Behavioral Ecology
The official journal of the
ISBE
International Society for Behavioral Ecology

Behavioral Ecology (2020), XX(XX), 1–2.

Invited Commentary

First evidence for a significant effect of the regression to the mean fallacy in mate copying: a comment on Davies et al.

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Davies et al.'s (2020) meta-analysis on mate copying shows a series of suggestive, interesting results. Here, we elaborate on their discussion by emphasizing two conceptual points and one technical point.

"MATE-CHOICE COPYING" OR "MATE COPYING"

The widespread distribution of mate copying suggests an ancient origin or multiple convergent evolutions, raising the question of its benefits. These benefits are tightly linked to the deep nature of the information provided by the demonstration. The classical view is that the information lies in the choice of the demonstrator. Hence, its usual name of mate-*choice* copying. However, as already suggested (Wagner and Danchin 2010), we think that the information in fact lies in the performance of one male—and not the other(s)—in copulating with other females. We, thus, prefer calling it mate copying, a term that avoids putting the stress on the demonstrator female's choice.

THE TWO FORMS OF MATE COPYING

We agree with Davies et al. (2020) that it is crucial to distinguish two forms of copying. Females can learn to prefer (or avoid) a given male over another: this is individual-based mate copying. Although interesting, this basic form of mate copying has limited evolutionary impacts as it only persists for as long as the individual males survive. Females may rather learn to prefer any male with a given trait: this is what Davies et al. (2020) call generalized copying, although it is more appropriate to call it trait-based mate copying (Bowers et al. 2012). Only trait-based mate copying can lead to the emergence of persistent cultural traditions that can affect sexual selection and evolution over generations. We recommend incorporating this distinction into future studies on mate copying.

DAVIES ET AL.'S RESULTS MAY REVEAL THE EFFECT OF THE REGRESSION TO THE MEAN IN BEFORE-AND-AFTER DESIGNS

Although technical, a nice result of Davies et al. (consistent with Jones and DuVal 2019) is their finding that "before-and-after" designs lead to stronger copying than "no pretest" designs. A biological explanation may be that social information is more striking to the observer when it contradicts the observer's prior preference or that observers may be cognitively "turned on" by the pretest, leading to better learning scores. However, here, we would like to provide a purely technical explanation. There are two kinds of before-and-after designs: the male that receives positive information during the demonstration is decided by the experimenter either a priori (before-and-after-a) independently from the result of the first preference test or only after (before-and-after-b) the first test so that demonstrations are positive for the male that was nonpreferred during the first test. Both of these designs, and particularly so before-and-after-b, are subject to the regression to the mean (RTM) statistical fallacy that is rampant as soon as the same individuals or lineages are tested twice (Danchin et al. 2014).

RTM emerges when the same measurement occurs twice per entity, which is the case in before-and-after designs. These measurements have a certain distribution with a mean and a norm (the most common value). Pick a first measurement with an extreme value (large or small) and draw the second measurement randomly from that distribution. This second measurement will tend to be closer to the most common value (usually close to the mean) just for purely statistical reasons. This generates a placebo effect in that, after an extreme value of, say, cholesterol that you measured in the first step, the second measurement is now closer to normal (and healthy), independently from any treatment, just by chance. In the treatment group that received a drug, or saw a demonstration, part of the change, thus, results from the treatment (a drug against cholesterol or the demonstration) but another part will be due to the RTM effect.

In the case of mate copying, RTM occurs when females that have shown, by chance, a strong preference for a given option is tested again after a demonstration providing positive information for the other option to assess any reversal in her preference. Because the first preference would be stronger than expected, the after-demonstration preference will seem to show some reversion even in the absence of any effect of social information.

So the finding that experiments using before-and-after designs lead to stronger copying probably reveals the fact that these designs incorporate both effects, that of true mate copying, plus that of the RTM. More generally, studies should never use before-and-after-b that violate the general experimental principle that individuals must be attributed randomly to the treatments. We recommend using no pretest designs and, when this is not possible 1) to incorporate an uniformed control and 2) to correct the statistical analyses as in Kelly and Price (2005) as it was done in experiment 1 of Mery et al. (2009).

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Received 18 July 2020; editorial decision 22 July 2020; accepted 23 September 2020.

doi: 10.1093/beheco/araa076

REFERENCES

Bowers RI, Place SS, Todd PM, Penke L, Asendorpf JB. 2012. Generalization in mate-choice copying in humans. Behav Ecol. 23(1):112–124. doi: 10.1093/beheco/arr164.

Danchin É, Wajnberg É, Wagner RH. 2014. Avoiding pitfalls in estimating heritability with the common options approach. Sci Rep. 4: 3974. doi: 10.1038/srep03974.

Davies AD, Lewis Z, Dougherty LR. 2020. A meta-analysis of factors influencing the strength of mate choice copying in animals. Behav Ecol. doi: 10.1093/beheco/araa064.

Jones BC, DuVal EH. 2019. Mechanisms of social influence: a meta-analysis of the effects of social information on female mate choice decisions. Front Ecol Evol. 7:14. doi:39010.3389/fevo.2019.00390.

Kelly C, Price TD. 2005. Correcting for regression to the mean in behavior and ecology. Am Nat. 166:700–707.

Mery F, Varela SA, Danchin E, Blanchet S, Parejo D, Coolen I, Wagner RH. 2009. Public versus personal information for mate copying in an invertebrate. Curr Biol. 19:730–734.

Wagner RH, Danchin É. 2010. A taxonomy of biological information. Oikos. 119:203–209.