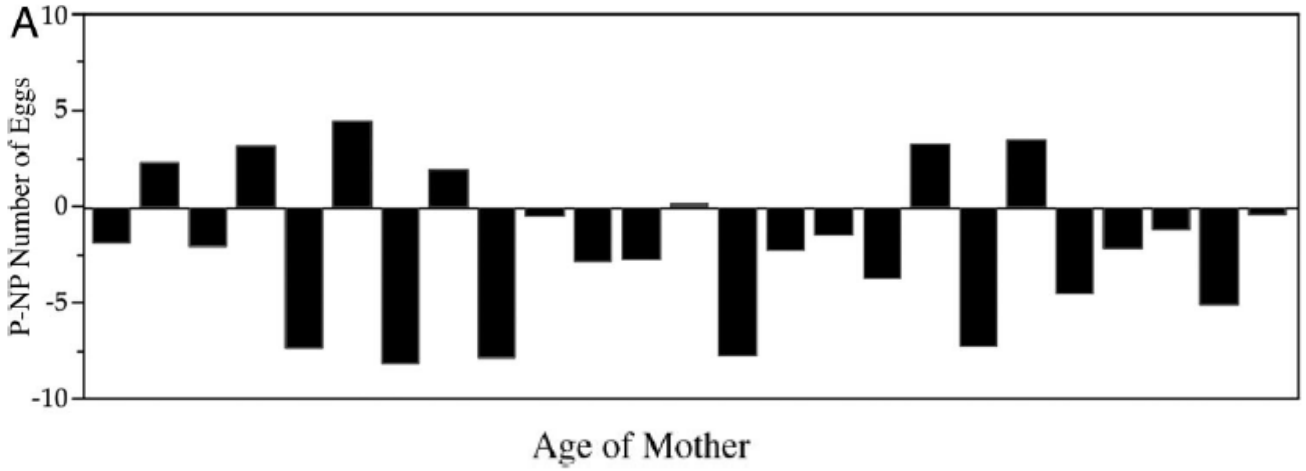




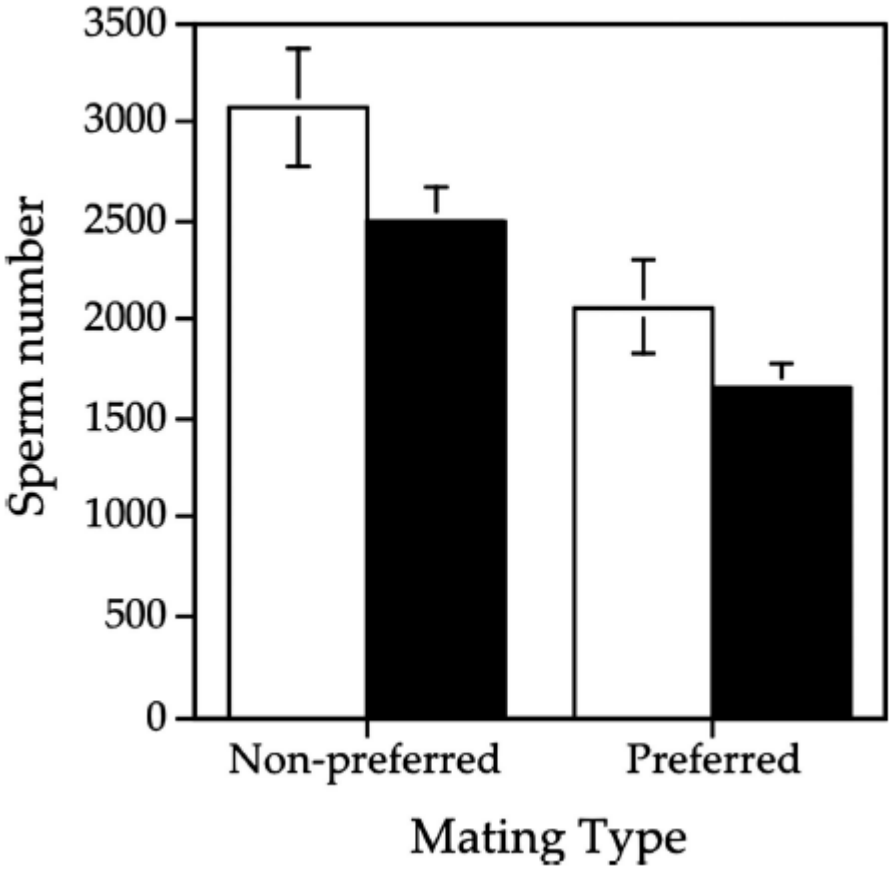


(Wyatt W., Patricia Adair Gowaty, et al. PNAS, 2007)

The Compensation Hypothesis



(Wyatt W., Patricia Adair Gowaty, et al. PNAS, 2007)



(Patricia Adair Gowaty, Wyatt W., et al. PNAS, 2007)

Species?

Size?

Age?

Diet?

Housing experience?

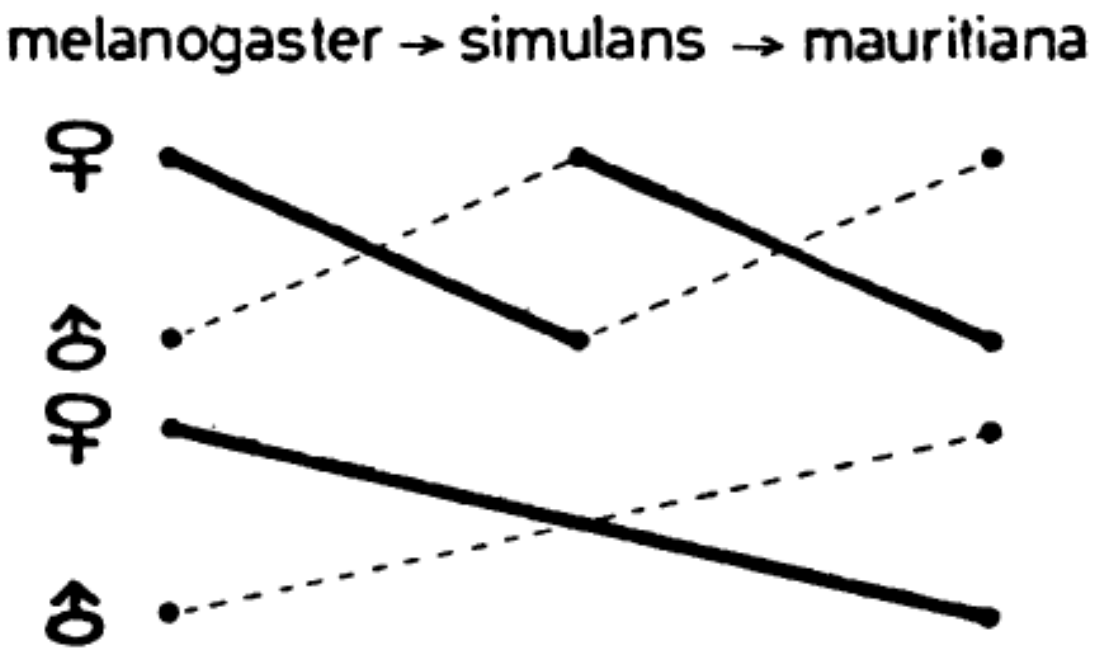
Wing color?

Chemical?

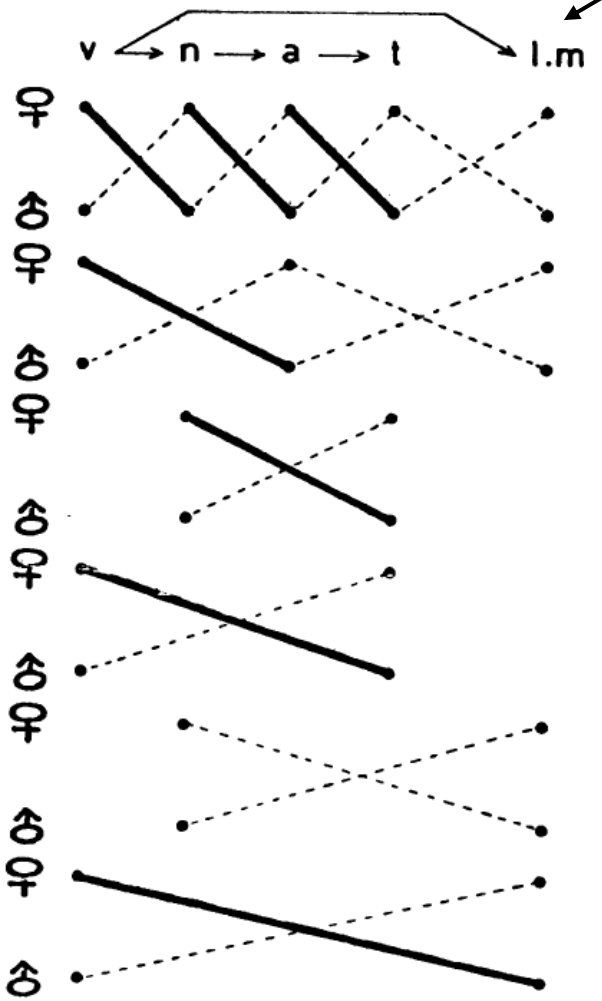
图源：https://zhuanlan.zhihu.com/p/166651084

1. Species

10 ♂ A vs 10 ♀ A+10 ♀ B
10 ♂ B vs 10 ♀ B+10 ♀ A

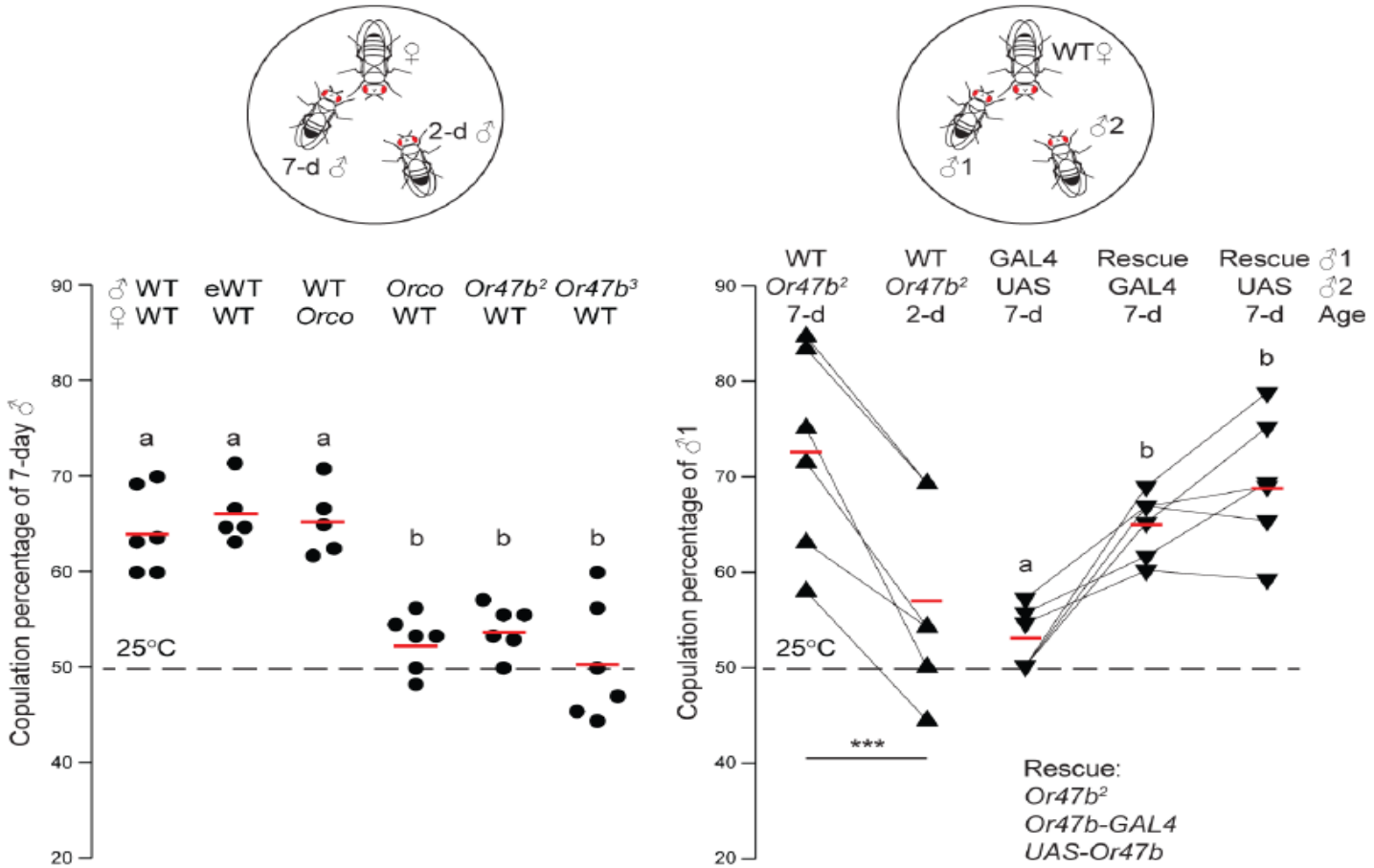


virilis→novamexicana→americana→texana
Virilis→lacicola＆montana.



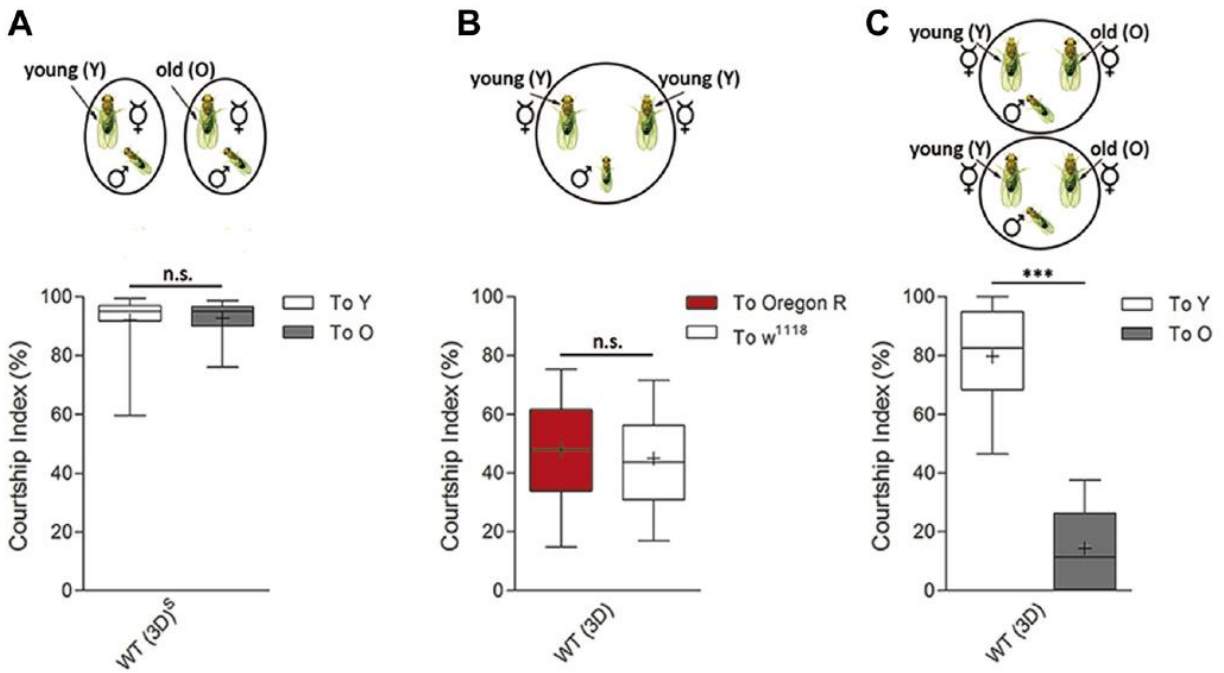
(T K Watanabe, M Kawanishi. Science, 1979)

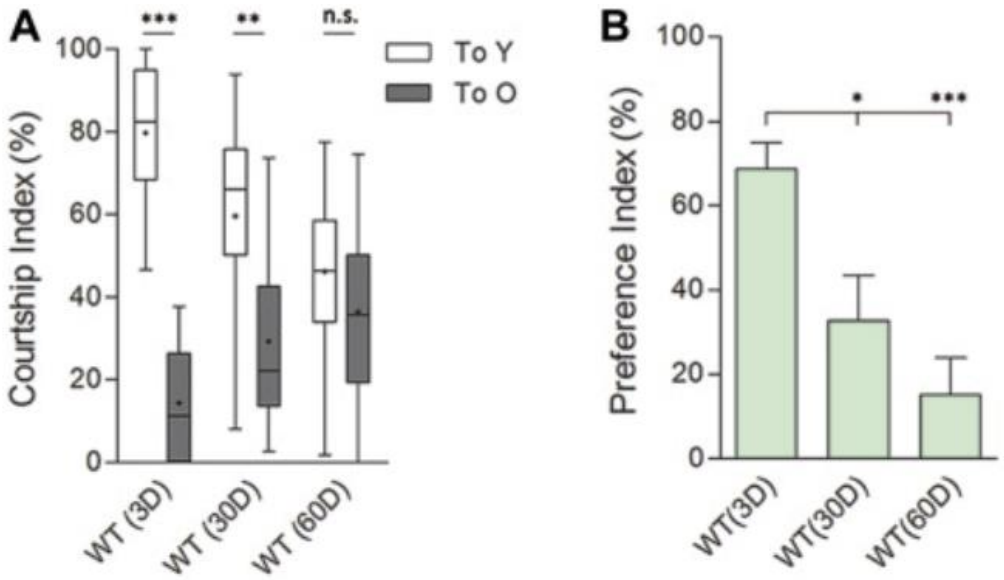
2. Age



(Hui-Hao Lin, Jing W. Wang. Neuron, 2017)

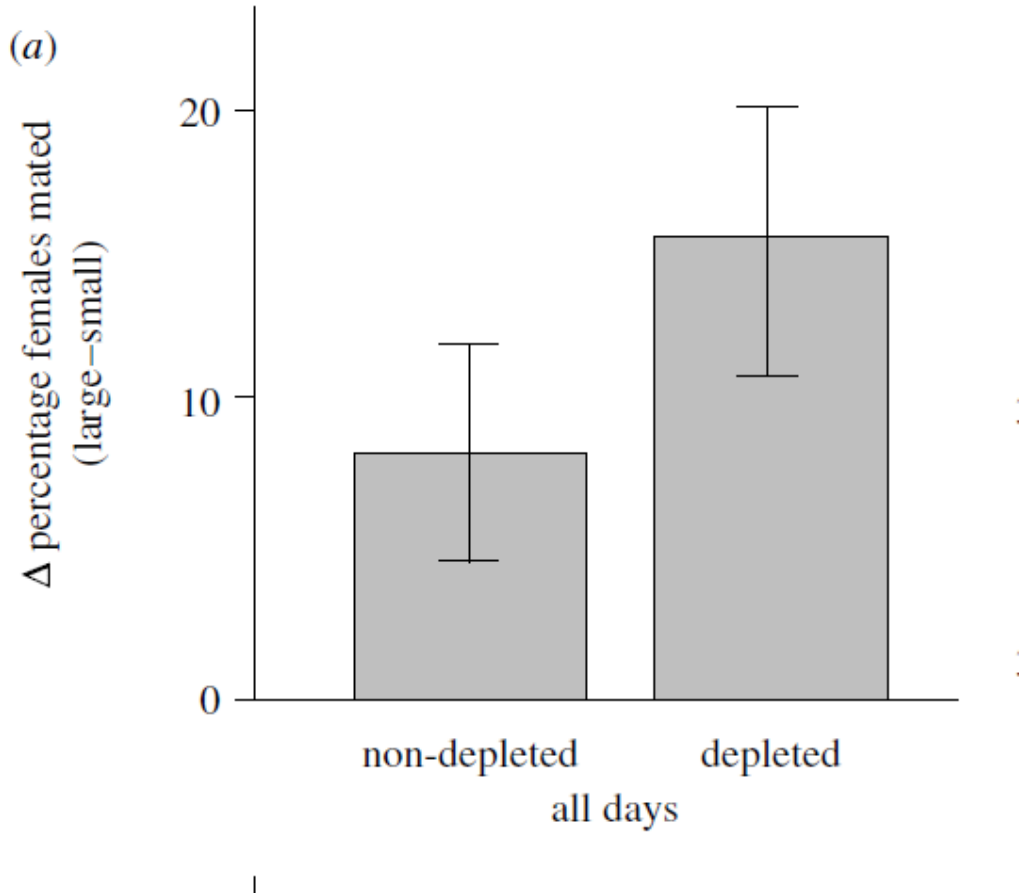
2. Age



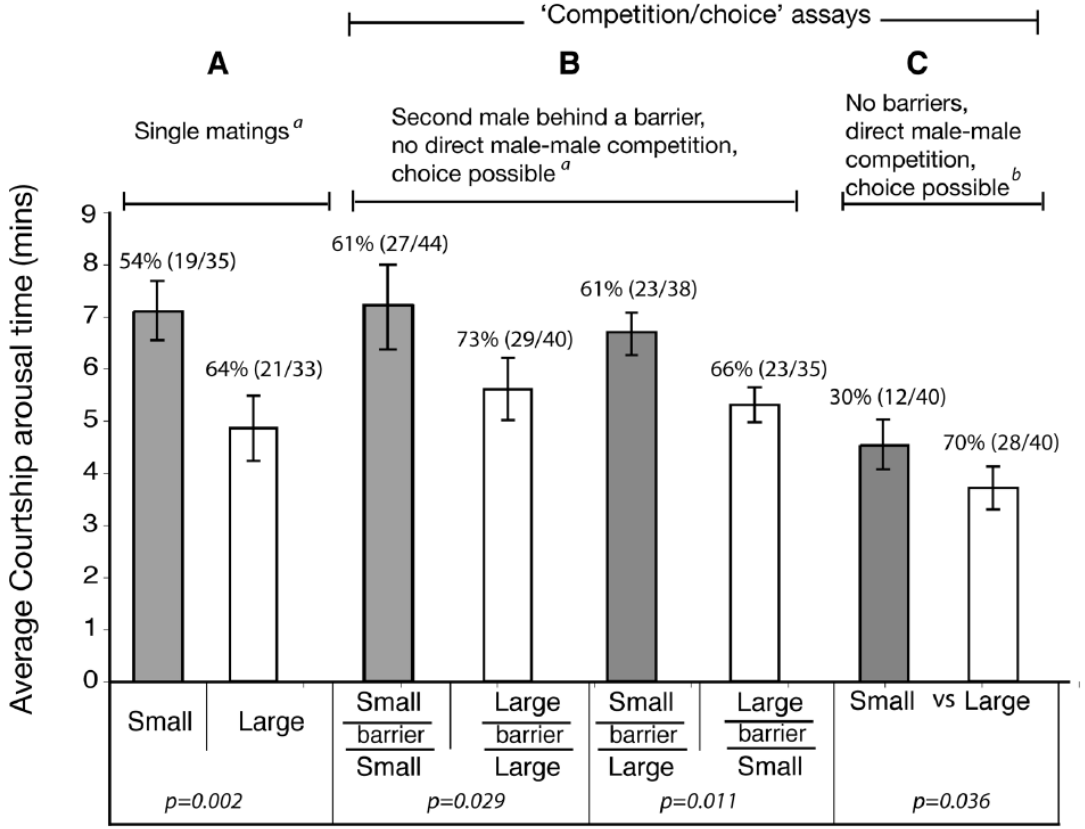


(Yujia Hu, LeiXue.
Neurobiology of Aging, 2014)

3. Body size

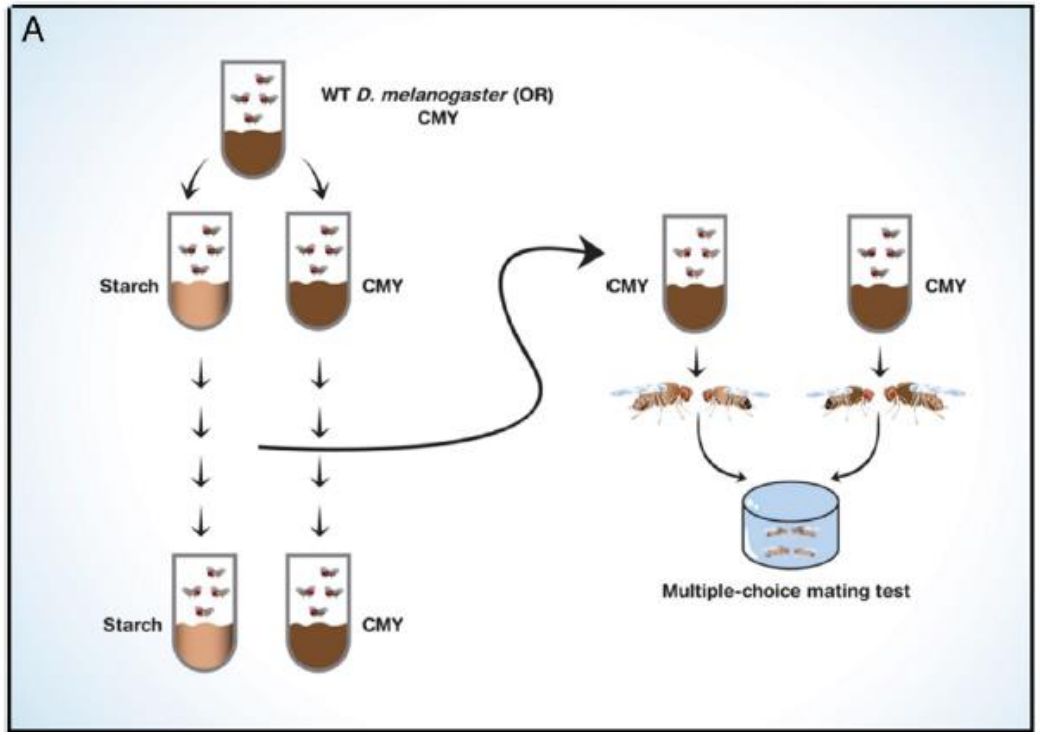


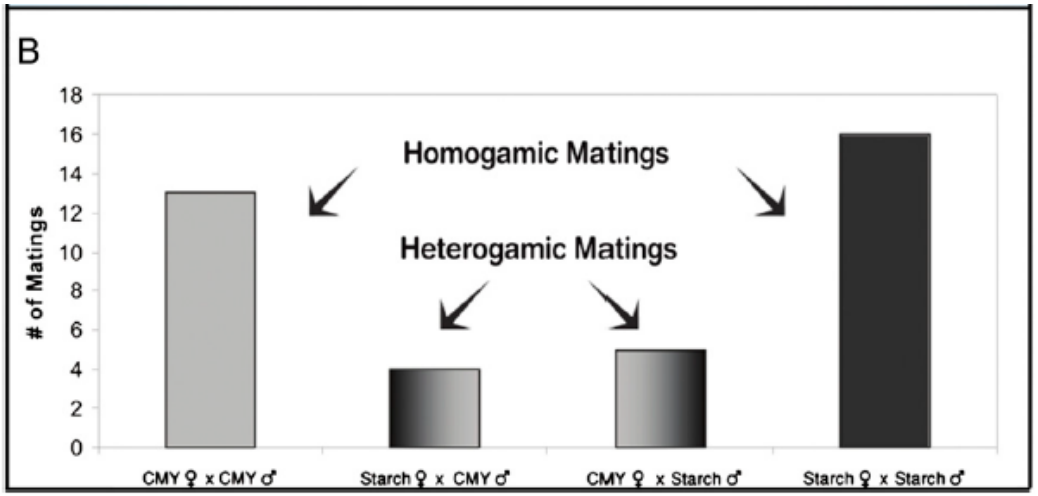
(Phillip G Byrne, William R Rice. Proc Biol Sci, 2006)



(Santosh Jagadeeshan, Rama S Singh. PLoS One, 2015)

4. Diet





(Gil Sharon, Eugene Rosenberg. PNAS, 2010)

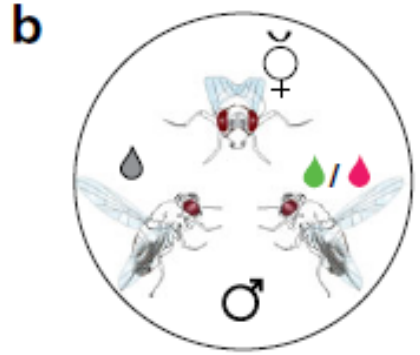
4. Diet

Table 1. The role of bacteria in diet-induced mating preference of *D. melanogaster*

Experiment	Fly treatment*	Matings	SII, mean ± SEM	*P* value†
1	Starch-grown × CMY-grown	18	0.27 ± 0.02	<0.0001
2	Experiment 1 after antibiotics	10	0.01 ± 0.03	0.4483
3	Experiment 2 after infection with homologous bacteria‡	4	0.22 ± 0.03	0.0024
4	Experiment 3 with *Lactobacillus* replacing homologous bacteria in starch-bred flies	4	0.16 ± 0.06	0.0392
5	Experiment 3 with *Lactobacillus plantarum* replacing homologous bacteria in starch-bred flies	5	0.19 ± 0.05	0.0004
6	Infection control (no added bacteria)	4	−0.04 ± 0.08	0.4052

(Gil Sharon, Eugene Rosenberg. PNAS, 2010)

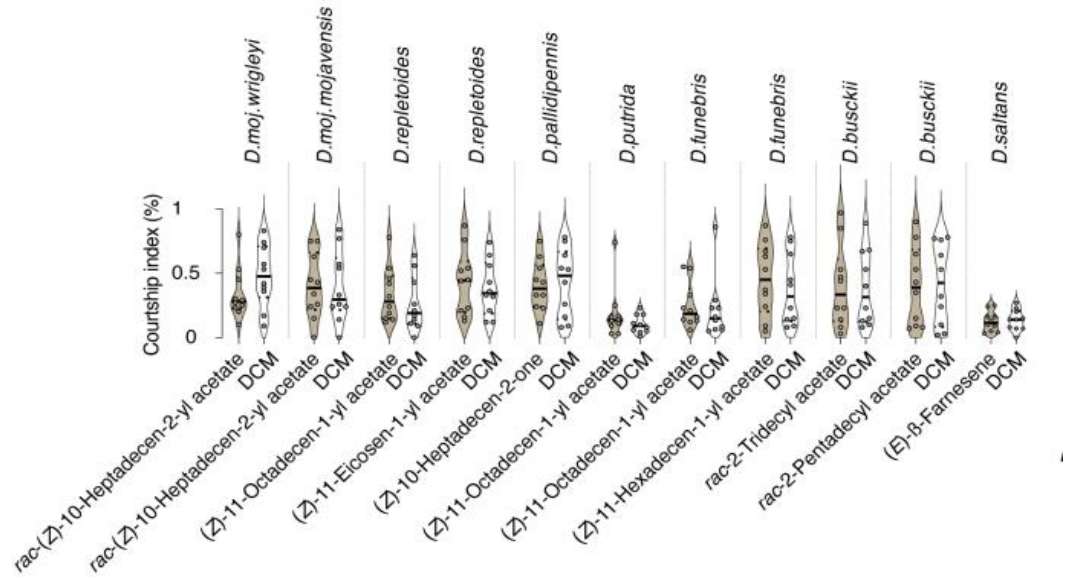
5. Chemical

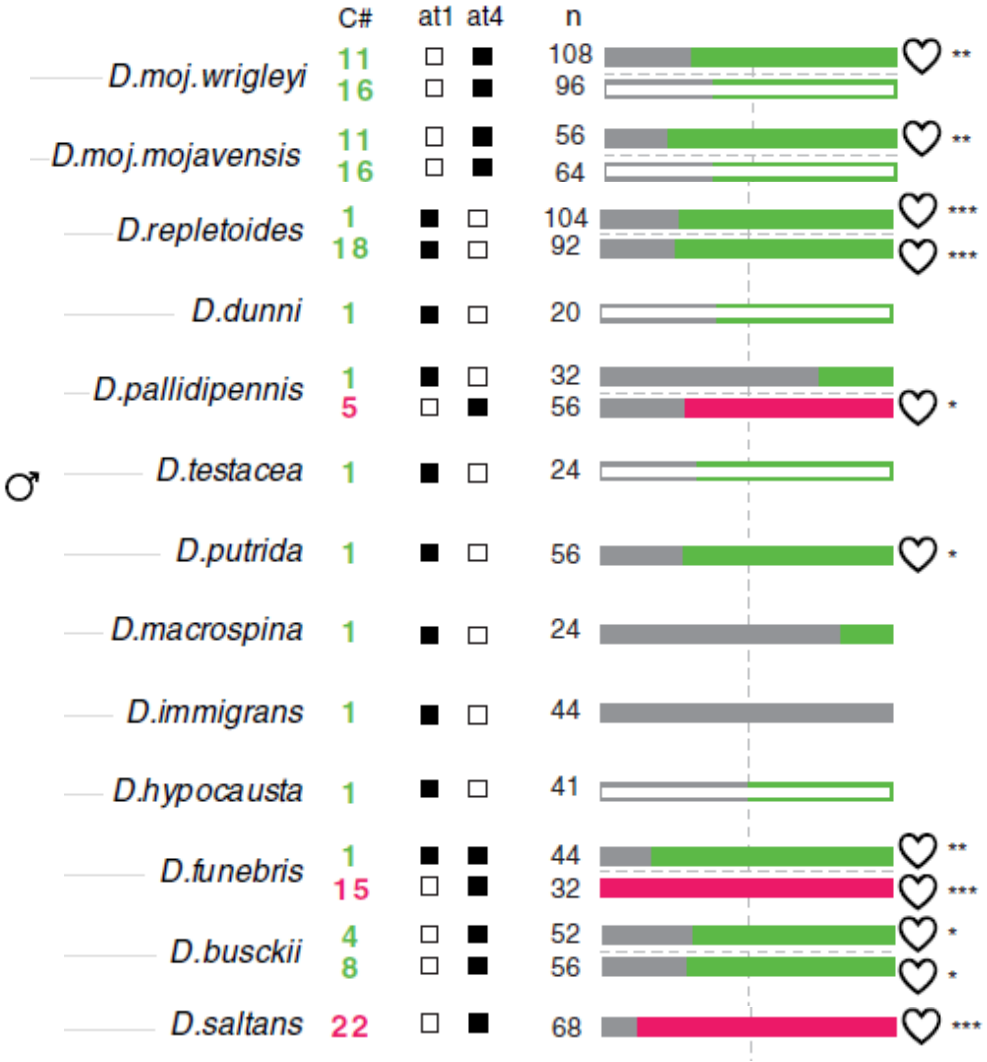


Hexane Untransferred c. Transferred c.

♡ : Aphrodisiac to ♀ ⊘ : Anti-aphrodisiac to ♂

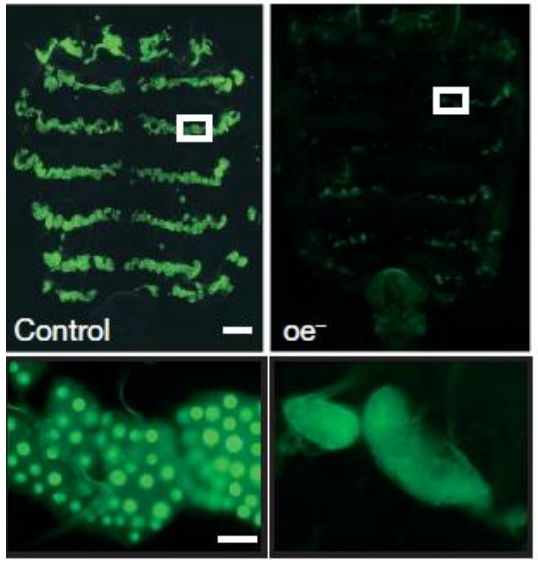
Pheromone
DCM

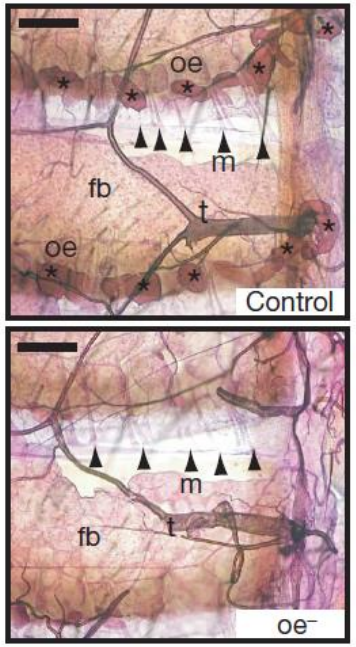


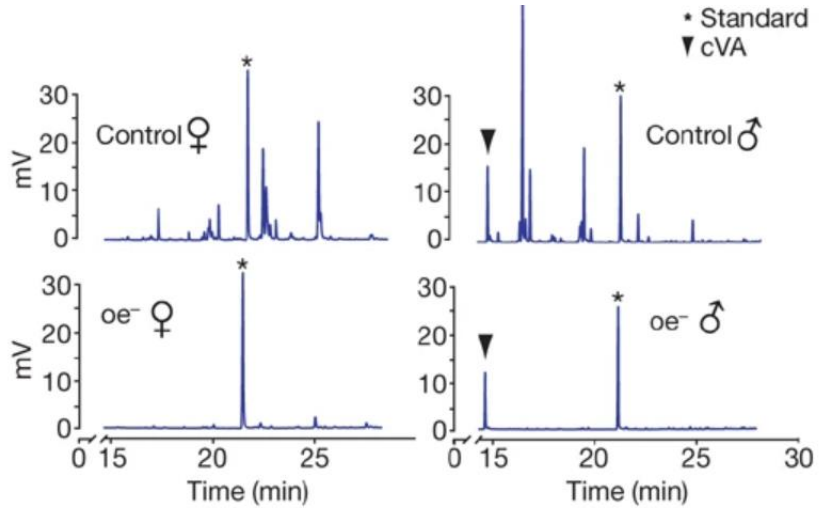


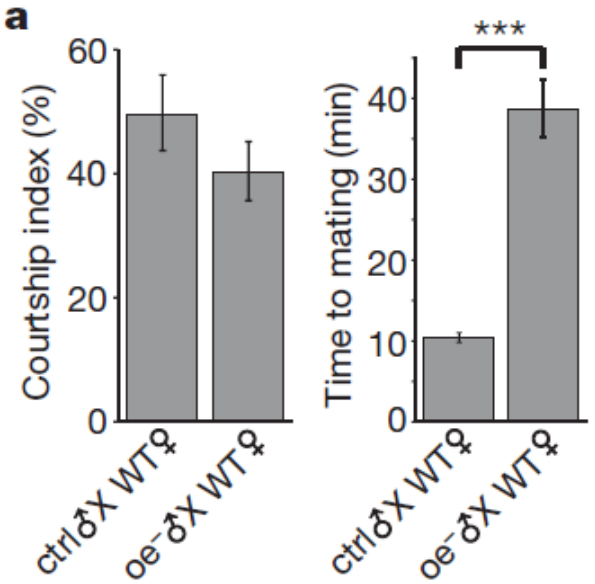
(Mohammed A. Khallaf, Markus Knaden. Nature Communications, 2021)

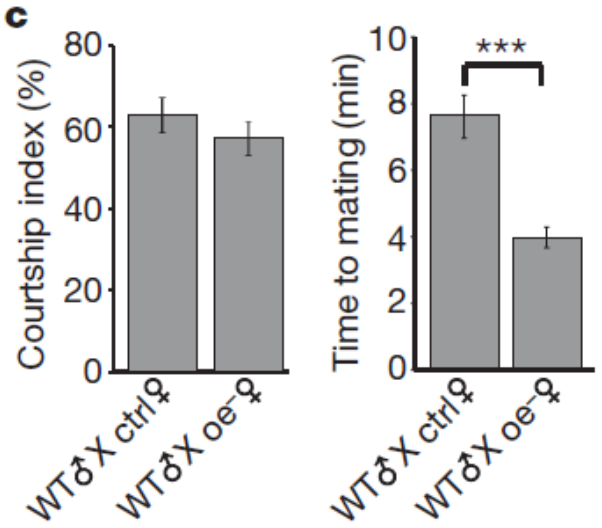
5. Chemical

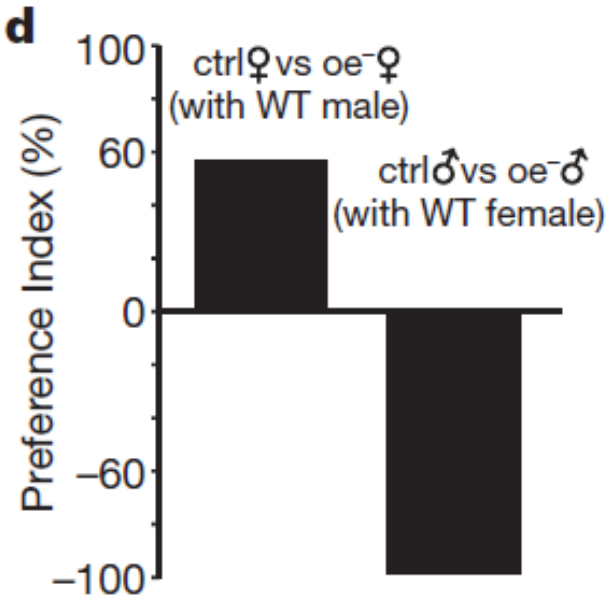












(Jean-Christophe Billeter, Joel D. Levine. Nature, 2009)

6. Housing experience

Table II. Courtship and Mating Under Female 'Choice' Conditions in Flies Subjected to Differential Posteclosion Housing

♂♂/♀♀	(a) [I, G)/G]			(b) [I, G)/I)		
	I	G	χ^2	I	G	χ^2
Mean courtship latency (min)	0·81 ± 0·24	0·89 ± 0·28		1·11 ± 0·68	1·21 ± 0·54	
No. of initial approaches	28	24	0·40	37	11	4·08**
Mean latency (min)	5·4 ± 1·32	7·4 ± 1·53		4·4 ± 0·89	4·3 ± 1·60	
No. of matings	16	31	5·48*	34	10	13·09**

** $P < 0·01$; * $P < 0·05$.

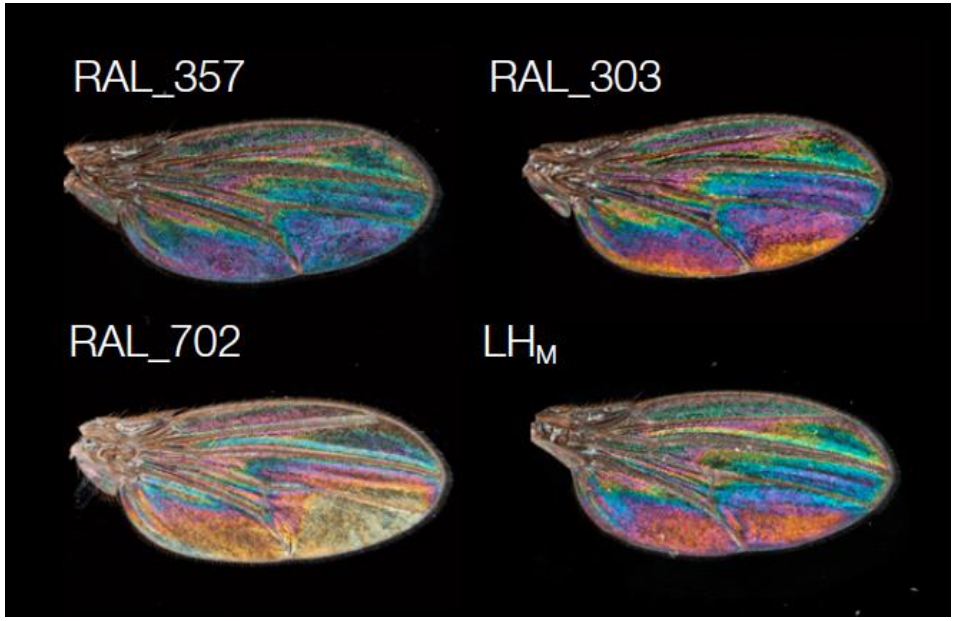
Table III. Courtship and Mating Under Male 'Choice' Conditions in Flies Subjected to Differential Posteclosion Housing

♂♂/♀♀	(c) [G/I, G]			(d) [I, IG]		
	I	G	χ^2	I	G	χ^2
Mean courtship latency (min)	1·5 ± 0·31	1·3 ± 0·16		0·73 ± 0·16	0·57 ± 0·12	
No. of initial approaches	20	26	0·40	26	23	0·40
Mean mating latency (min)	6·7 ± 0·95	5·7 ± 1·38		4·4 ± 0·41	4·8 ± 0·83	
No. of matings	29	14	5·48*	33	12	8·77**

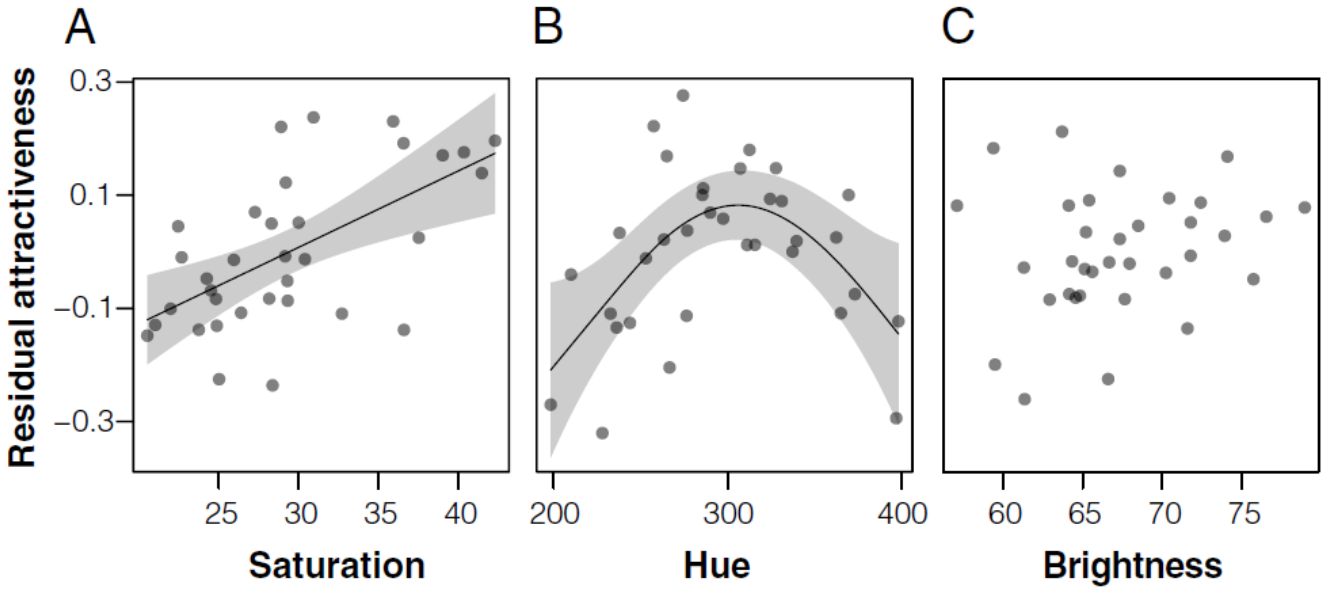
** $P < 0·01$; * $P < 0·05$.

(L B Ellis, S Kessler. Animal Behaviors, 1975)

7. Wing color



Smooth effect of variable	edf	*F* statistics	*P* value
Hue	2.522	5.828	0.003
Saturation	1.000	12.491	0.001
Brightness	1.000	0.678	0.417



(Natsu Katayama, Erik I. Svensson. PNAS, 2014)

summary

1. Lower offspring viability when individuals are constrained to breed with individuals they do not prefer.
2. The Compensation Hypothesis——parents increase reproductive effort in offspring to make up for lowered offspring viability.
3. Species——derived species ☿ 👉 ancestral species ♁ 💔
   ancestral species ☿ 👉 derived species ♁ ❤️
4. Age——females 👉 older males 🤍
   males 👉 younger females ❤️
5. Body size——males 👉 large females ❤️
   females 👉 large males 🤍
6. Diet——females in cornmeal-molasses-yeast(CMY) ❤️ males in CMY
   females in starch ❤️ males in starch
7. Chemical——females 👉 males with male-specific compounds ❤️
   males 👉 females lacking cuticular hydrocarbon ❤️
   females 👉 male lacking cuticular hydrocarbon 💔

Thanks!

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Part II:

Study on courtship preference in male flies

王林

2022/4/28

为什么雄蝇只对同种的雌蝇产生偏好？

雄蝇择偶的过程是理性的吗？

雄蝇心目中的“女神果蝇”是什么样子？

雄蝇的偏好和雌蝇的特征哪个更早的出现？

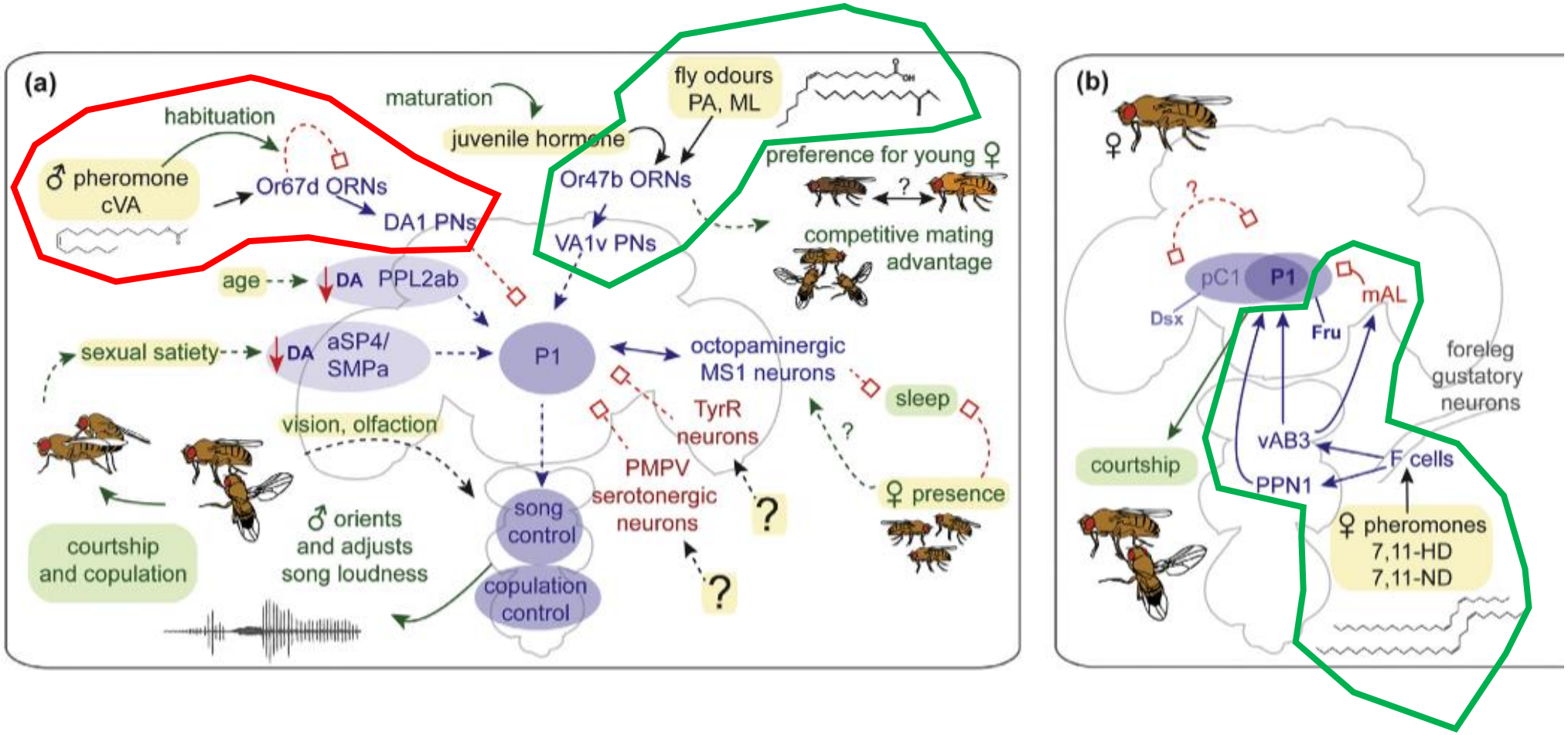
Three elements of attractiveness

- Body size: Males prefer to mate with large females.
  （Seema Sisodia et al. 2004）

- Pheromone
  - aphrodisiac: 7,11-HD, 7,11-ND, ML
  - anti-aphrodisiac: cVA

- Female receptivity: Males prefer to mate with more receptive female.
  (Devin Arbuthnott et al.2016)

The influence of pheromones on courtship preference



Ellendersen, B. E and Anne C von Philipsborn, *Curr. Opin. Insect. Sci*,2017

Commensal bacteria play a role in mating preference of *Drosophila melanogaster*

Gil Sharon[a], Daniel Segal[a], John M. Ringo[b], Abraham Hefetz[c], Ilana Zilber-Rosenberg[d], and Eugene Rosenberg[a,1]

[a]Department of Molecular Microbiology and Biotechnology, Tel Aviv University, Tel Aviv 69978, Israel; [b]School of Biology and Ecology, University of Maine, Orono, ME 04469; [c]Department of Zoology, Tel Aviv University, Tel Aviv 69978, Israel; and [d]18 Rachavat Ilan St., Givat Shmuel 51905, Israel

Edited by R. John Collier, Harvard Medical School, Boston, MA, and approved September 28, 2010 (received for review July 12, 2010)

SCIENTIFIC REPORTS

OPEN

High fat diet alters *Drosophila melanogaster* sexual behavior and traits: decreased attractiveness and changes in pheromone profiles

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Accepted: 13 March 2018
Published online: 29 March 2018

Janna N. Schultzhaus[1,3], Chloe J. Bennett[1], Hina Iftikhar[1], Joanne Y. Yew[2], Jason Mallett[1] & Ginger E. Carney[1,4]

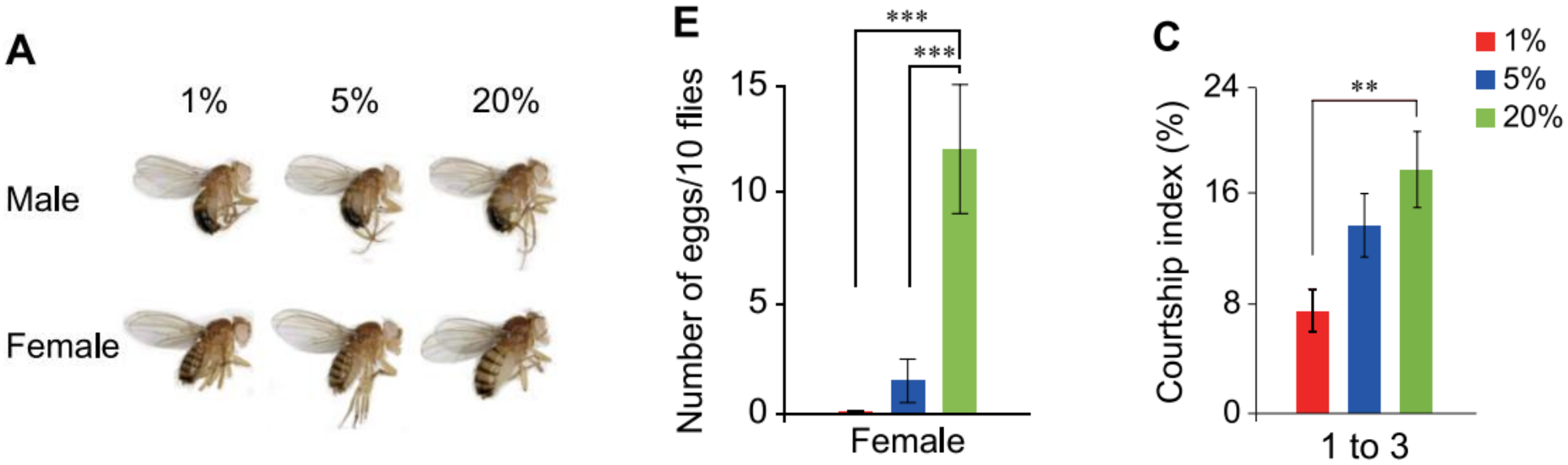
OPEN BIOLOGY

rsob.royalsocietypublishing.org

Or47b plays a role in *Drosophila* males' preference for younger mates

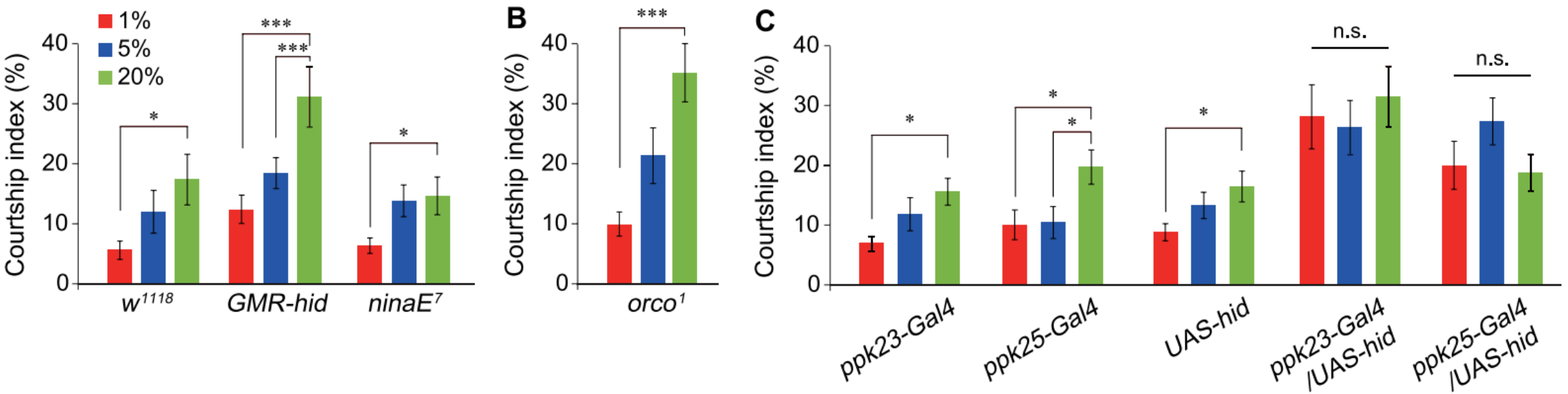
Luming Zhuang[1,†], Ying Sun[1,†], Mi Hu[2], Chenxi Wu[1,3], Xiaojin La[3], Xinhong Chen[1], Yu Feng[1], Xingjun Wang[1], Yujia Hu[1,‡] and Lei Xue[1]

Dietary yeast affects female attractiveness in flies



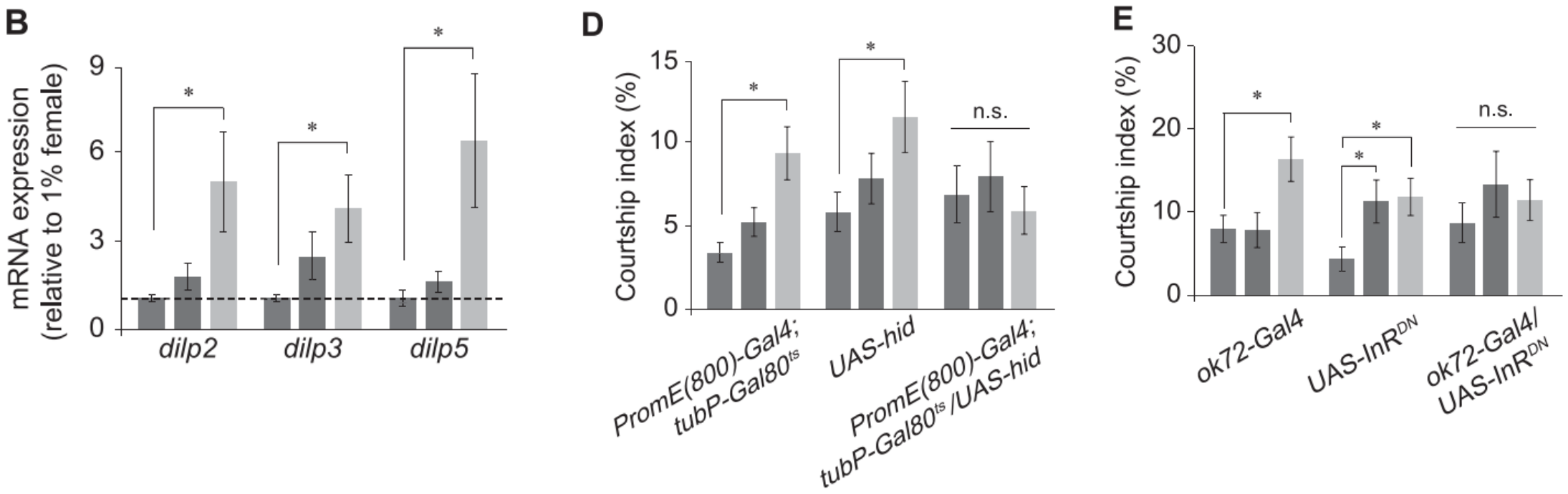
Wei-Sheng Lin et al.,*The Faseb Journal*,2017

Gustatory perception mediates male courtship preference



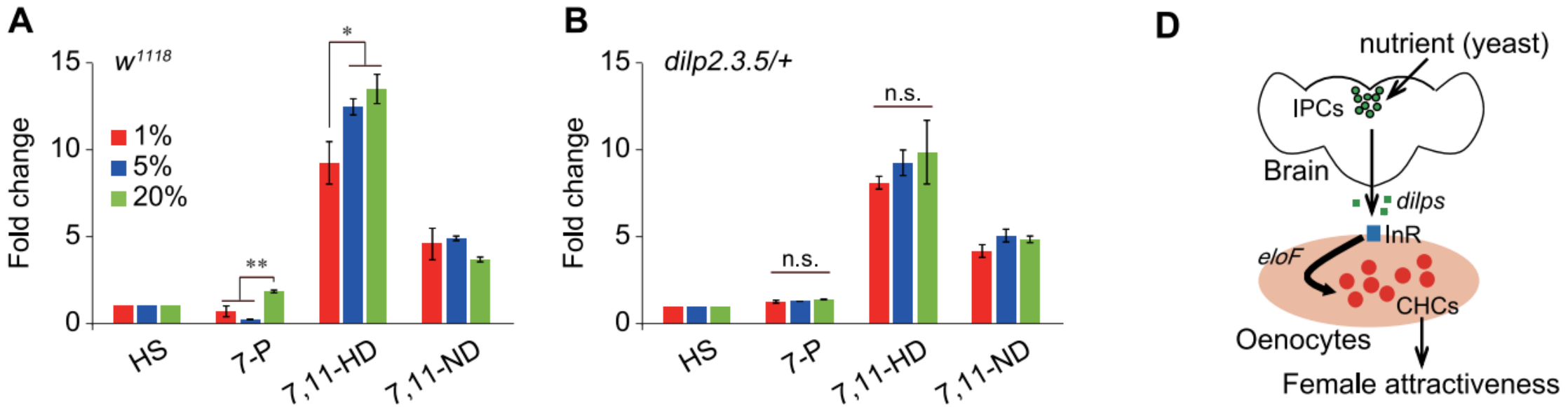
Wei-Sheng Lin et al.,*The Faseb Journal*,2017

Insulin-like signaling acts on female oenocytes to modulate female attractiveness



Wei-Sheng Lin et al.,*The Faseb Journal*,2017

Dietary yeast and *dilp* signaling interact to affect CHC expression and sexual attractiveness



Wei-Sheng Lin et al.,*The Faseb Journal*,2017

为什么雄蝇只对同种的雌蝇产生偏好？

雄蝇择偶的过程是理性的吗？

雄蝇心目中的“女神果蝇”是什么样子？

雄蝇的偏好和雌蝇的特征哪个更早的出现？

ARTICLE

https://doi.org/10.1038/s41586-018-0322-9

Evolution of a central neural circuit underlies *Drosophila* mate preferences

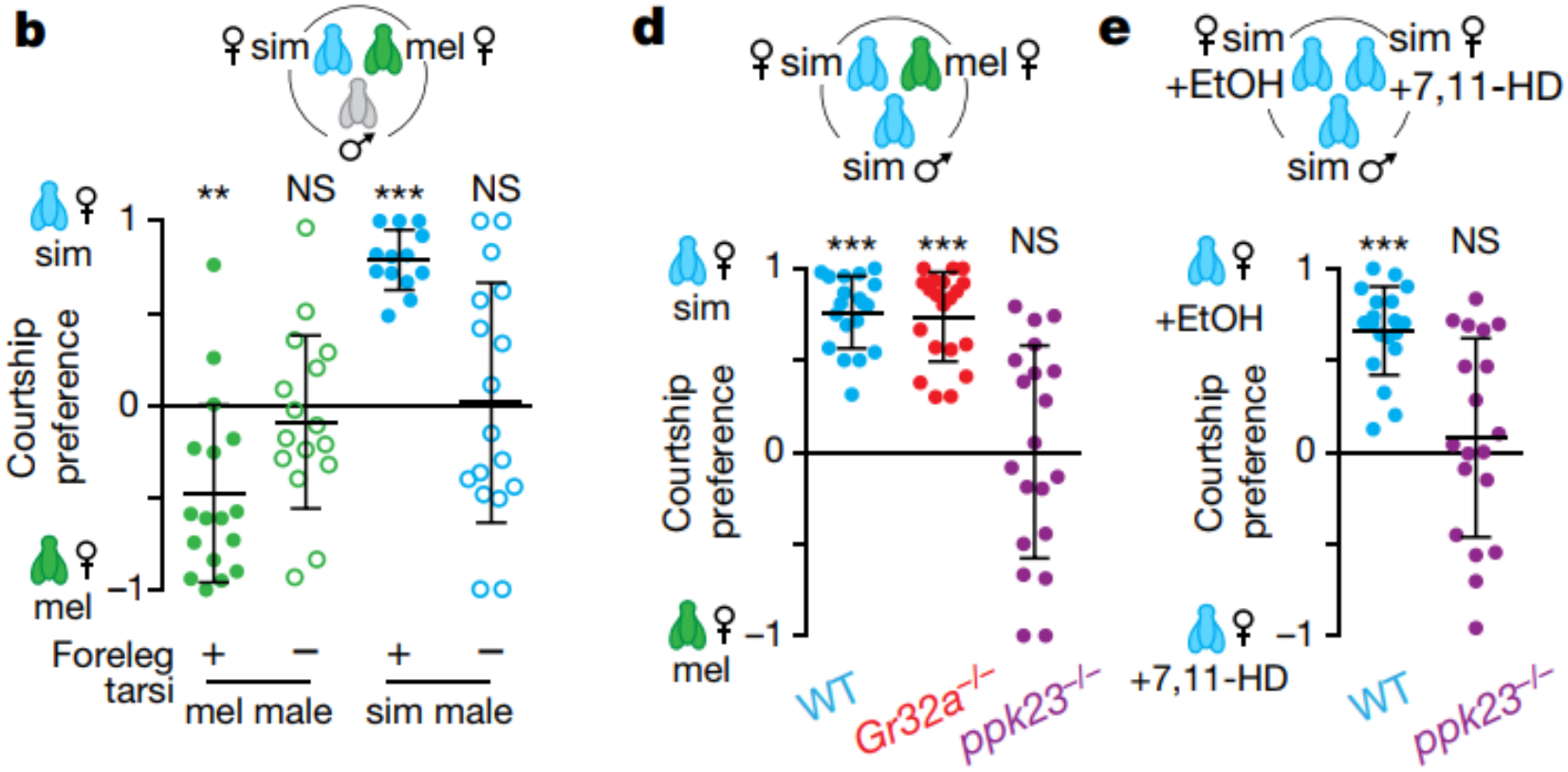
Laura F. Seeholzer[1], Max Seppo[1], David L. Stern[2] & Vanessa Ruta[1]*

Pheromone regulation of *D. simulans* courtship

D. melanogaster and *D. simulans* diverged 2–3 million years ago

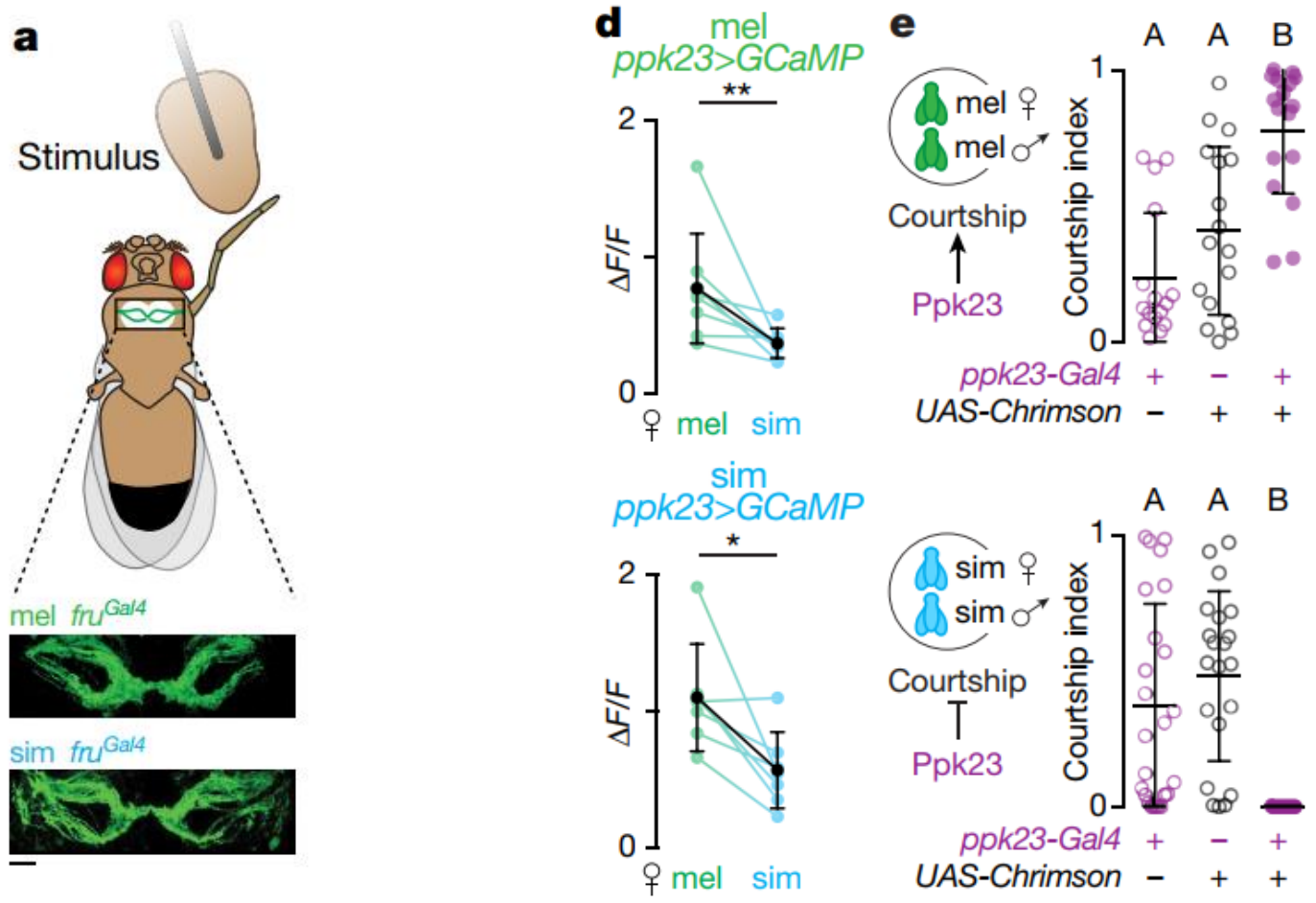
D. simulans **7-T**

D. melanogaster **7,11-HD**



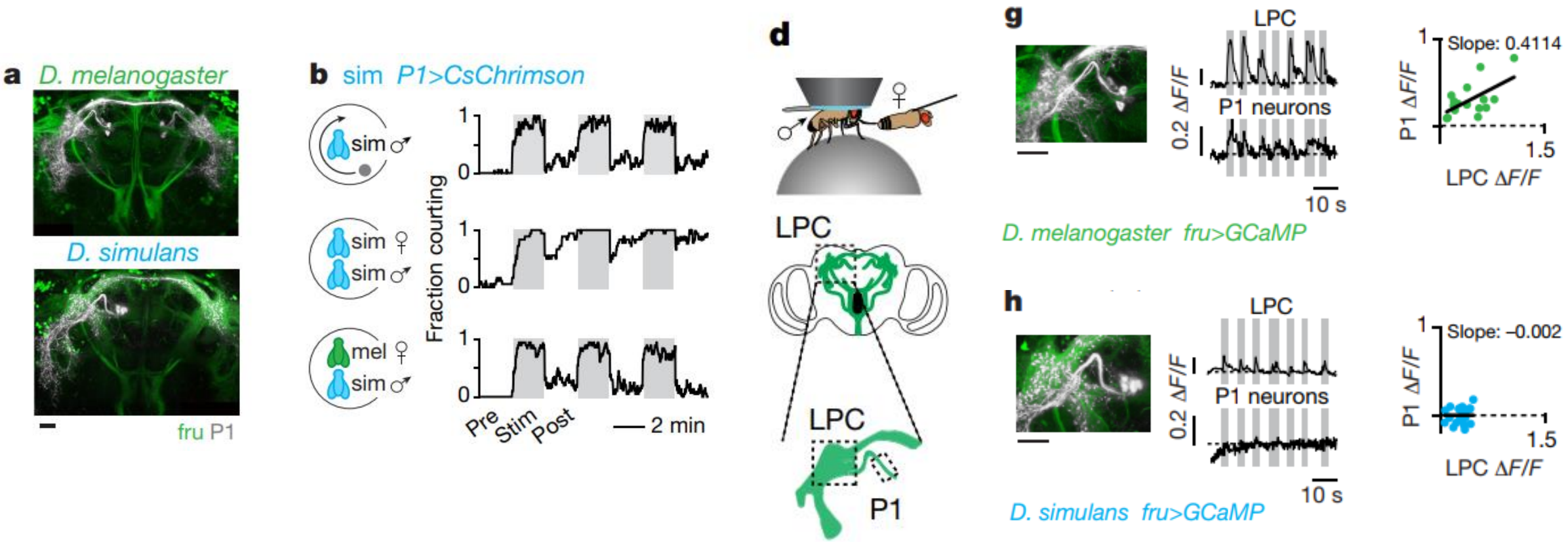
laura F. S et al.,*Nature*,2018

Conserved pheromonal tuning of *ppk23*$^{+}$ neuron



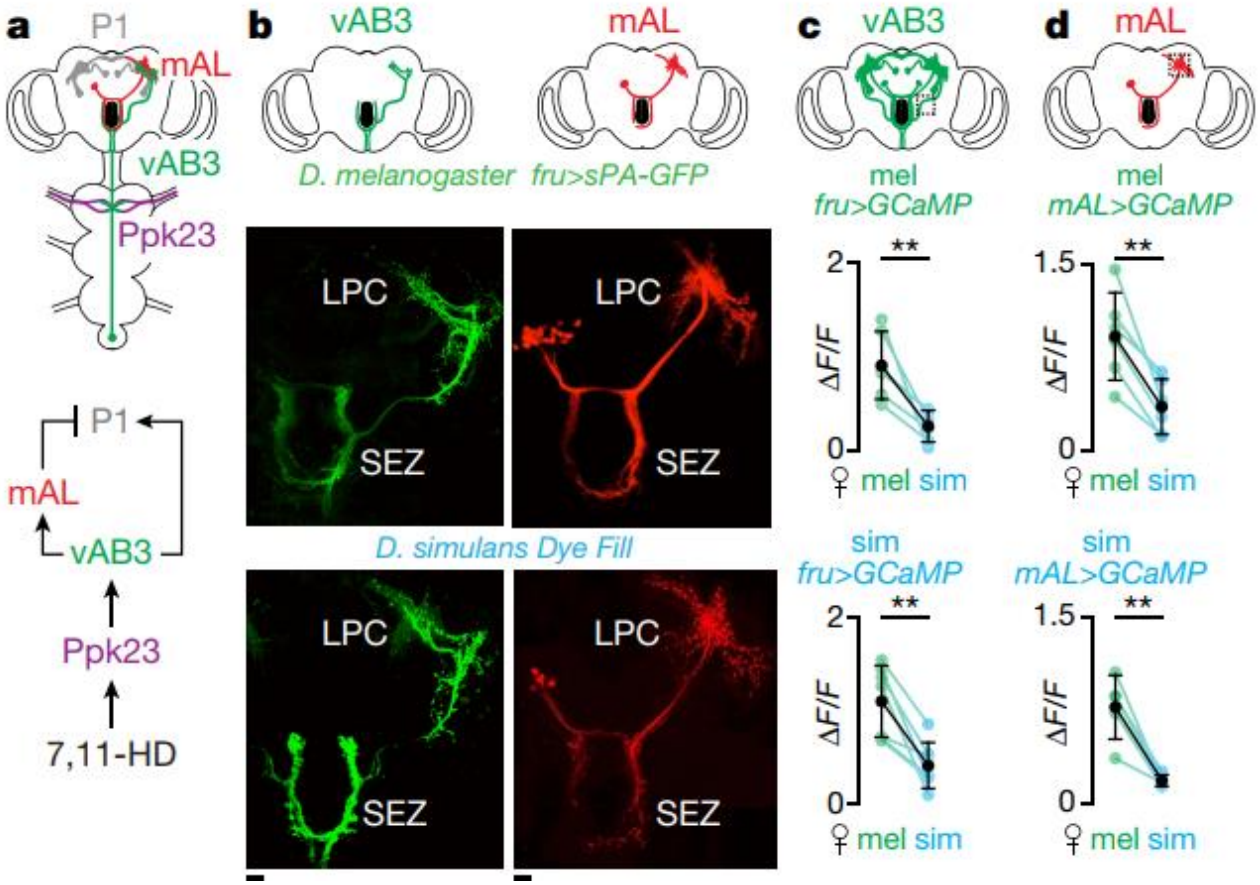
laura F. S et al.,*Nature*,2018

Divergent responses in central circuits

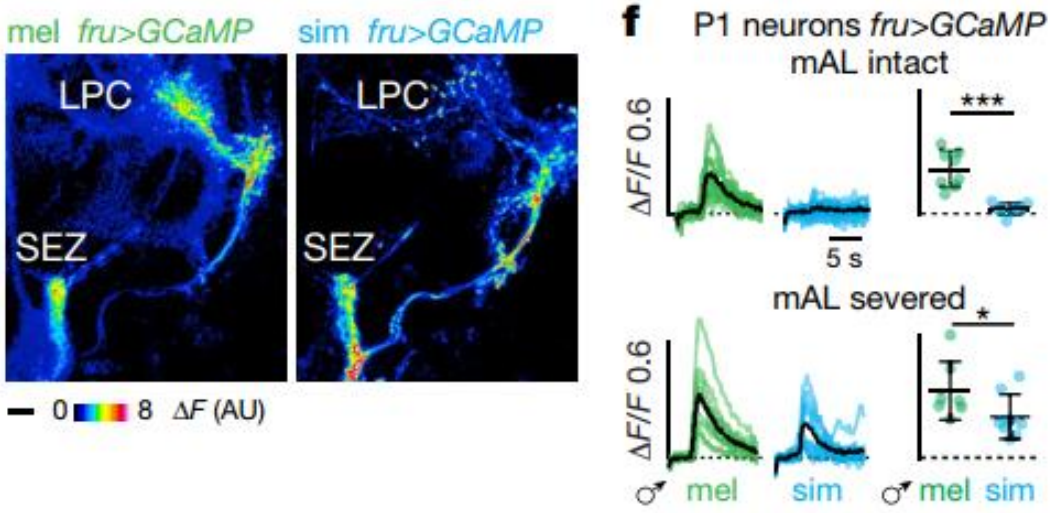


laura F. S et al.,*Nature*,2018

Differential propagation of ascending pheromone signals to P1 neurons.



vAB3 stimulation



laura F. S et al.,*Nature*,2018

nature COMMUNICATIONS

ARTICLE

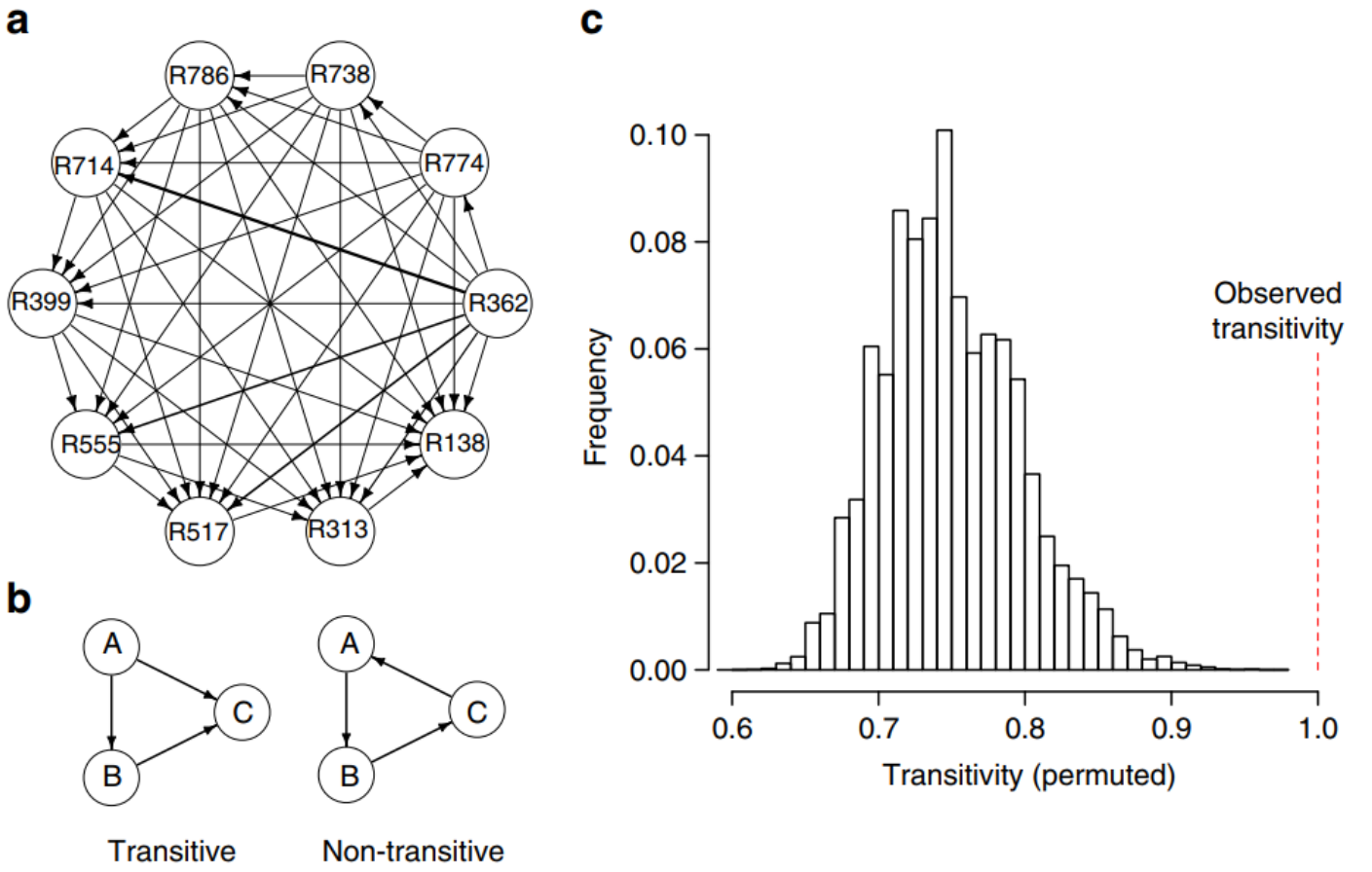
Received 5 May 2016 | Accepted 16 Nov 2016 | Published 17 Jan 2017

DOI: 10.1038/ncomms13953 OPEN

Mate choice in fruit flies is rational and adaptive

Devin Arbuthnott[1,2], Tatyana Y. Fedina[3], Scott D. Pletcher[3] & Daniel E.L. Promislow[1,4]

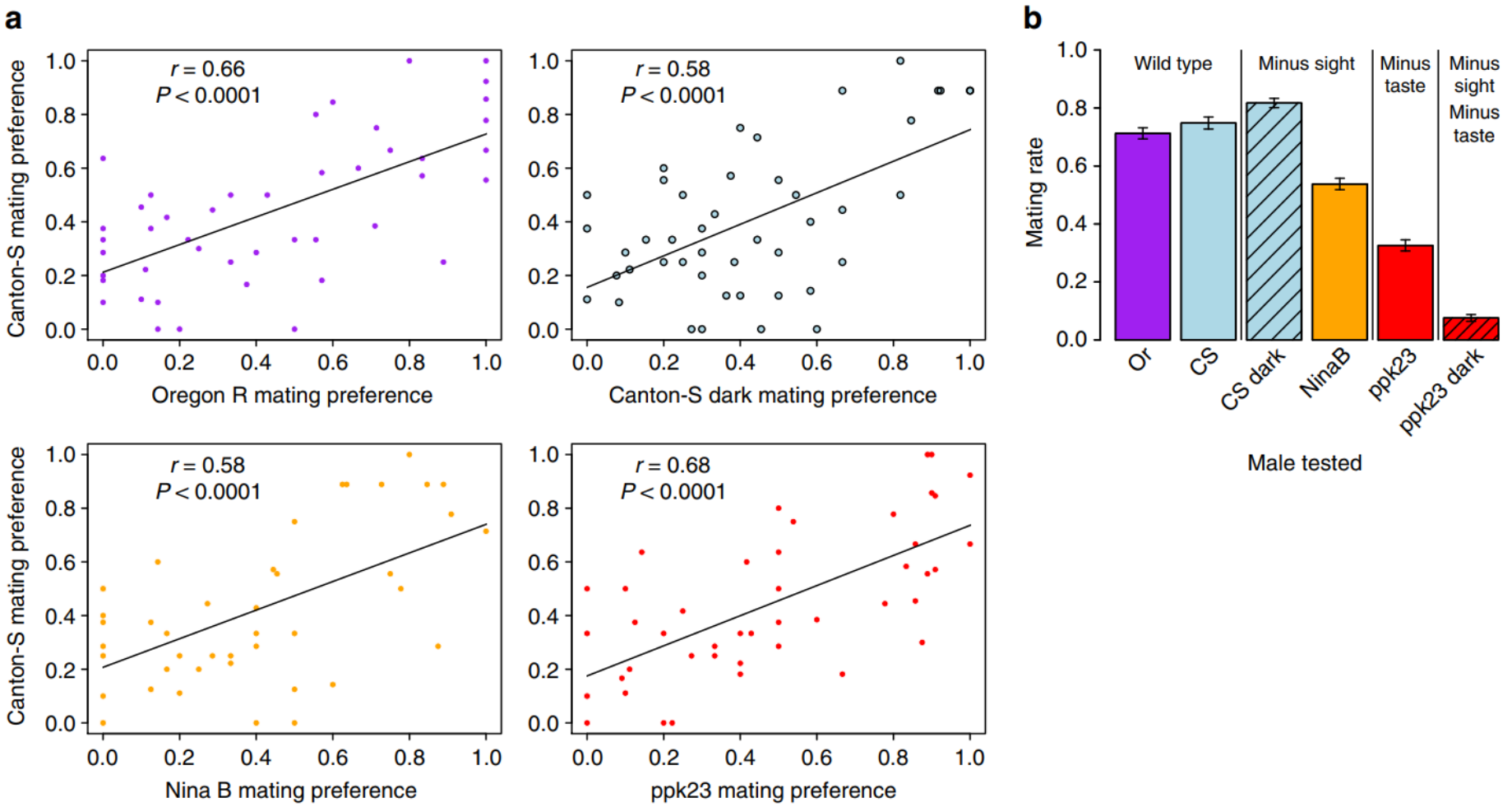
Male *D. melanogaster* display transitive mate choice.



These ten inbred female lines represent a linear hierarchy with respect to male mating bias.

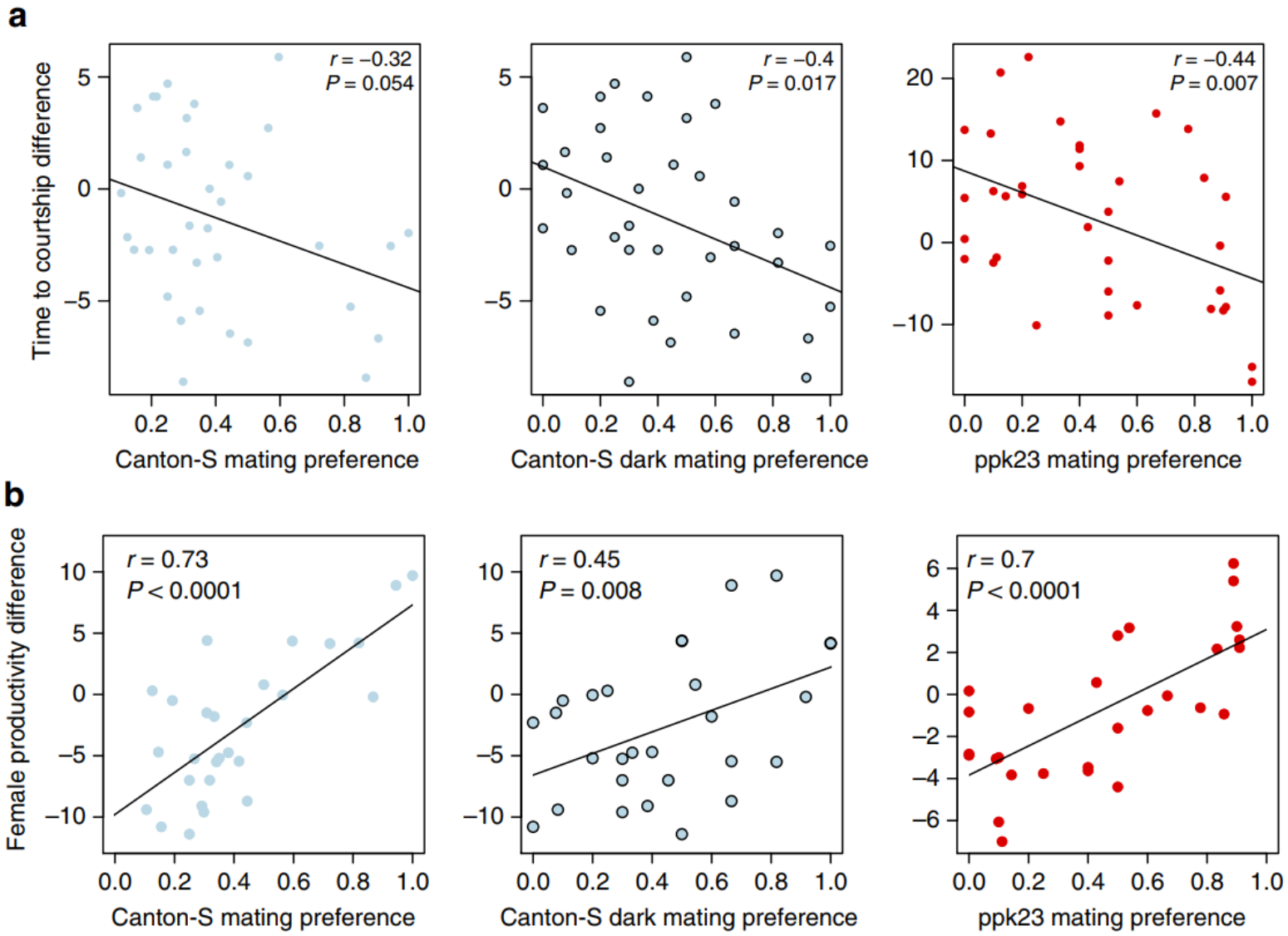
Devin Arbuthnott et al., *Nat. Commun.* 2017

Males with impaired signal detection make similar mate choices.



Devin Arbuthnott et al., *Nat. Commun.* 2017

Male mating preferences coincide with female receptivity and offspring production



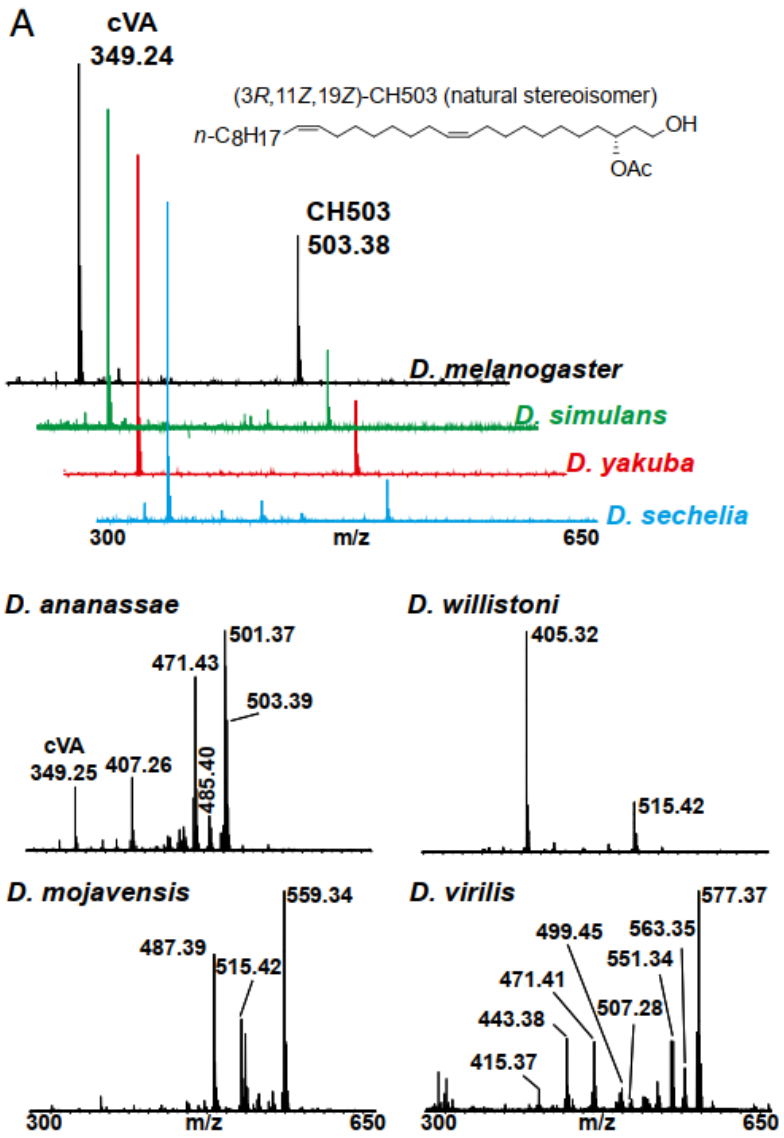
Pheromone evolution and sexual behavior in *Drosophila* are shaped by male sensory exploitation of other males

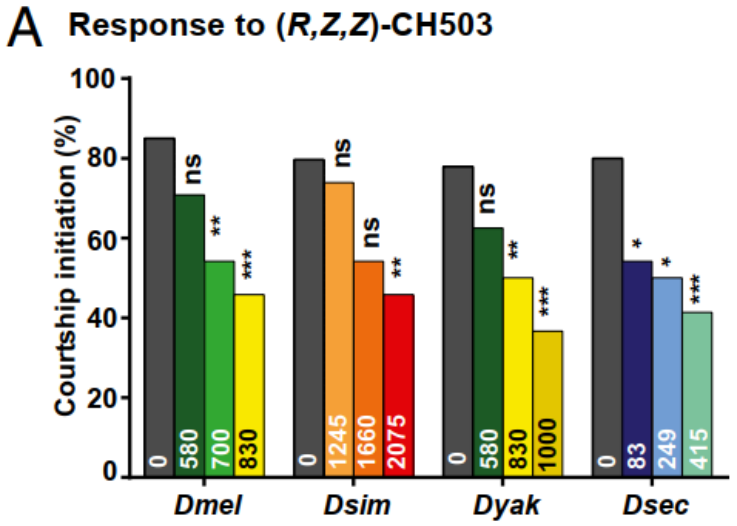
Soon Hwee Ng[a], Shruti Shankar[a,b], Yasumasa Shikichi[c], Kazuaki Akasaka[d], Kenji Mori[c], and Joanne Y. Yew[a,b,1]

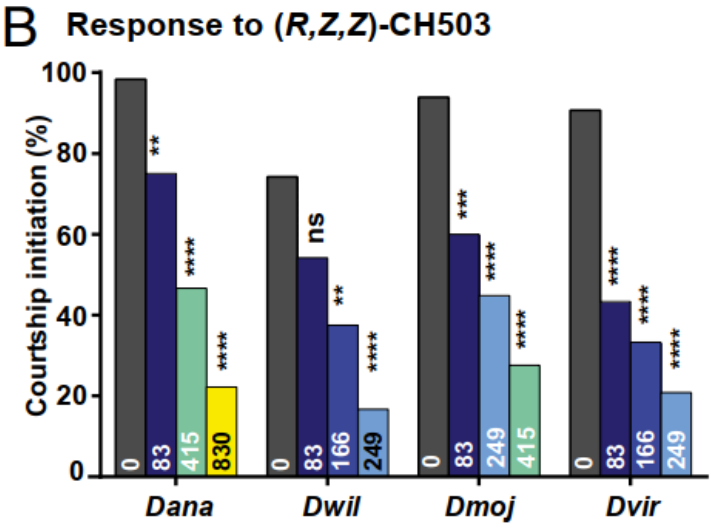
[a]Temasek Life Sciences Laboratory, National University of Singapore, Singapore 117604; [b]Department of Biological Sciences, National University of Singapore, Singapore 117546; [c]Photosensitive Materials Research Center, Toyo Gosei Co., Ltd, Inzai-shi, Chiba 270-1609, Japan; and [d]Shokei Gakuin University, Natori-shi, Miyagi 981-1295, Japan

Edited* by Edward A. Kravitz, Harvard Medical School, Boston, MA, and approved December 31, 2013 (received for review July 19, 2013)

Conserved function of CH503 as an anti-aphrodisiac

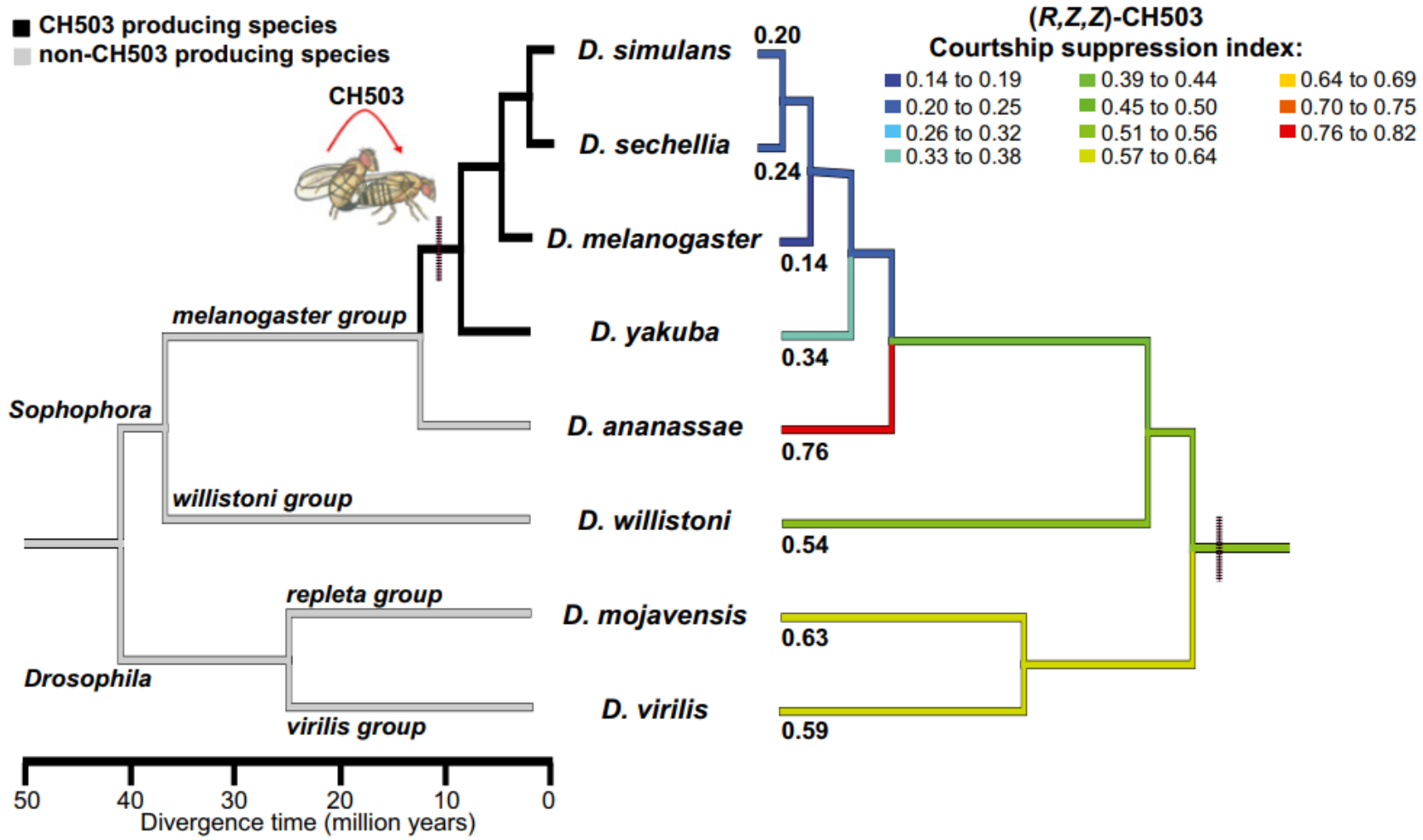






Soon Hwee Ng et al., *PNAS*, 2014

Evolution of CH503 expression and the behavioral response to CH503



Soon Hwee Ng et al., *PNAS*, 2014

总结

1. 为什么雄蝇只对同种的雌蝇产生偏好？
答：主要依赖于信息素的种属特异性和求偶神经环路的特异性。

2. 雄蝇择偶的过程是理性的吗？
答：在特定的范式下认为是理性的。

3. 雄蝇心目中的“女神果蝇”是什么样子？
答：体型较大、易接受、生殖能力强、具有更多的催情类信息素。

4. 雄蝇的偏好和雌蝇的特征哪个更早的出现？
答：在特定的范式下认为是偏好先于特征。

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4. Seeholzer L F, Seppo M, Stern D L, et al. Evolution of a central neural circuit underlies Drosophila mate preferences[J]. Nature, 2018, 559(7715): 564-569.
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8. Sharon G, Segal D, Ringo J M, et al. Commensal bacteria play a role in mating preference of Drosophila melanogaster[J]. Proceedings of the National Academy of Sciences, 2010, 107(46): 20051-20056.
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10. Arbuthnott D, Fedina T Y, Pletcher S D, et al. Mate choice in fruit flies is rational and adaptive[J]. Nature Communications, 2017, 8(1): 1-9.

Thank You for Listening

The mate choice in female flies

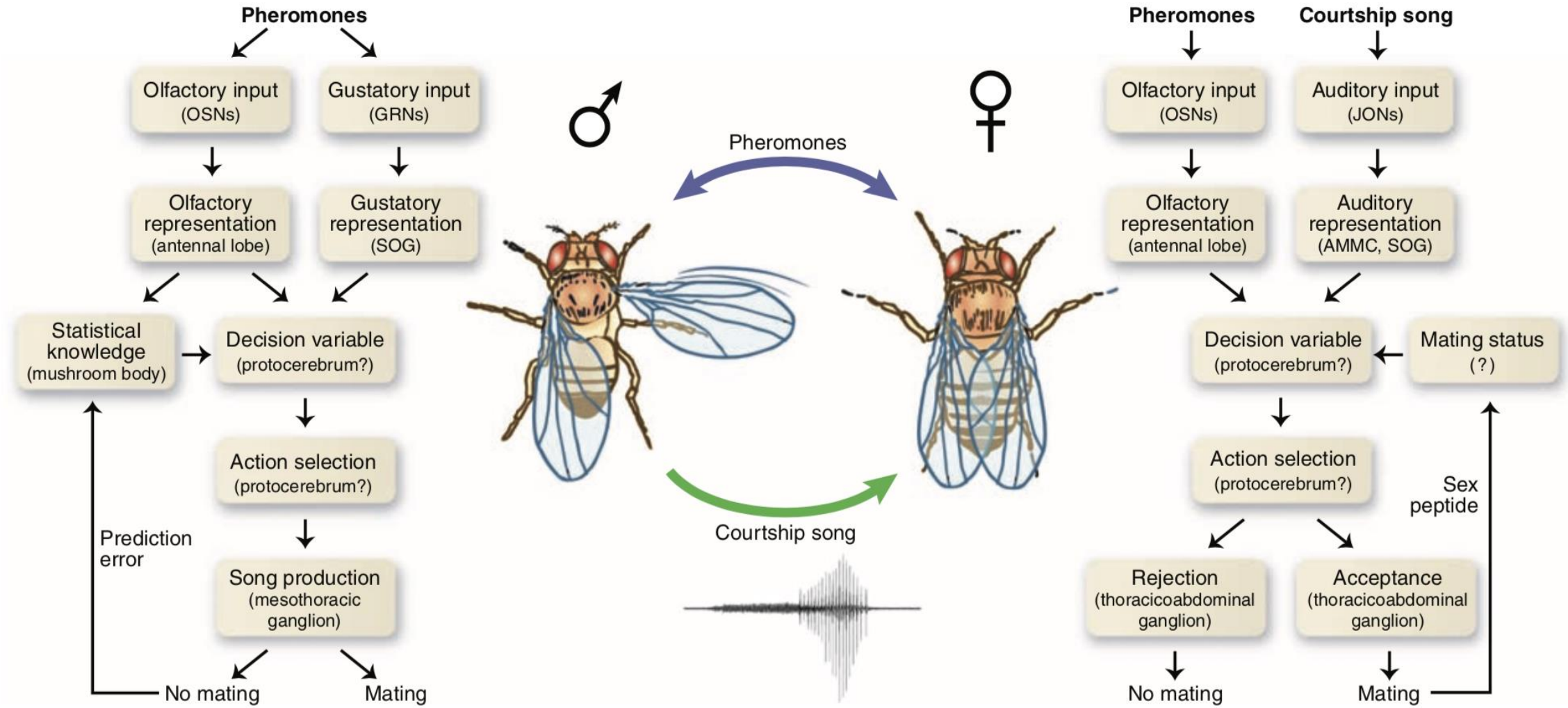
陈洁

2022.4.22

The interest of each male is to father all the offspring, and the interest of each female is to maximize paternal quality

—— PAUL I. WARD

Mating decisions in *Drosphila*



Dickson BJ. Science. 2008

Which type of males that females bias mating with?

- Body size?
- Wing interference patterns ?
- Symmetry ?
- Inbreeding male ?
- Mate Copying?

Body size

The large male:

more emphatic song

higher harassment
wounding during copulation
transfer more toxic seminal fluid

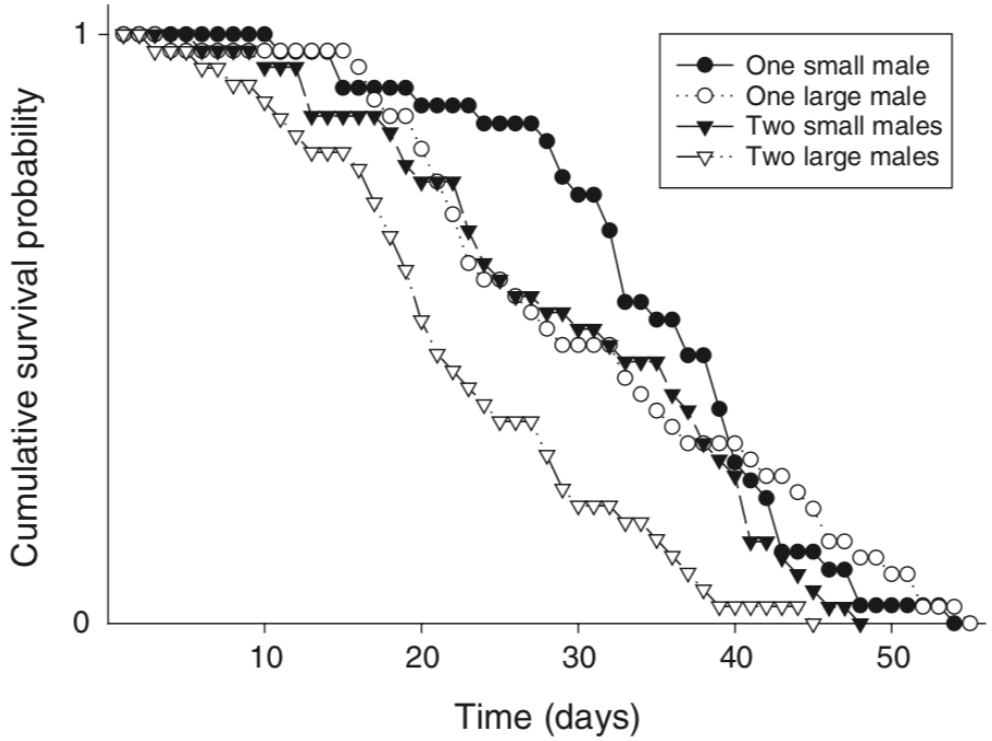
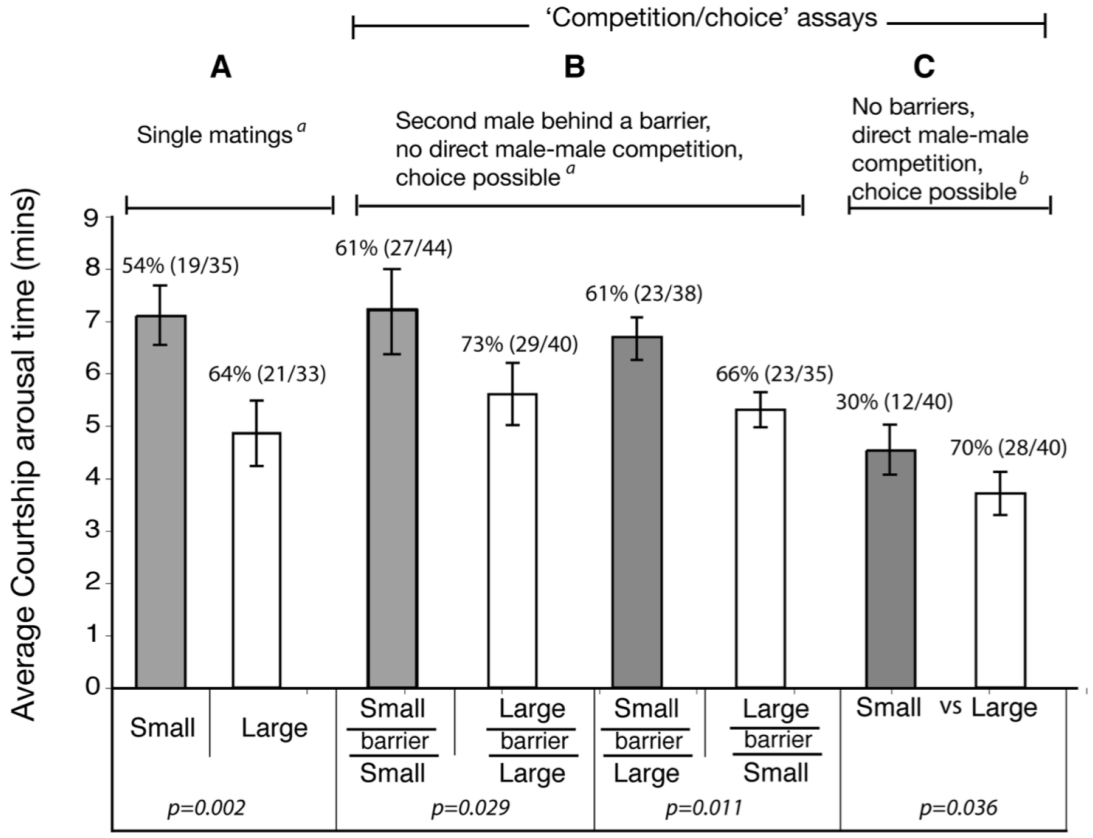
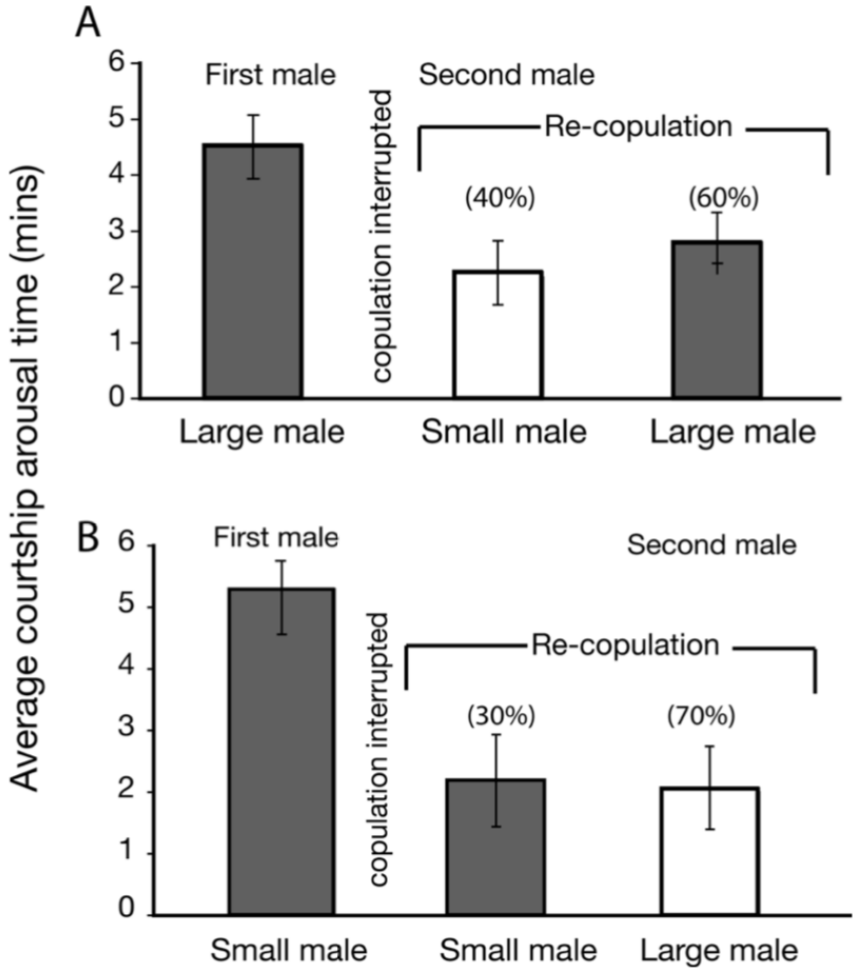


Fig. 1 Cumulative survival probability for females in the four treatment combinations.

Friberg U, Arnqvist G. J Evol Biol. 2003

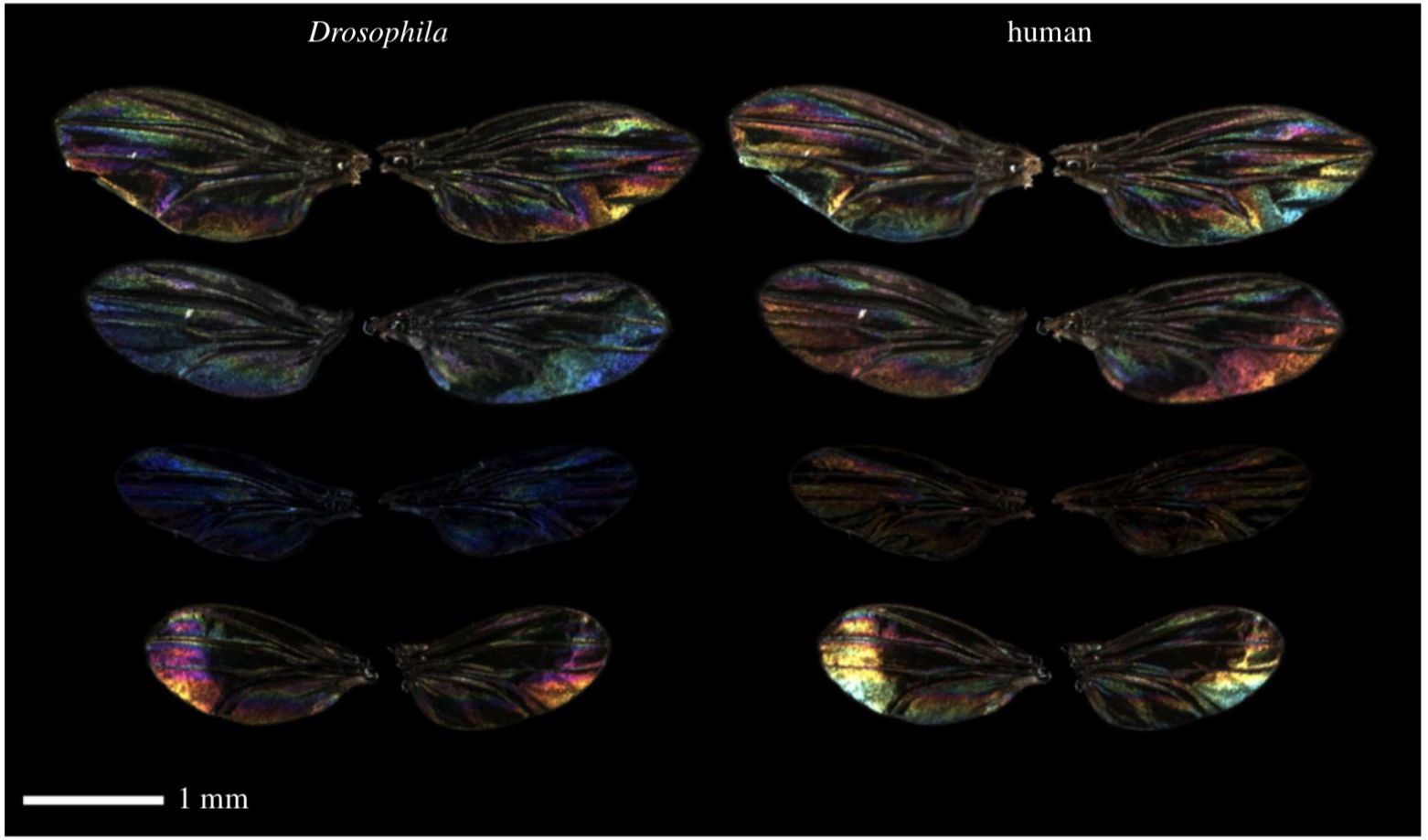
Body size





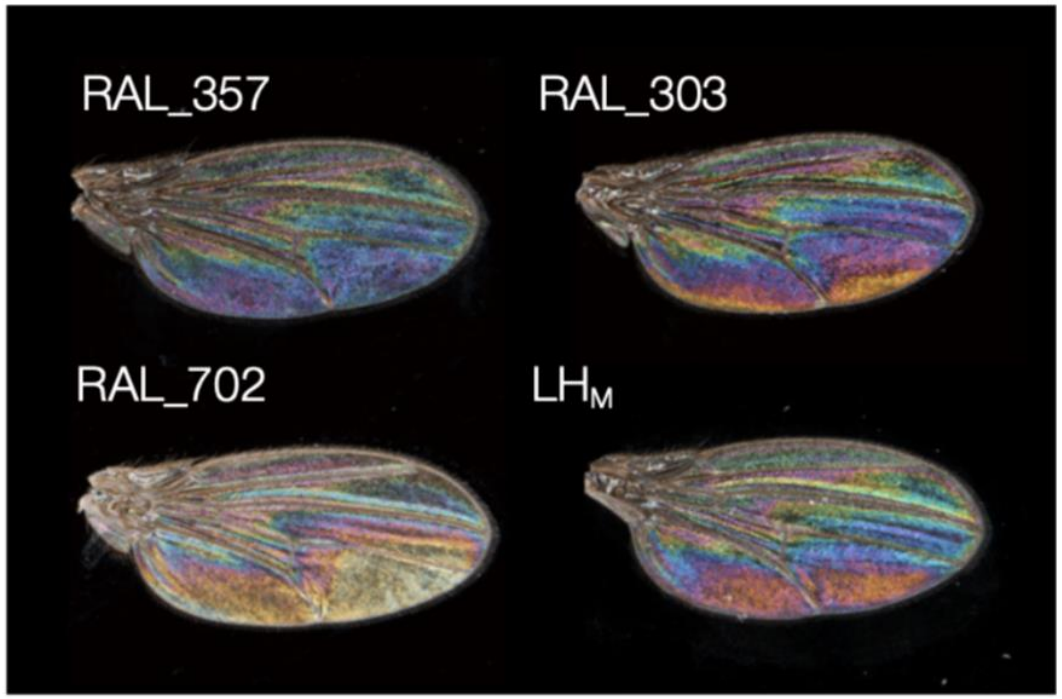
Jagadeeshan, Santosh et al. PloS one . 2015

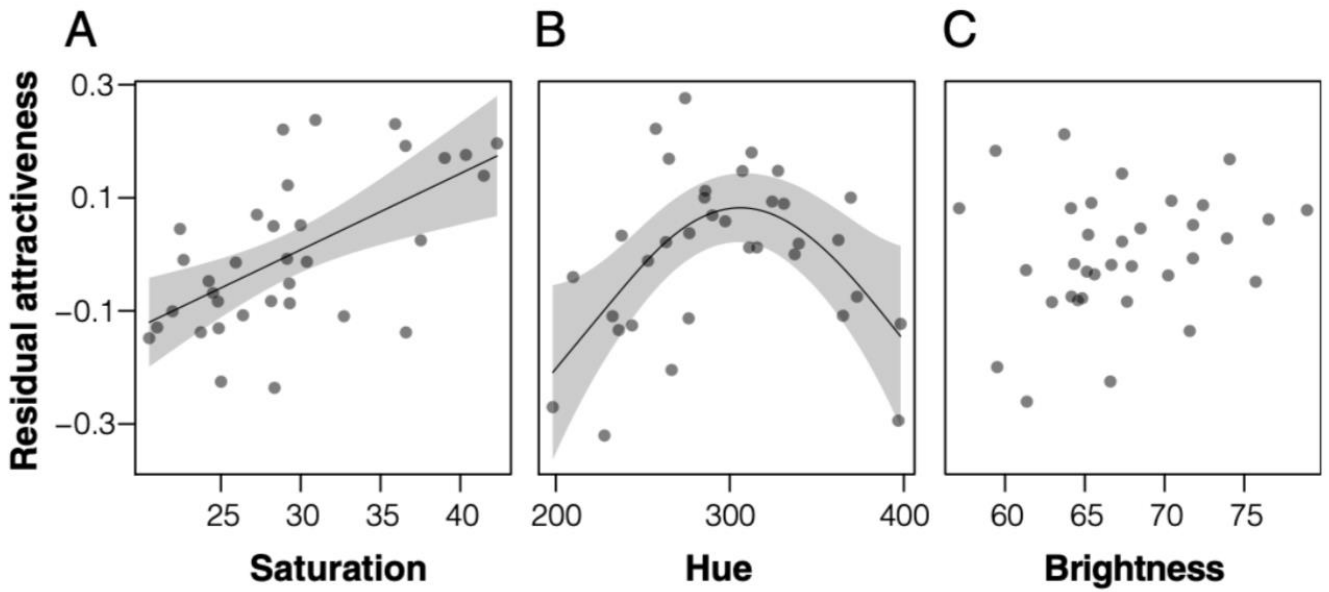
Wing interference patterns



Hawkes MF et al. Proc Biol Sci. 2019

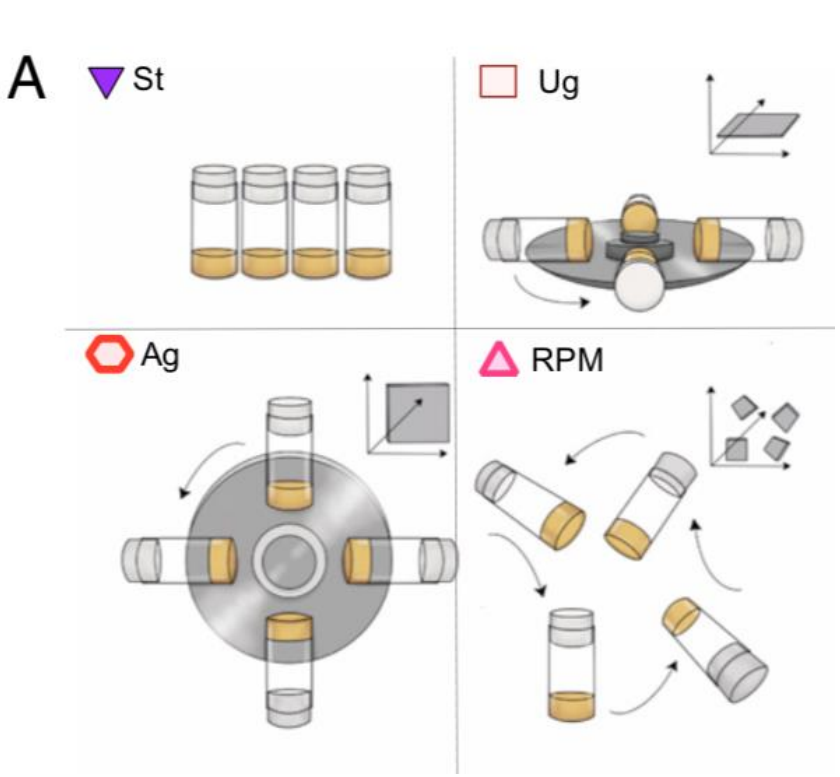
Wing interference patterns

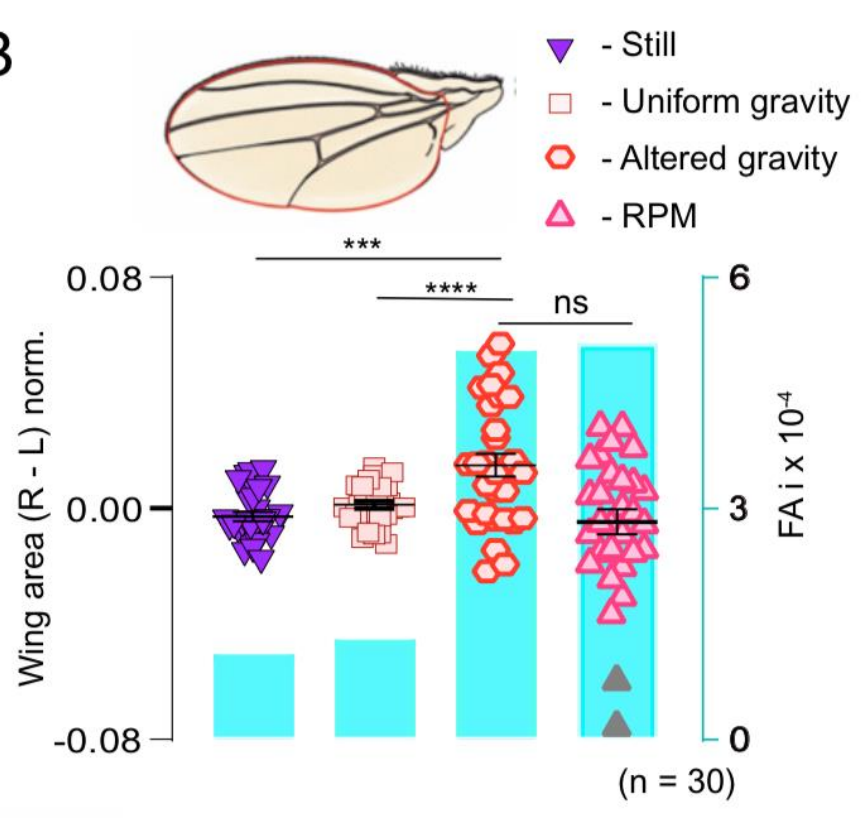


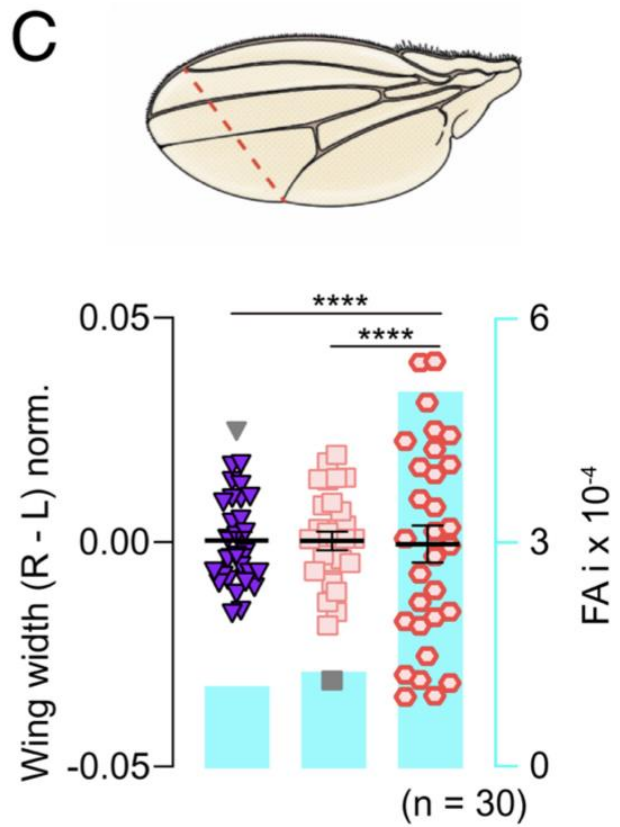


Katayama, Natsu et al. Proc Natl Acad Sci U S A. 2014

Symmetry



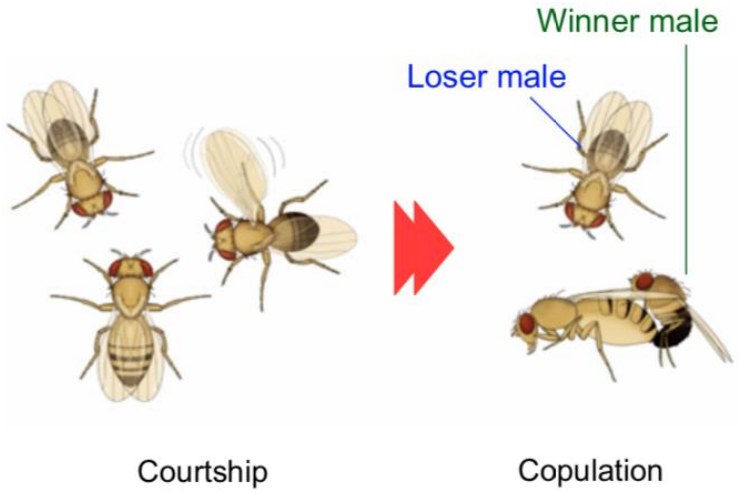


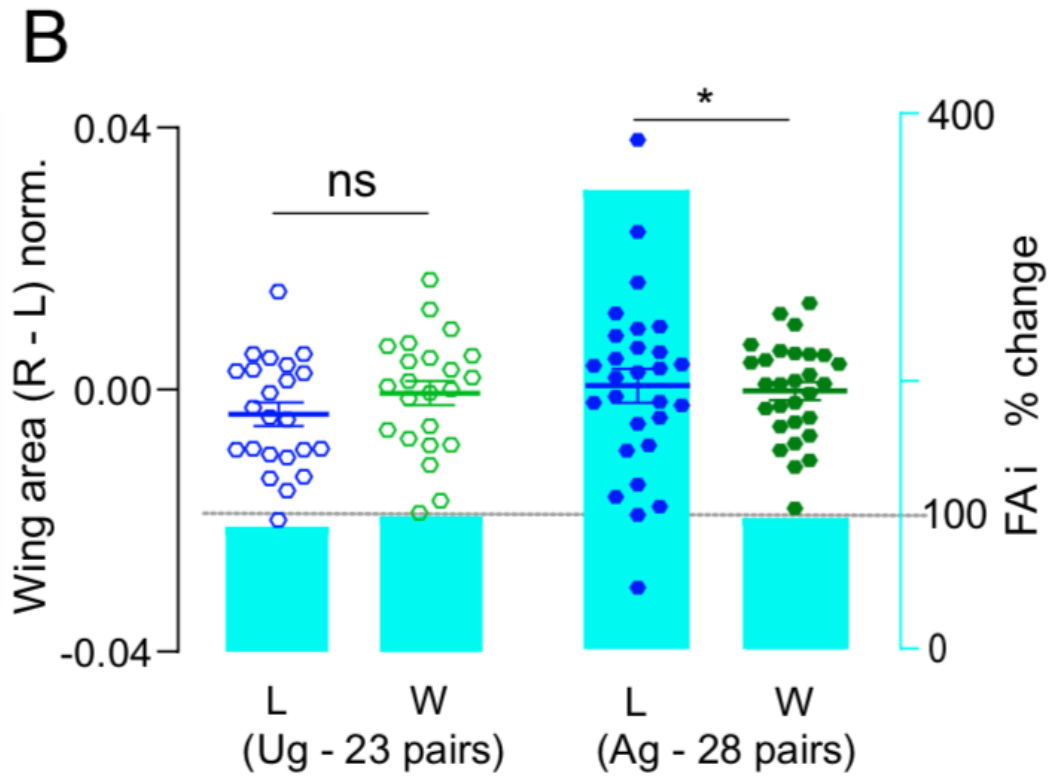


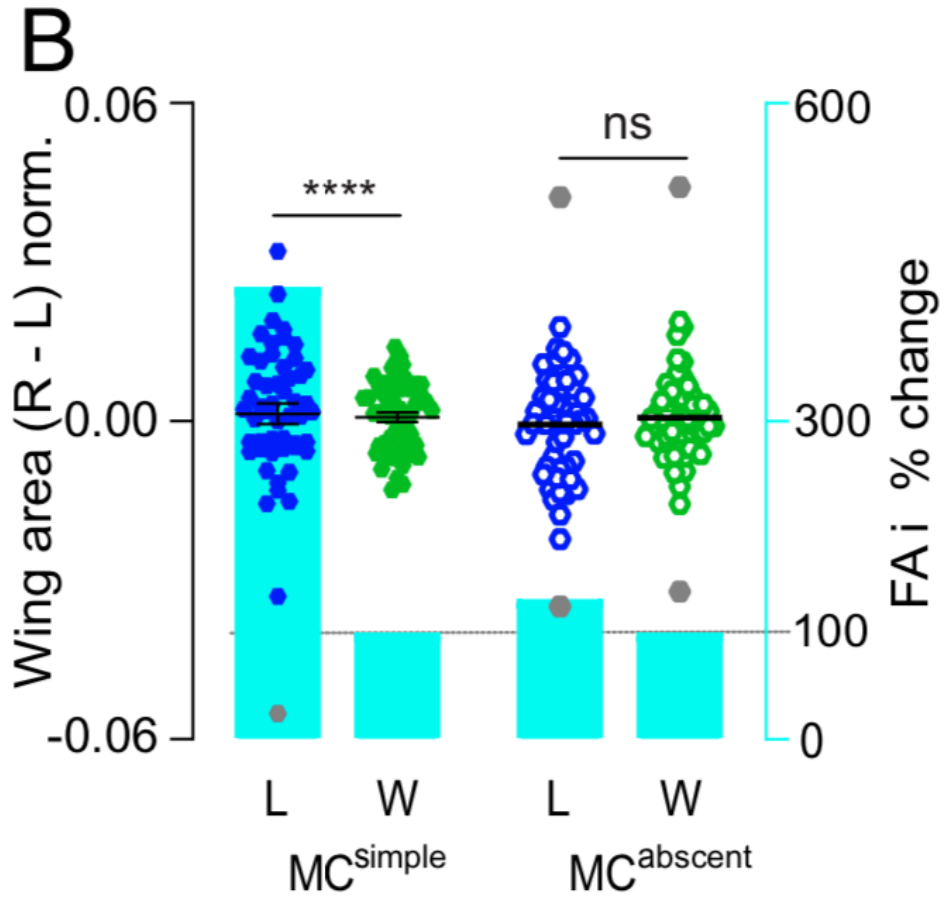
Ug: uniform gravity
Ag: altered gravity
RPM: random positioning machine

Vijendravarma RK et al. Proc Natl Acad Sci U S A. 2022

Symmetry

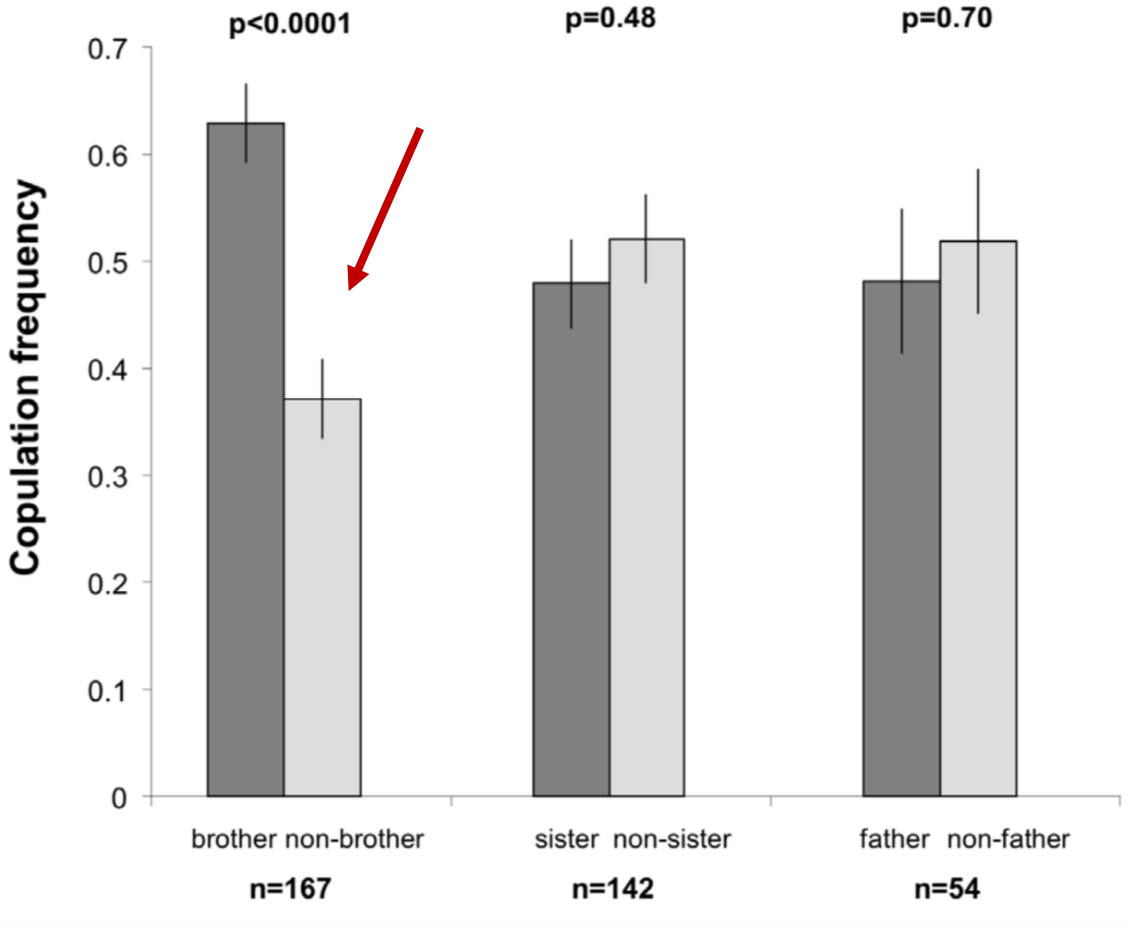


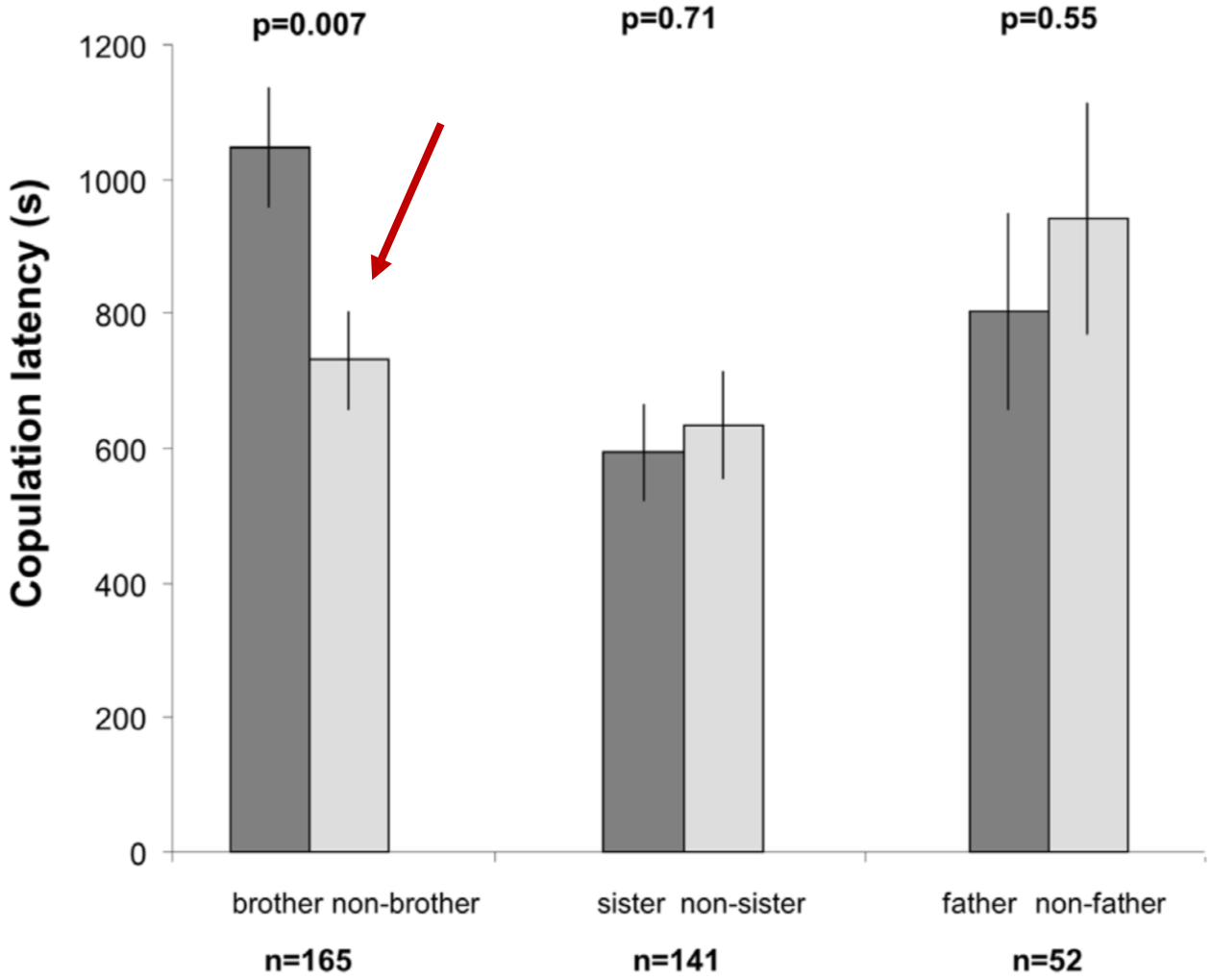




Vijendravarma RK et al. Proc Natl Acad Sci U S A. 2022

Inbreeding

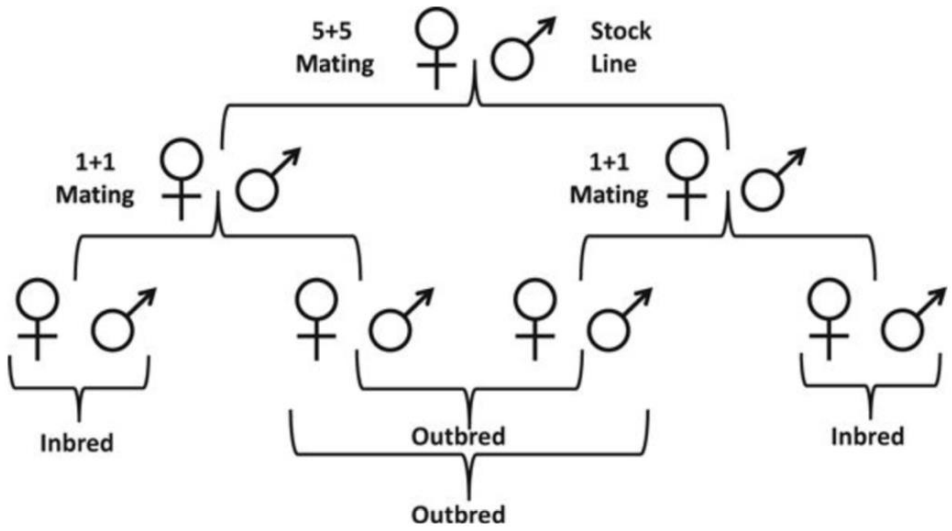


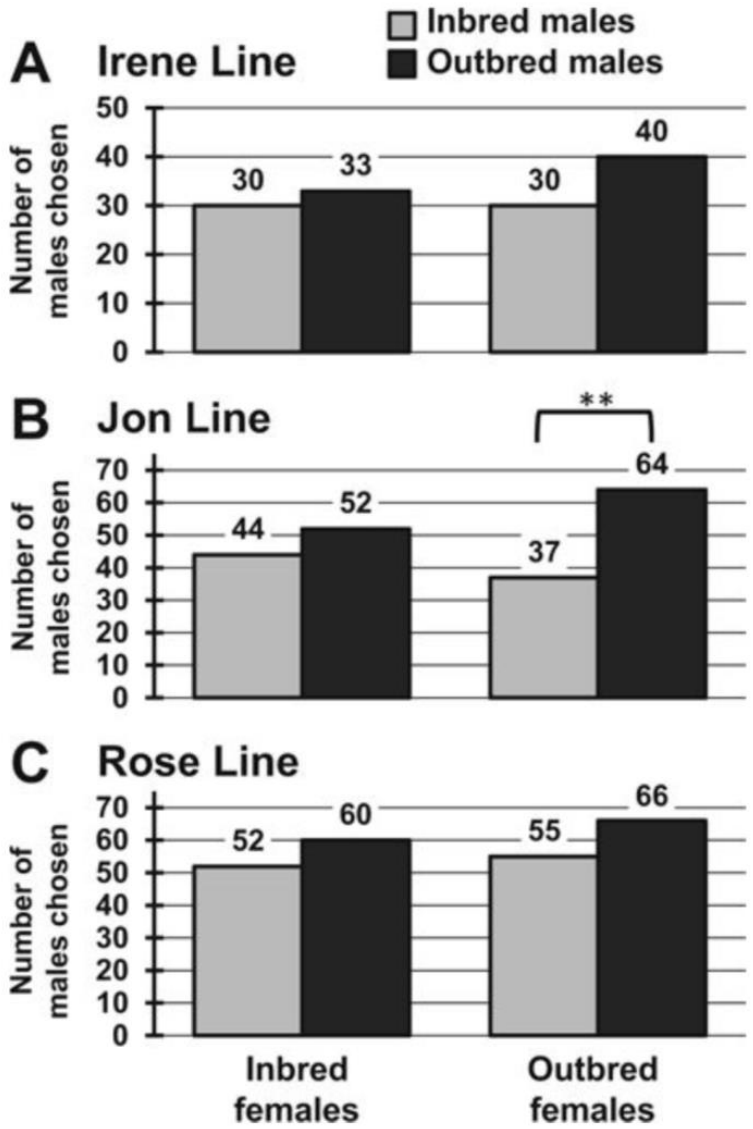


Inbred males preference

Loyau, Adeline et al. *PloS one* vol. 2012

Inbreeding

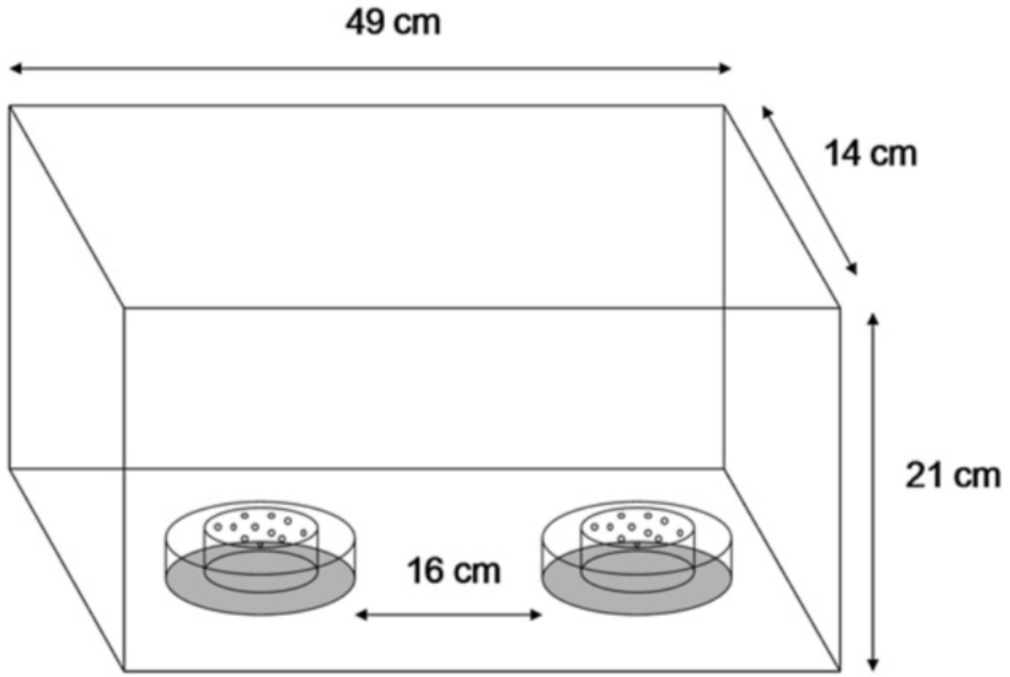


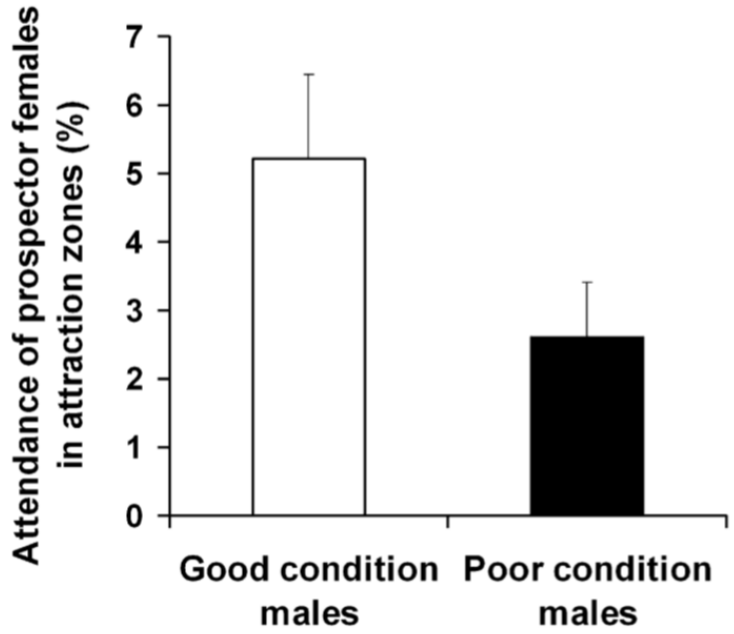


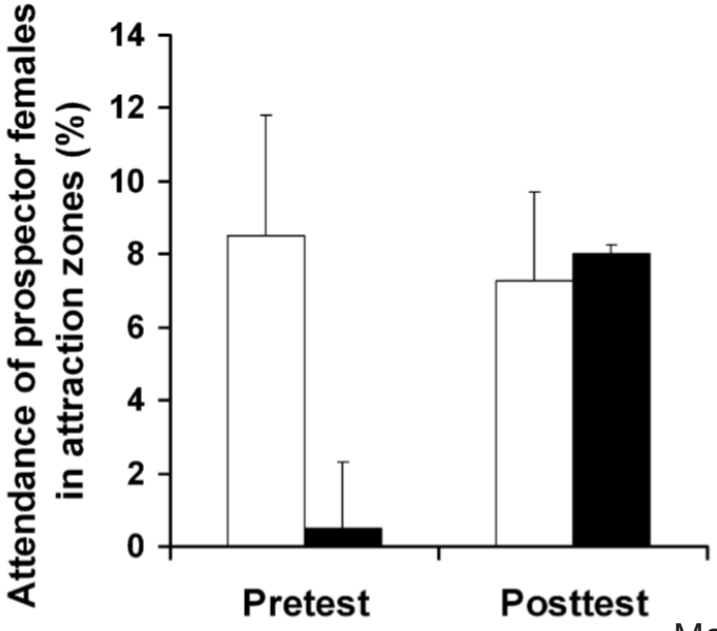
Outbred males preference

McKee, Amberle A et al. *Journal of insect behavior* vol.2014

Mate Copying

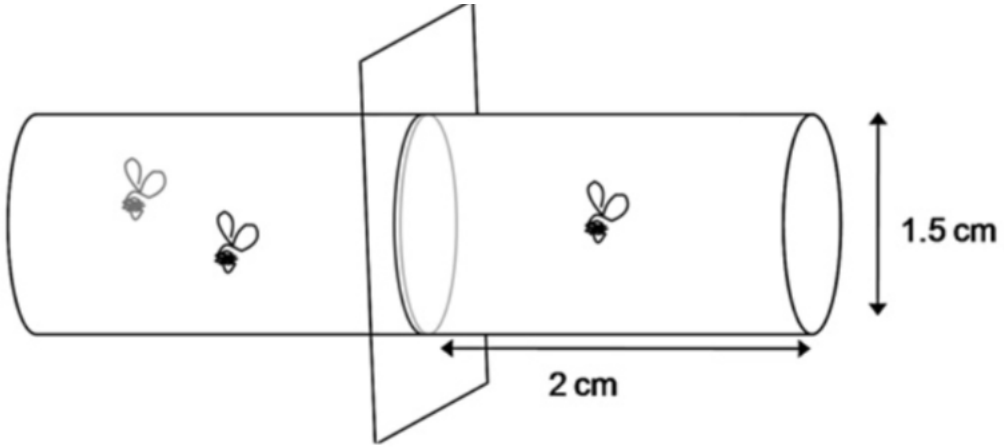


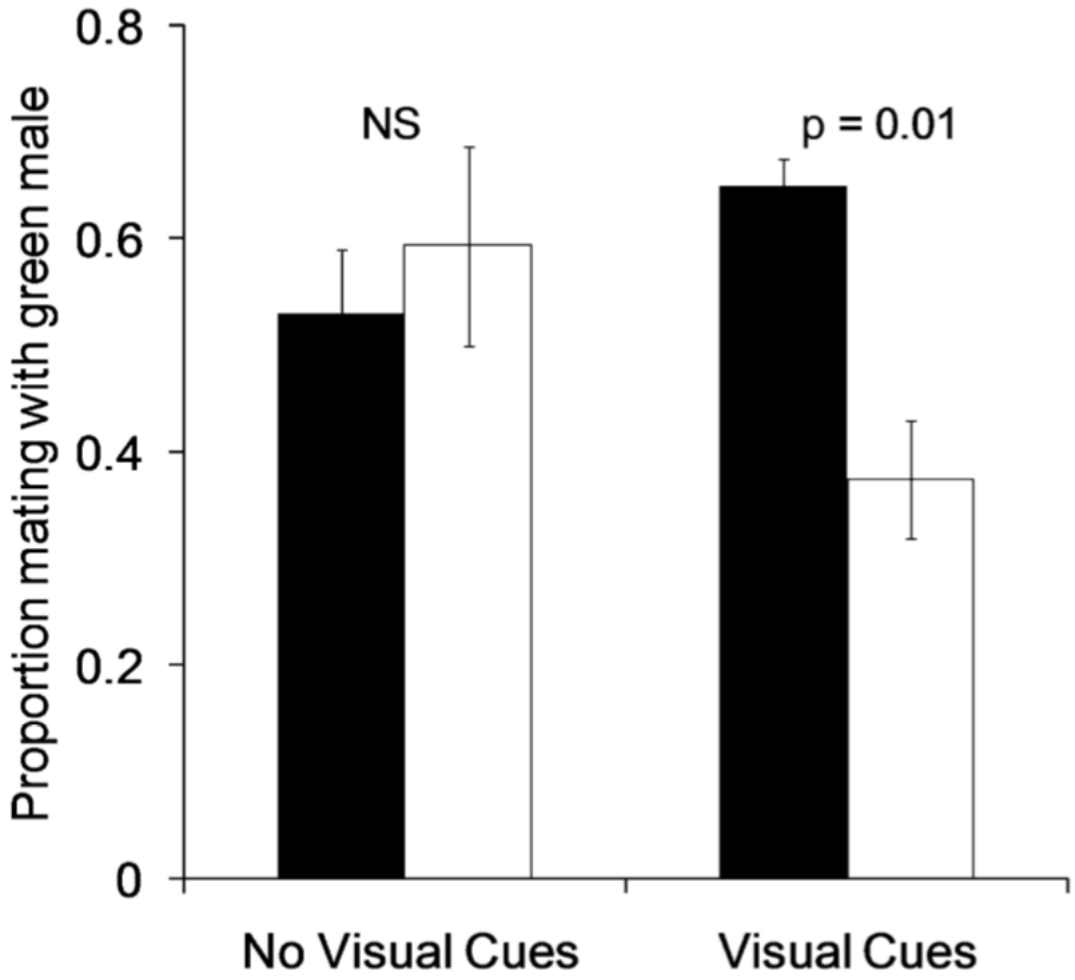




Mery, Frédéric et al. *Current biology* 2009.

Mate Copying





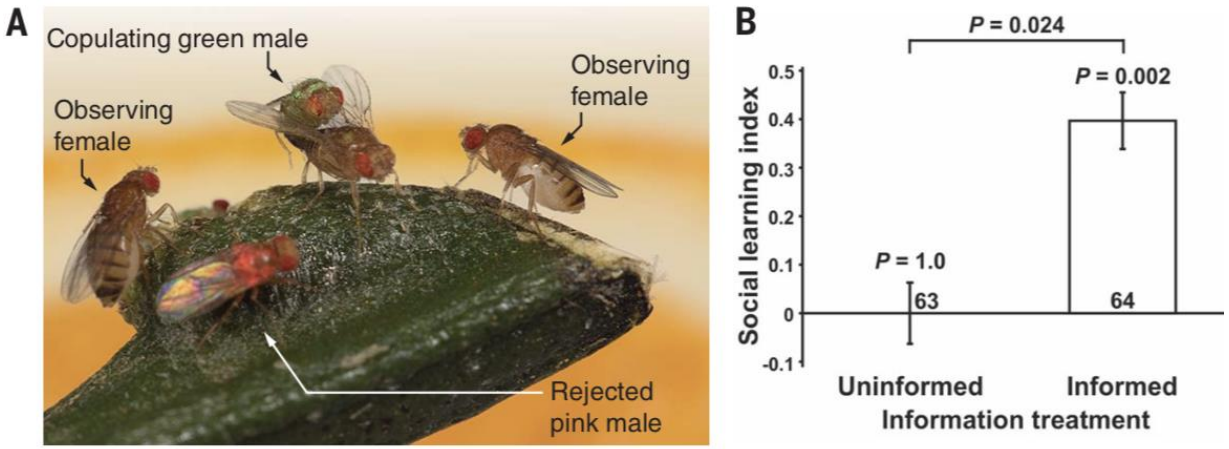
Mery, Frédéric et al. *Current biology* 2009.

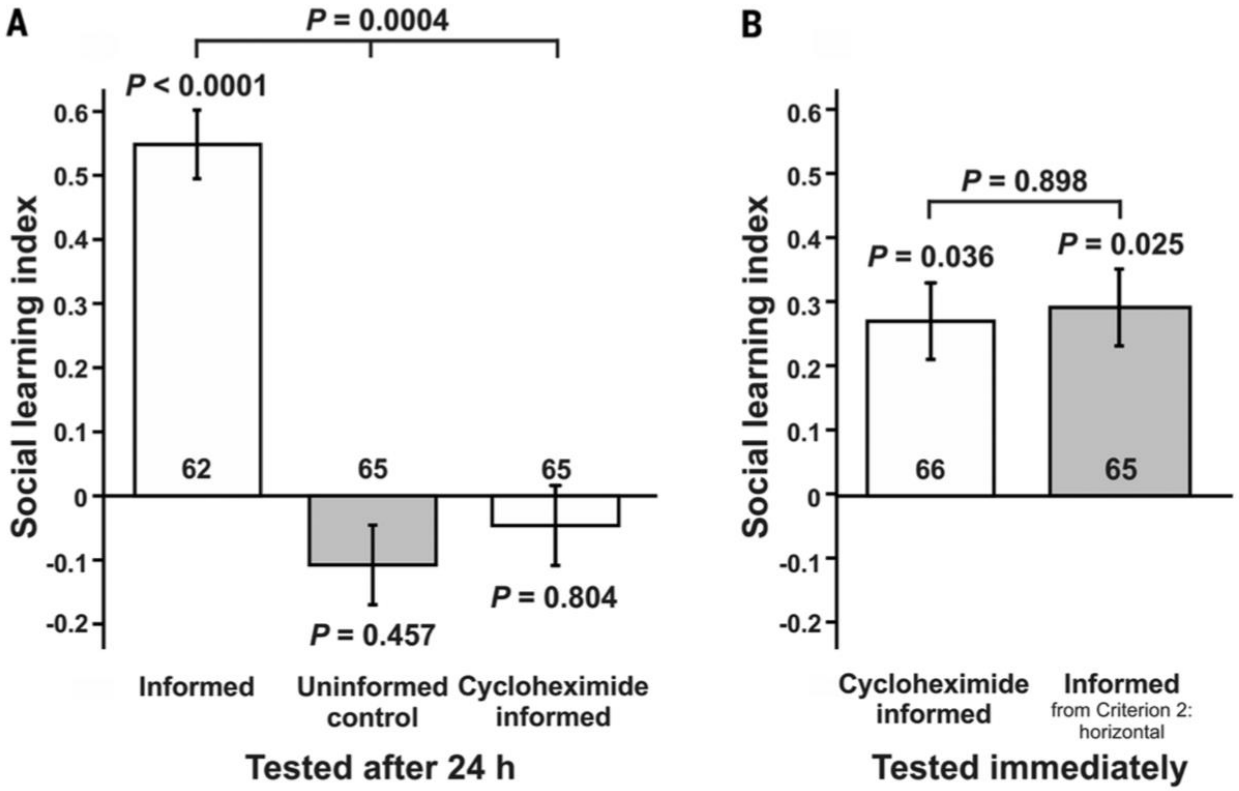
Mate Copying

ANIMAL CULTURE

Cultural flies: Conformist social learning in fruitflies predicts long-lasting mate-choice traditions

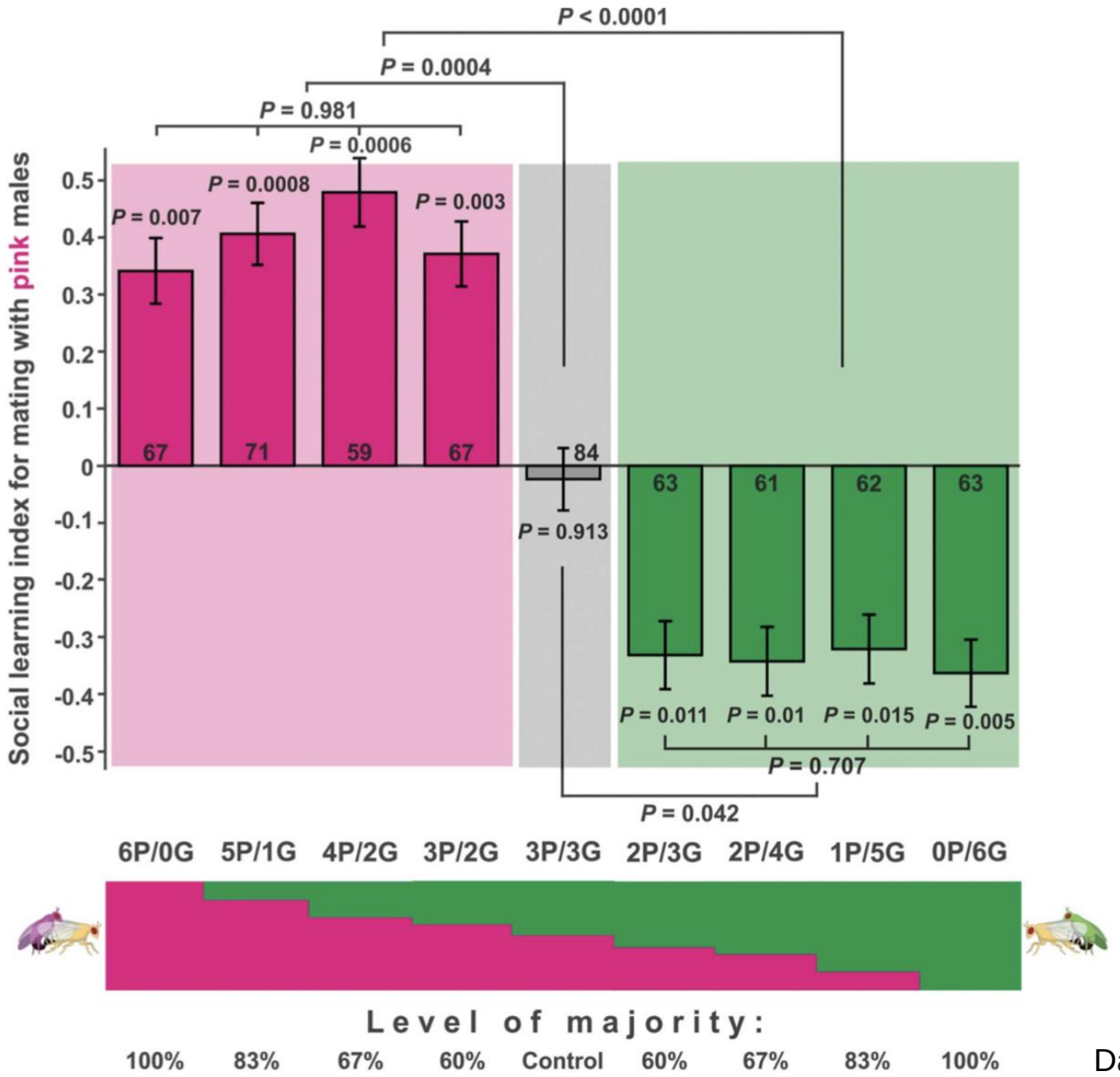
Etienne Danchin[1*†], Sabine Nöbel[1,2*], Arnaud Pocheville[3*], Anne-Cecile Dagaeff[1], Léa Demay[1], Mathilde Alphand[1], Sarah Ranty-Roby[1], Lara van Renssen[1,4], Magdalena Monier[1], Eva Gazagne[5], Mélanie Allain[1,6], Guillaume Isabel[6]





Danchin, Etienne et al. Science. 2018.

Mate Copying

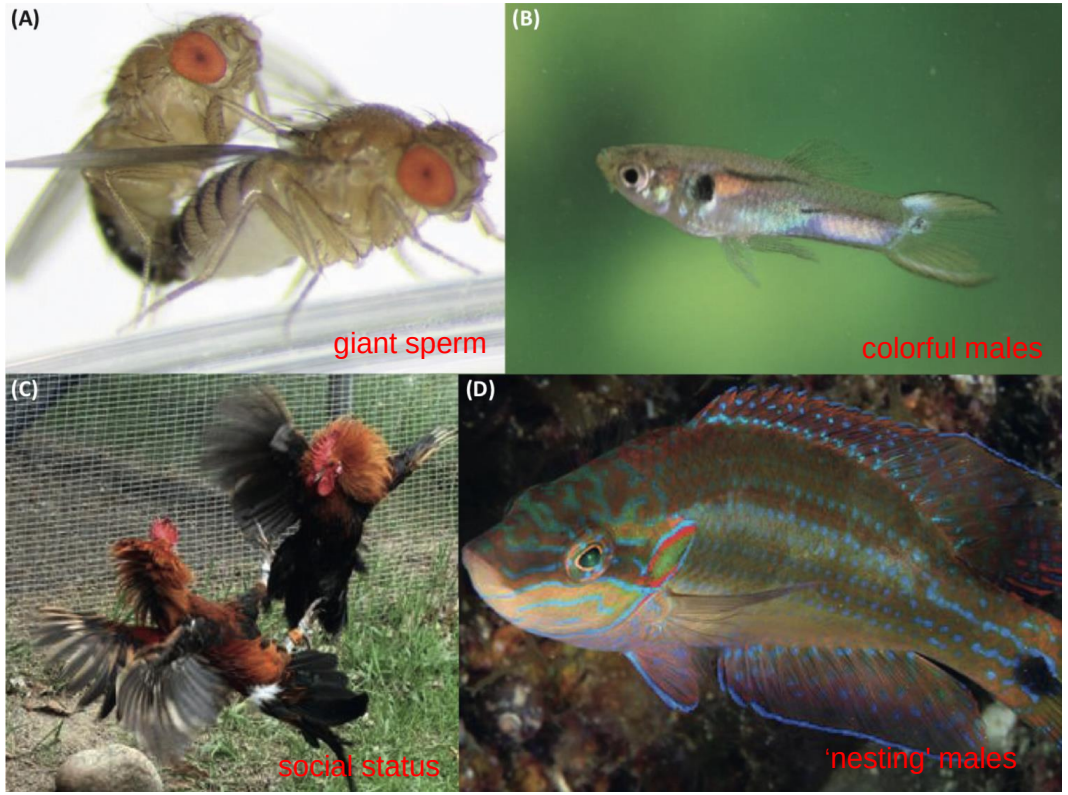


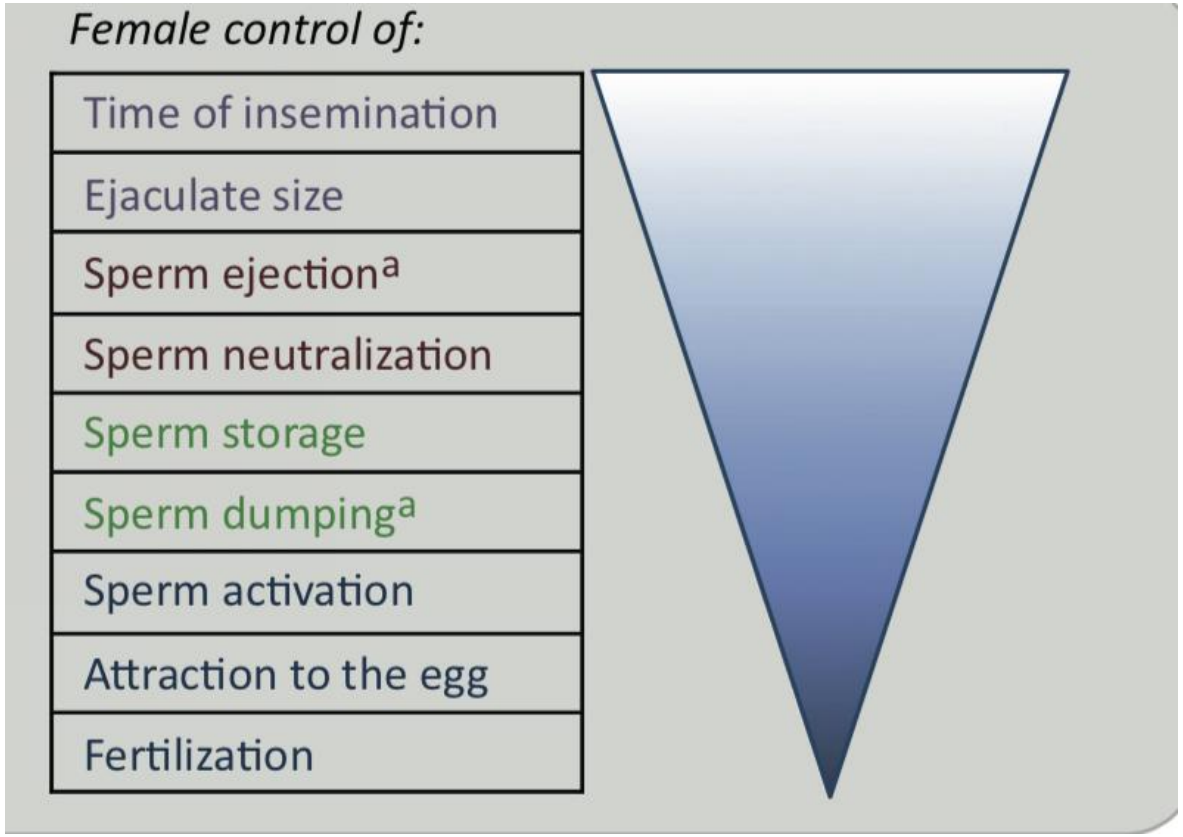
Danchin, Etienne et al. Science. 2018.

Cryptic female choice (CFC)

Cryptic female choice (CFC) represents postmating intersexual selection arising from female-driven mechanisms at or after mating that bias sperm use and impact male paternity share.

Cryptic female choice (CFC)



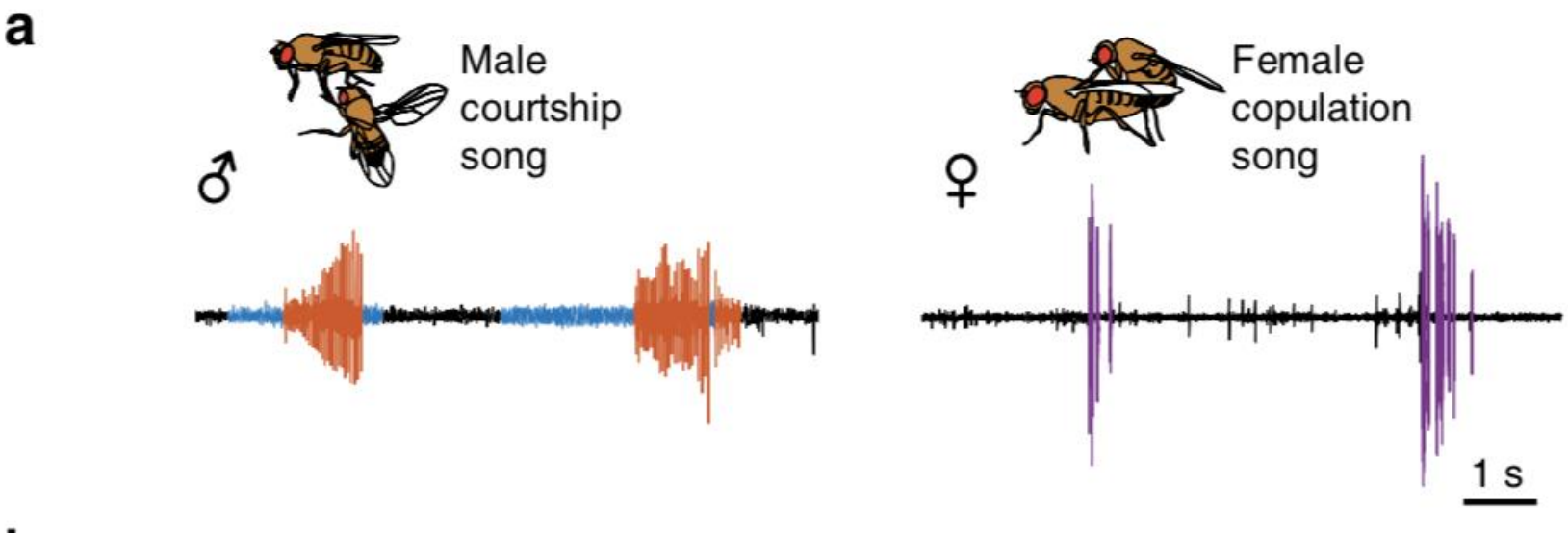


ARTICLE

https://doi.org/10.1038/s41467-020-15260-6 OPEN

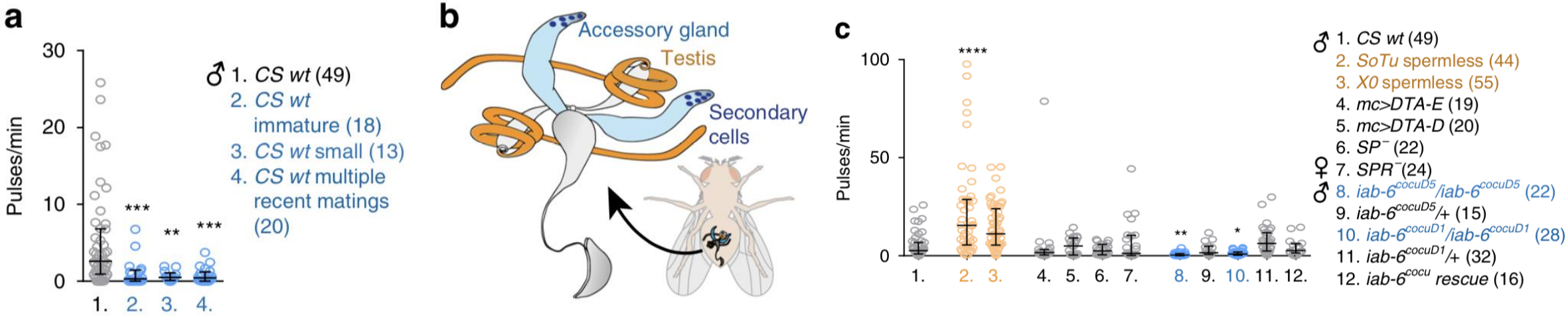
Female copulation song is modulated by seminal fluid

Peter Kerwin[1], Jiasheng Yuan[1] & Anne C. von Philipsborn[1✉]



Kerwin P, Yuan J, von Philipsborn AC. Nat Commun. 2020

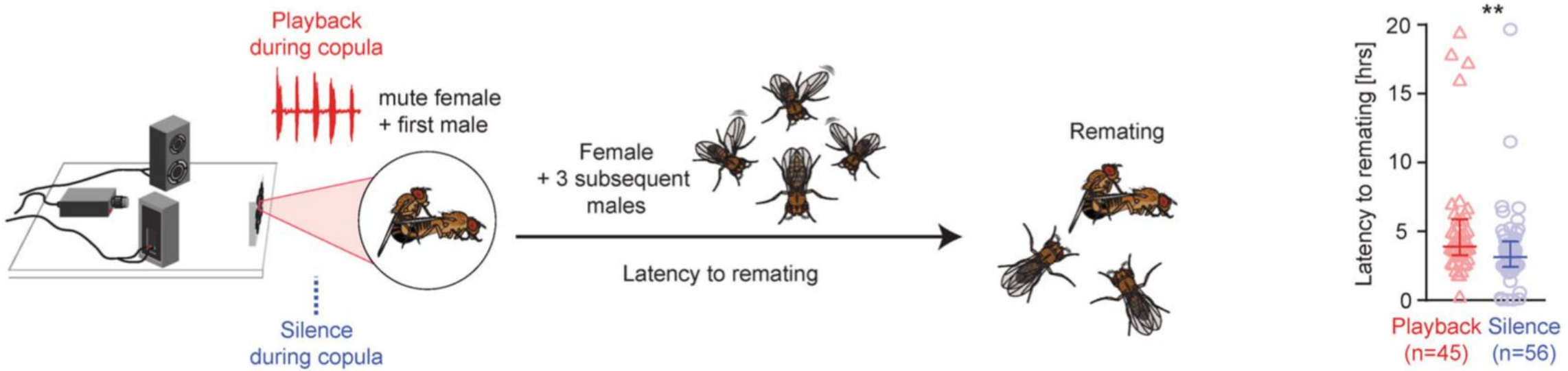
Female copulation song depends on seminal fluid transfer



mc：main cell
iab-6cocu mutant males：have defective secondary cells

Kerwin P, Yuan J, von Philipsborn AC. Nat Commun. 2020

Female copulation song influences remating



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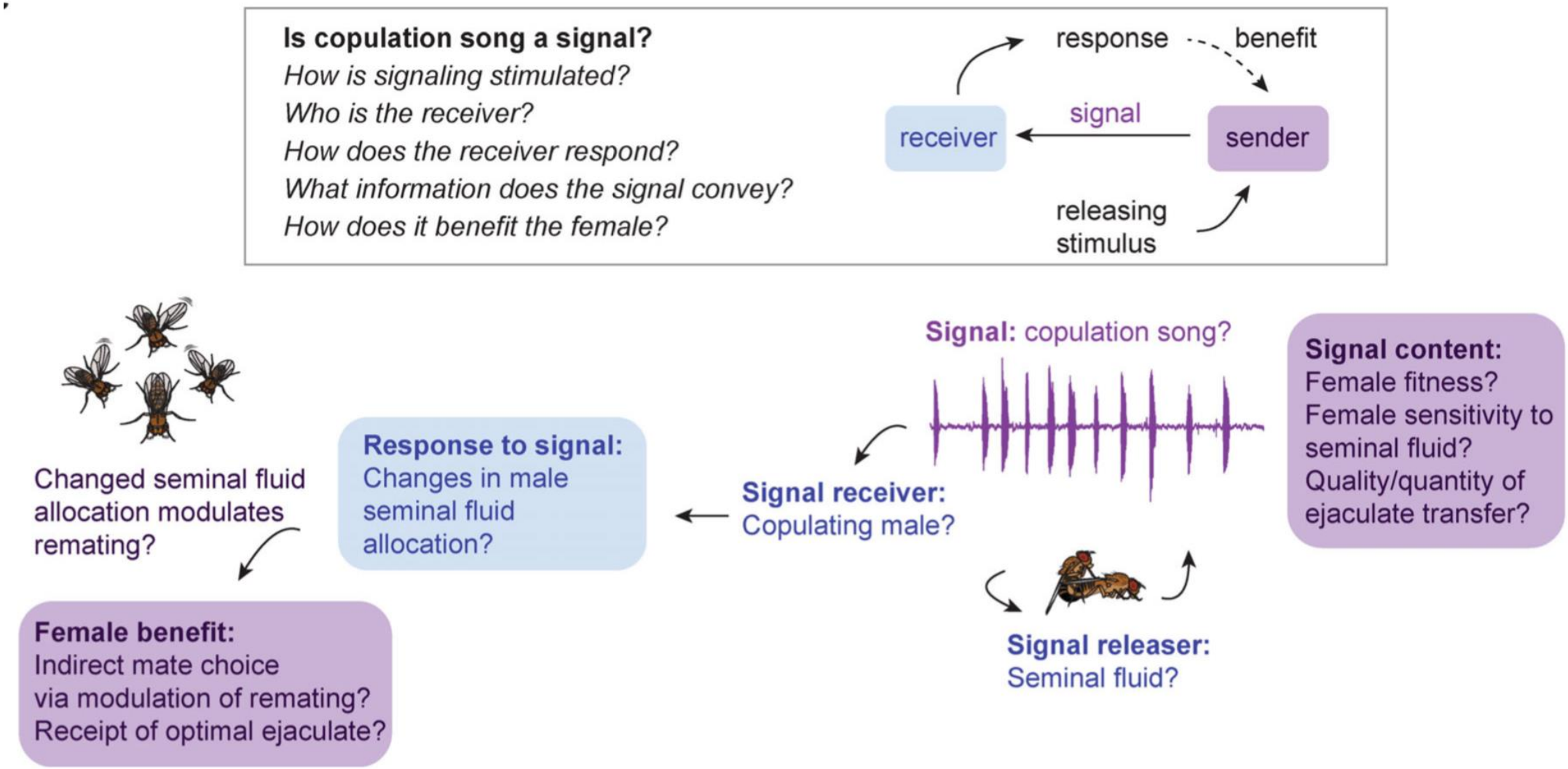
Female copulation song acts as signal in postcopulatory mate choice



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