Strength of preference for conspecifics in darters (genus *Etheostoma*)
A within-lab meta-analysis

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Background

Studies investigating mate preference in darters (Percidae: *Etheostoma*) usually find that species demonstrate a varying degree of preference for conspecifics over heterospecifics. What drives such a trend?

We hypothesized that differences among species could be driven by geographic relationships, predicting that sympatric species have a stronger preference due to reinforcement. We also expected a positive relationship between genetic distance/relatedness and preference for conspecifics. Finally, we tested the strength of preference (SOP) for conspecifics between the sexes to test whether females are choosier, as predicted by most sexual selection theory.

We conducted a meta-analysis of 12 published papers and three unpublished datasets from our lab, for a total of 20 focal darter species.

Inclusion criterion: All studies used a dichotomous mate preference paradigm, in which individuals do not have physical access to one another, opposing conspecific and heterospecific individuals (figure 1).

Effect sizes: we computed a Pearson's correlation coefficient *r* (not Z-transformed) of the measured times spent in the association zones for each study, species, and sex (n=62).

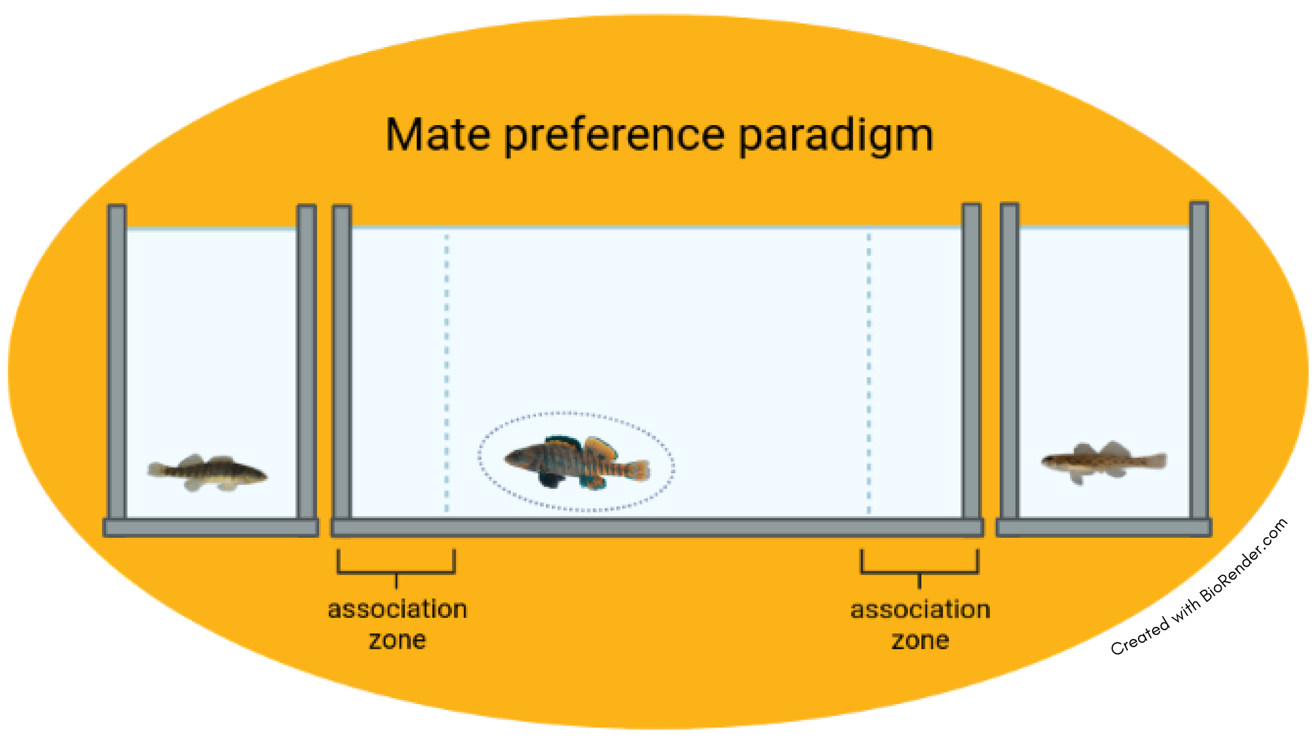

Figure 1: Illustration of a dichotomous mate preference paradigm. The main measure is the time that the focal fish (circled) spends in both association zones next to which stands either a conspecific or a heterospecific individual of opposite sex.

Effect sizes for each included study

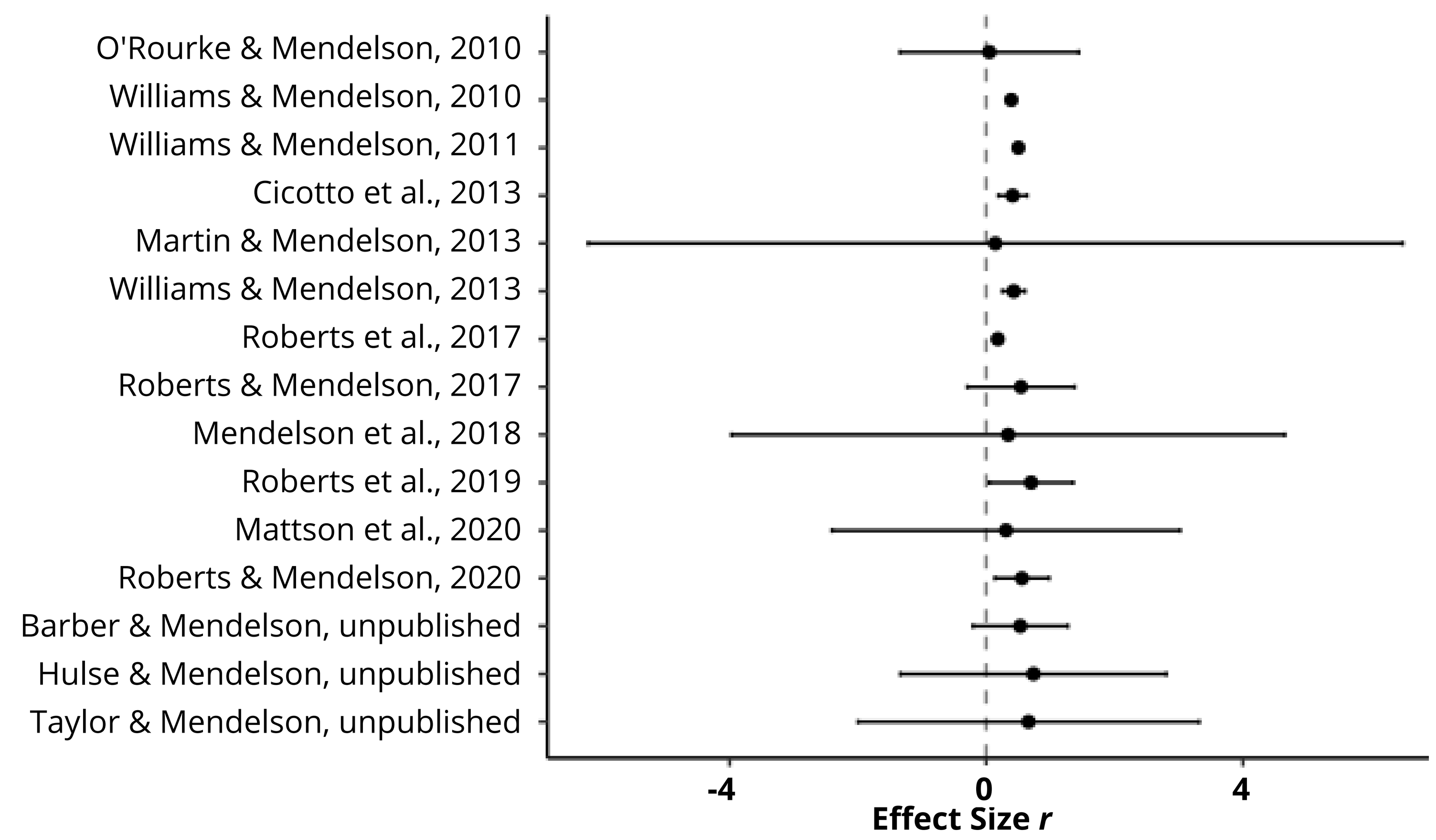

Figure 2: Forest plot showing mean effect sizes averaged across species and sex for each of the included studies (12 published papers and 3 unpublished datasets).

Funnel plot

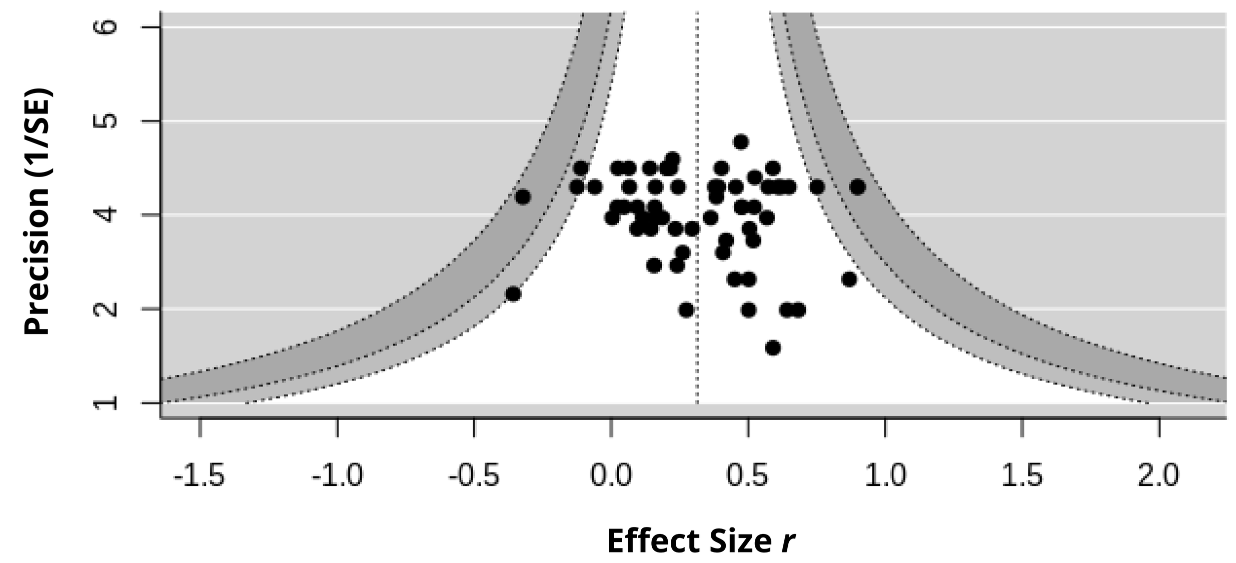

Figure 3: The funnel plot is roughly symmetrical, indicating no publication bias, which was confirmed by an Egger's regression test: Z = 0.6991, p = 0.4845.

Statistical model and results

Multilevel meta-analysis model (R package metafor): rma.mv
→ random effects (effect sizes non independent): study, phylogeny (variance-covariance matrix)
→ moderators: sex, allopatry/sympatry, association zone size, stimulus type, recording time

Result of the main model: The overall effect size is of medium strength
Overall effect size = 0.3496, p = .0001, CI = 0.1689 - 0.5303 (medium)
Total amount of heterogeneity across effect sizes (I^2): 21.18% (3.25% comes from phylogeny and 17.9% from study iD)

Positive correlation between the effect sizes and genetic distance (cyt b)
Overall: ρ = 0.342 (CI: 0.101 0.545), t = 2.8212, p = 0.0065
Females only: ρ = 0.4219 (CI: 0.092 - 0.668), t = 2.591, p = 0.0145
Males only: ρ = 0.2375 (CI: -0.141 - 0.556), t = 1.2706, p = 0.2147

Moderator	QM	*p*-value	mean	95% CIs
Sex of the focal individual	0.4954	0.4815	F: 0.3648 (n=32) M: 0.4176 (n=30)	0.2137 - 0.5158 0.2593 - 0.5759
Allopatry vs. sympatry	**13.9438**	**0.0002**	**A: 0.2252 (n=42) S: 0.5434 (n=20)**	**0.1138 - 0.3366 0.3810 - 0.7058**
Size of the association zone	0.0875	0.7673	5cm: 0.3722 (n=53) 10cm: 0.4171 (n=9)	0.2114 - 0.5329 0.1470 - 0.6872
Stimulus type	2.1426	0.5433	live: 0.3713 (n=53) video: 0.2880 (n=3) motorised: 0.6001 (n=4) animation: 0.3324 (n=2)	0.2293 - 0.5134 -0.1100 - 0.6860 0.2878 - 0.9123 -0.2305 - 0.8952
Recording times	0.8924	0.8273	5mn: 0.4419 (n=4) 10mn: 0.3910 (n=1) 15mn: 0.4611 (n=19) 20mn: 0.3394 (n=38)	-0.0187 - 0.9026 -0.1923 - 0.9743 0.2792 - 0.6429 0.1581 - 0.5208

Post Hoc t-tests
Effect sizes for sympatric species are bigger than for allopatric species, for females only
Females: t = -2.9452, p = 0.009 (meanA = 0.226; meanS = 0.528)
Males: t = -2.1052, p = 0.057 (meanA = 0.256; meanS = 0.48)

Effect sizes for sex and geographic relationship

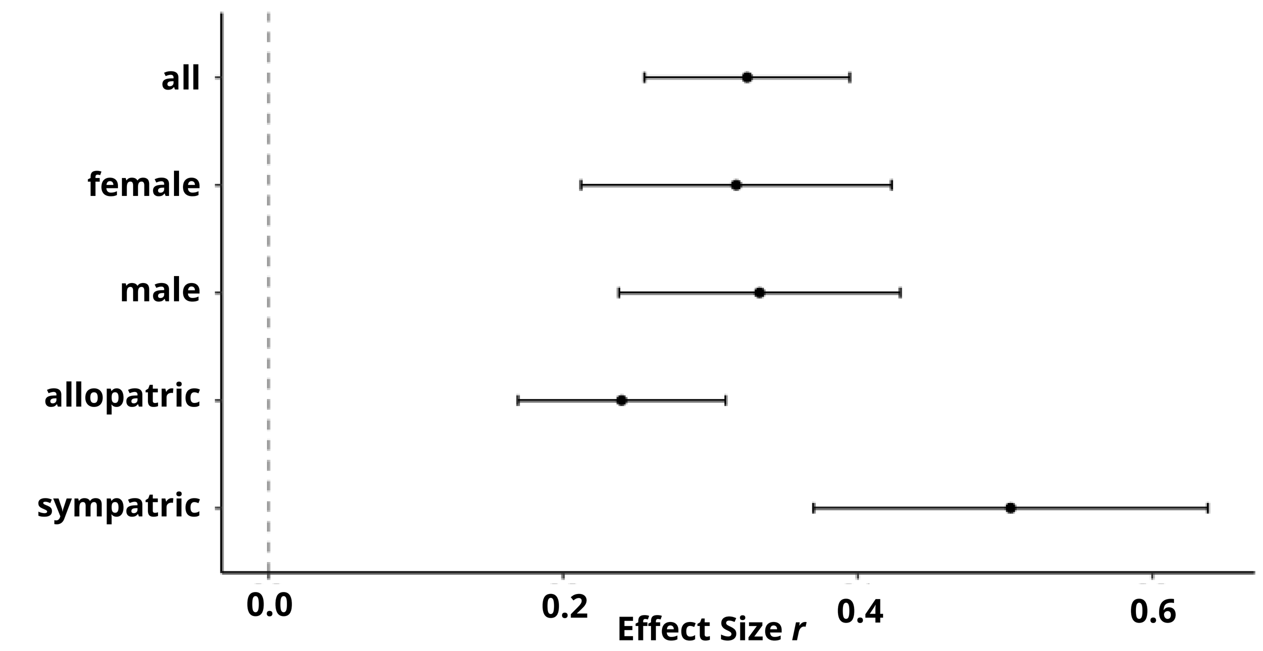

Figure 4: Forest plot showing mean effect sizes of the main moderators: sex and geographic relationship, as well as an average of all the moderators included in the analysis.

Conclusion

We found an overall effect size of medium strength with no difference between males and females.
We further found that species differ in SOP based on genetic distance AND geographic relationship. The positive relationship with genetic distance is expected given the number of studies showing that reproductive isolation between lineages accumulates in strength over time.
As for the effect of geographic relationship, stronger preferences in sympatric species is consistent with a hypothesis of reinforcement. In our case, reinforcing selection translates into greater SOP in females, consistent with the idea that mating with a heterospecific is more costly for females than for males.

Methodological references

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