Do morphological adaptations for gliding influence clinging and jumping?

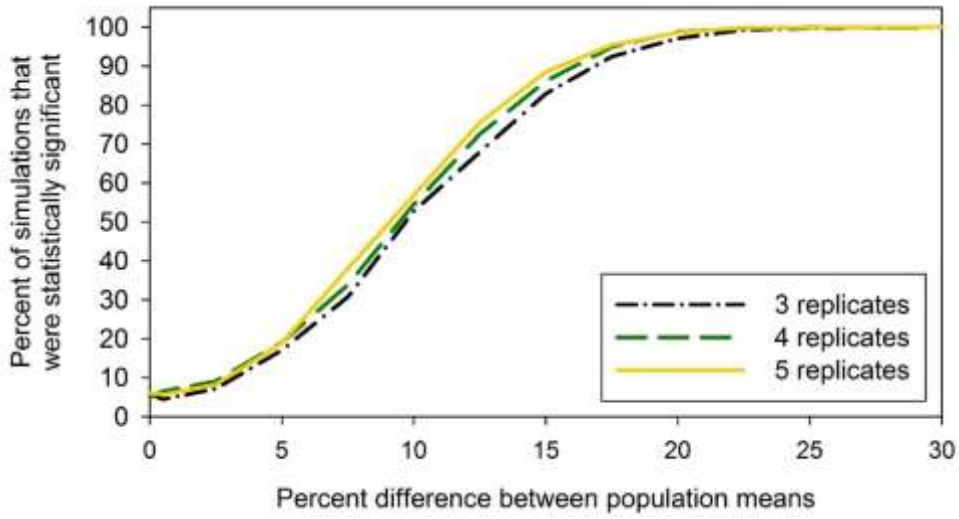
Donald T. McKnight, Jodie Nordine, Brad Jerrett, Margaret Murray, Paul Murray, Rebecca Moss, Merric Northey, Nittya Simard, Ross A. Alford, and Lin Schwarzkopf

Appendix S2 Discussion of repeated measurements tests. Description of the script used for testing the effects of repeated performance measurements, as well as a figure and discussion of the results.

Number of replicates

Adolph and Pickering[1] showed that increasing the number of replicates per individual would improve maximum performance estimates, but they did not test the effect of increased replicates on statistical tests comparing maximum performance estimates among populations. We wrote a simulation to do this (S3 Script). The simulation takes two populations of 30 individuals each, with specified population means, population standard deviations, and individual standard deviations. For each iteration, it selects mean individual maximum performances for the specified number of individuals per population by randomly sampling normal distributions defined by the population means and population standard deviations. Then, for each individual, it uses that selected mean and the specified individual standard deviation to construct a distribution for that individual's performance, and it randomly selects the specified number of points (replicates) from that distribution. It does this for both populations, then it takes the maximum value for each individual (max performance) and does a t-test comparing populations. It then returns the percent of iterations that were statistically significant.

We used this basic code to first construct a baseline population that would match the one used by Adolph and Pickering[1]. We found that population mean = 2, population SD = 0.35, and individual SD = 0.35 allowed us to reproduce Figure 5 of Adolph and Pickering[1]. We used this as our baseline population, and we used the simulation to compare it to populations with gradually increasing means (S2 Table 1). We did this with three samples per individual, four per individual, and five per individual. We found that although increasing the number of replicates per individual does increase the statistical power, the increase is fairly small, and the difference in power between studies with three and five replicates is minimal (S2 Figure 1).



S2 Figure 1: Results of simulations showing the percent of iterations (out of 1,000) that were statistically significant using different numbers of replicates per individuals.

S2 Table 1. The parameters used for the second population in our simulations. We used the same SD for both the population SD and individual SD. The SD scaled linearly with the mean so that it was proportionately always the same.

Population Mean	SD
2	0.35
2.01	0.35175
2.05	0.35875
2.1	0.3675
2.15	0.37625
2.2	0.385
2.25	0.39375
2.3	0.4025
2.35	0.41125
2.4	0.42
2.45	0.42875
2.5	0.4375
2.55	0.44625
2.6	0.455

Sensitivity analysis

Our flying frog data contained few individuals of the largest two species (*Rhacophorus dulitensis* and *Rhacophorus nigropalmatus*), resulting in a very skewed mass distribution. To ensure that the few large frogs were not disproportionately affecting our performance data, we performed a sensitivity analysis by checking the slopes of regressions of mass against performance ($\log_{10}$ transformed data) after removing each of the four largest frogs, as well as after removing both *R. dulitensis* or both *R. nigropalmatus* (S2 Table 3). Removing any individual frog had a minimal effect on the slopes, as did removing both *R. dulitensis*. Removing both *R. nigropalmatus* resulted in a more noticeable drop in slope, but the new slope was still within the 95% confidence interval of the original. Therefore, we do not think our data were overly influenced by these individuals.

S2 Table 2. Slopes for each performance metric (against mass; $\log_{10}$ transformed data) after removing the number and species of individuals specified ("none" shows the original values without removing individuals).

Number and species removed	Glide	Jump	Sheer
none	0.261	0.173	0.648
1 *Rhacophorus dulitensis*	0.261	0.195	0.627
1 *Rhacophorus dulitensis*	0.257	0.158	0.671
2 *Rhacophorus dulitensis*	0.257	0.180	0.650
1 *Rhacophorus nigropalmatus*	0.313	0.182	0.619
1 *Rhacophorus nigropalmatus*	0.261	0.173	0.641
2 *Rhacophorus nigropalmatus*	0.311	0.157	0.555

References

1. Adolph, S. C. & Pickering, T. Estimating maximum performance: effects of intraindividual variation. J. Exp. Biol. 2008; 211: 1336–1343.