SUPPORTING INFORMATION APPENDIX

2

3 **<u>Methods</u>**

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5 **Data compilation**

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7 All data used in analyses were compiled from existing, published datasets, described

8 and referenced in full below.

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10 <u>Phylogeny</u>

11

12 Comparative datasets were matched to a dated consensus phylogeny for 301 primate

13 species (10kTrees version 3, using GenBank taxonomy (1)). Taxonomic mis-matches

14 were resolved using the 10kTrees Translation Table and the IUCN Red List website (2).

15 All sample sizes provided below refer to those after matching species in the original

16 datasets to those in the phylogeny. We do not include humans in any analyses.

17

18 <u>Brain volume and body mass</u>

19

20 Data on endocranial volume (ECV, in cubic centimeters) and body mass (in grams)

21 originally from museum collections were obtained from (3). 88% of individuals used for

22 ECV measurements were wild-caught, and comparison of species where measures of

23 ECV were available from both wild and captive individuals suggested no strong and

24 consistent differences in brain size estimates between these sources (3). Body mass

25 estimates in this source were taken from a combination of museum specimens and

26   existing compilations, including both wild and captive individuals. To maximize sample

27   size, here we selected data for all species where 'species mean' values were provided for

28   ECV or body mass in the dataset (N=184 and 186 species respectively), rather than

29   selecting any subset based on a minimum number of individual specimens per species

30   (see (3)). These ECV and body mass data included values averaged across multiple

31   males and females (for the majority of anthropoid species, for whom sexual size

32   dimorphism is frequent), values averaged across multiple individuals of unknown sex

33   and values from single individuals of either sex (for prosmians, where sexual size

34   dimorphism is limited or absent) (3).

35

36   <u>Social learning and research effort</u>

37

38   Measures of social learning and research effort were obtained from (4), via the

39   DataDryad digital repository (5) (N=186 species with both data on social learning and

40   research effort, after matching species to the phylogeny). To create a quantitative

41   measure of social learning propensity across primate species, Reader et al. (4) used the

42   'taxonomic counts' (6, 7) approach, which estimates a species' tendency to perform a

43   particular behavior based on counts of reports of the relevant behavior identified in

44   appropriate literature, controlling for species differences in research effort. Expanding

45   upon a prior survey (8, 9), Reader et al. (4) performed a search of over 4000 articles

46   published between 1925–2000, principally from four primate behavior journals

47   (*Primates, American Journal of Primatology, Folia Primatologica, and the International*

48   *Journal of Primatology*), though with additional searches of other relevant literature

49   cited by publications that were located in the first round of search. Following the

50   approach pioneered by Lefebvre et al. (7), keywords were used to classify instances of

2

51   social learning, defined as learning skills and acquiring information from others (e.g.:

52   "social learning", "social transmission", "cultural transmission", "traditional",

53   "teaching", "imitation", "protoculture", "[goal] emulation", "observational learning",

54   "learning from each other", "culturally acquired", "local enhancement", "stimulus

55   enhancement", "socially mediated learning") (4, 8, 9). For example, Hosey et al. (10)

56   describe ring-tailed lemurs (*Lemur catta*) using their tails to access hard-to-reach

57   water, using the phrases "almost certainly […] social learning", "stimulus enhancement",

58   and "imitation is also a possibility"; therefore this was counted as one report of social

59   learning in *L. catta*. Thus, the judgment of whether a behavior pattern qualified as an

60   instance of social learning was made by the author of the surveyed article. This

61   approach minimizes subjective bias during the collation of the data (7, 8, 11), but leaves

62   open the possibility of reporting biases in the original articles. As mentioned in previous

63   work (4, 8, 11, 12) social learning may be particularly prone to reporting biases as the

64   majority of the reports of social learning were observational, and social learning is

65   difficult to identify without controlled experiments (13). Inter-observer reliability for

66   the original survey of social learning was, however, high (index of concordance (14) =

67   0.95; (8)). Despite its potential limitations, this approach allows for more naturalistic

68   and ecologically valid quantitative behavioral measures, permitting large-scale

69   comparative analyses across a far broader diversity of species than are possible using

70   alternative approaches based solely on experimental tests (4, 6, 8, 11, 12, 15, 16).

71   Further, compared to a common approach in comparative analyses in which cognitive

72   and/or behavioral traits are inferred from proxies such as brain volume or dietary

73   measures, the taxonomic counts approach offers a more direct measure of cognitive and

74   behavioral traits (6, 7, 11).

75

76   For reports to be included in the behavioral database as distinct examples of social

77   learning, they needed to be classified as unique behaviors (4, 12). The database was

78   therefore screened for possible repeated examples, with reports in the same species,

79   context, and involving the same food and substrate only counted once. For example,

80   two reports in one species of socially learning to open dead branches to consume larvae

81   would be counted only once, whereas one account of opening branches to consume

82   larvae and another of opening branches to access fungi would be counted as two

83   reports. Similarly, socially learning to dig soil to access larvae and to open branches to

84   access larvae would count as two reports. These behavioral data thus provide a

85   measure of the number of unique reports of social learning for each species, i.e. social

86   learning richness, analogous for example to parasite richness, rather than data on the

87   frequency of use or time spent on social learning (12). These data include reports of

88   social learning mostly observed in the wild, but records from captivity are included, as

89   well as those within the context of experimental manipulations and as a result of human

90   intervention such as food provisioning (4, 8). However, in a previous analysis,

91   associations between social learning and a measure of brain size ('executive brain ratio'

92   – the relative size of the neocortex and striatum) did not differ when observations of

93   social learning outside of naturalistic settings were excluded (8). Therefore, to

94   maximize sample size, here we include all reports of social learning regardless of the

95   context in which they were observed. Further details of how data were collated and

96   discussion of the validation and utility of the approach are given in (4, 8, 11, 12).

97   Examples came from varied behavioral contexts, most commonly within foraging

98   behavior (~50% reports in the original survey (8, 9)), while others were reported for

99   example in the context of communication, display, grooming and play.

100

101   Since species with a greater amount of research attention should have more reports of a

102   given behavior simply due to an increased likelihood of observing it, behavioral

103   measures based on the 'taxonomic counts' approach must account for species

104   differences in research effort (4, 6–8, 11). Here, we required an estimate of research

105   effort that provided sufficient data for the broad taxonomic scale of our analysis.

106   Following recent comparative analyses (4, 15), we used the number of articles

107   published per species in the *Zoological Record* (1993-2001; a total of 7288 articles) to

108   estimate research effort, as these articles include primate behavioral research, but not

109   biomedical studies, which are unlikely to be relevant for behavioral measures. Previous

110   work has utilized and compared estimates of research effort derived from different

111   publication types, finding similar results regardless of the estimate (4, 8), suggesting

112   that results based on this dataset are robust to alternative estimates of research effort.

113

114   While we control statistically for broad-scale species differences in research effort, our

115   social learning data may be additionally affected by reporting biases, such as an

116   increased propensity to report social learning in particular taxa (4). We suspected that

117   any such biases would be particularly impactful for the great apes (4), due to their

118   phylogenetic proximity to our own species and their reputation for complex and socially

119   learned behavior. Therefore, we re-ran all analyses removing the great apes, finding no

120   major differences in our results (see below and main text). Further, previous

121   comparative analyses using this dataset have found associations with other variables

122   specific to social learning (socially transmitted parasite richness), which are not shared

123   with other behavioral measures from the same dataset (innovation and extractive

124   foraging, associated instead specifically with environmentally transmitted parasite

125   richness) (12). This result is not expected if researcher biases common to various

126   'complex' behaviors strongly determined the distribution of these behavioral measures

127   across species.

128

129   <u>Life history traits and social group size</u>

130

131   Data on social group size and life history traits were obtained from the PanTheria

132   dataset (17). Social group size in this source is defined as the number of individuals

133   spending the majority of their time together in a socially cohesive unit throughout a 24-

134   hour cycle, in non-captive populations (N=187 species). Life history traits, including

135   gestation length in days (N=140 species), weaning age in days (N=116), age of sexual

136   maturity in days (N=107) and maximum longevity in months (N=120), and body mass

137   in grams (N=222) include estimates from both wild and captive individuals. Here, as a

138   measure of maternal investment, we summed gestation length and weaning age,

139   following (18). To estimate reproductive lifespan, we subtracted age of sexual maturity

140   from longevity, after converting longevity from months to days. For two species with

141   ECV measures, but lacking body mass data in the Isler et al. (3) dataset, body mass was

142   taken instead from PanTheria.

143

144   **Statistical analyses**

145

146   We investigated the associations between brain volume (here measured as ECV), social

147   learning, group size and longevity in a series of multiple regression models (for all

148   parameters reported in full for each model, see SI Appendix Tables). Outcome variables

149   were always either brain volume or social learning. We analyzed brain volume both in

150   absolute terms, and relative to body mass, by varying whether body mass was included

151   as a predictor variable. Where social learning was the outcome variable, the research

152   effort measure from (4) was always included as a predictor to account for the effect of

153   research effort on social learning richness. Body mass was also included in models of

154   social learning and life history traits, to control for the well-established and potentially

155   confounding association of slower life histories with larger body mass (e.g.(19)). For all

156   models identifying either group size or life history traits as predictors of social learning,

157   we re-ran analyses controlling for both absolute and relative brain volume (by including

158   either brain volume or brain volume and body mass as additional predictors), to

159   investigate whether group size and life history traits predict social learning

160   independently of brain volume. Additionally, for all models including longevity as a

161   predictor, we ran additional analyses replacing longevity with either juvenile period

162   length (age of sexual maturity) or reproductive lifespan (juvenile period subtracted

163   from longevity). This allowed us to investigate whether relationships between social

164   learning and longevity, or brain volume and longevity, are driven by increases in

165   juvenile period length or post-juvenile lifespan in particular, or both. Further, for all

166   models identifying longevity, reproductive lifespan or juvenile period as a predictor of

167   either social learning or brain volume, we re-ran models including maternal investment

168   as an additional predictor, to account for the potentially confounding effect of maternal

169   investment on brain volume and lifespan in mammals (18). To investigate whether

170   group size and longevity independently predicted brain volume and social learning or

171   whether either relationship was confounded by the other, we ran additional models in

172   which both group size and longevity were included as predictors. Finally, to evaluate

173   the possibility of a strong influence of great ape species on results, we repeated all

174   analyses removing great ape species (*Pan troglodytes, Pan paniscus, Gorilla gorilla and*

175   *Pongo pygmaeus*), confirming that our key results were not contingent on this lineage

176   (results with and without great apes are presented throughout SI Appendix Tables).

177

178   Due to the non-independence of species data points arising from their shared

179   evolutionary history (20), here we used phylogenetic comparative statistical methods,

180   based on the 10kTrees consensus phylogeny (1). Specifically, we used Bayesian

181   phylogenetic generalized linear mixed models, which allow for both control for

182   phylogenetic non-independence and for modeling non-Gaussian response variables,

183   using the R package MCMCglmm (21). Here, phylogeny is treated as a random effect,

184   with the proportion of residual variance attributable to phylogeny estimated using

185   heritability (h^2) as a measure of phylogenetic signal. h^2 is equivalent to and interpreted

186   in the same way as the parameter Pagel's λ in phylogenetic generalized least squares

187   models, ranging from 0 to 1 indicating zero and maximum influence of phylogeny

188   respectively, assuming an underlying Brownian motion model of evolutionary change in

189   phenotypic traits (22, 23). For mean h^2 values from posterior distributions and all

190   model parameters reported in full, see SI Appendix Tables.

191

192   Where brain volume was the response variable, Gaussian models were used with all

193   variables log-10 transformed to achieve approximate normality of distributions. For

194   Gaussian models, we used default diffuse normal priors for the fixed effects with a mean

195   of 0 and a large variance (10^{10}), and inverse-Wishart priors for the phylogenetic and

196   residual variance (with V=1, ν=0.002), which corresponds to an inverse-gamma prior

197   with shape and scale parameters of 0.001 (21, 24). Where social learning was the

198   response variable, Gaussian models were not appropriate due to the highly-skewed

199   distribution of this variable, typical of count data. Therefore, we used Poisson models, in

200   which only predictor variables were log-10 transformed, leaving social learning

201   untransformed as the outcome variable. For Poisson models, we used the same priors

202   for the fixed effects and residual variance as for the Gaussian models, but with a

203   parameter-expanded prior ($V = 1$, $\nu = 1$, $\alpha\mu = 0$, and $\alpha V = 25^2$) for the phylogenetic

204   random effect (21), as used in (25), for example.

205

206   Following some previous analyses using the 'taxonomic counts' approach (e.g. (8),

207   though unlike (4), for example), here we include species with zero observations of

208   social learning. These species are still informative due to the inclusion of research effort

209   in all social learning models – i.e. if a species has no reports of social learning despite a

210   large amount of research effort, this suggests that the species has a very low propensity

211   to use social learning (26). Though a large proportion of the species in the Reader et al.

212   (4) dataset (~80%) have zero records of social learning, we did not use phylogenetic

213   zero-inflated Poisson models as they often fail to converge (24), which we found was

214   the case for our data. Using posterior predictive checks (see MCMCglmm course notes

215   (24)) for a simple model in which social learning was predicted by only research effort

216   as a fixed effect with phylogeny as a random effect, we found that the observed number

217   of zeros in the data did not fall outside of the range of values predicted by a standard,

218   non-zero inflated Poisson model, suggesting that these models are appropriate for our

219   data without a zero-inflation term (24). Over-dispersion is dealt with automatically in

220   MCMCglmm Poisson models (24).

221

222   All MCMC chains converged and performed adequately, as determined by visual

223   inspection of posterior distributions and trace plots for all estimated parameters. All

224   models were run for 2,200,000 iterations, thinning every 1000 iterations, with a 'burn-

225   in' period of 200,000 iterations, and all models returned effective sample sizes of >1000

226   for all parameters. From each model, we report the mean h^2, and mean β coefficient

227   estimate from posterior distributions. To assess the strength of evidence for fixed

228   effects, we use the % of posterior β estimates crossing zero in the direction opposite to

229   predictions (here, all associations are predicted to be positive in direction). We expect

230   posterior distributions for non-influential predictors to be centered on zero or

231   overlapping substantially with zero, while posterior distributions shifted substantially

232   away from zero in either a positive or negative direction indicate support for positive or

233   negative associations with predictor variables, respectively. As a measure of model fit,

234   we use a pseudo-R^2, here estimated as the squared Pearson's correlation between fitted

235   values and observed data, in order to provide a measure of model fit comparable across

236   both Gaussian and Poisson models (27) .

237

238   Multi-collinearity can cause serious problems for parameter estimation in multiple

239   regression analyses, common in analyses of biological datasets where predictor

240   variables are often inter-correlated (28). We therefore calculated variance inflation

241   factors (VIFs) using non-phylogenetic, frequentist generalized least squares (GLS)

242   regression models, which reflect the extent to which variance in estimated coefficients

243   for each predictor is inflated by collinearity of the predictors. Here, use of non-

244   phylogenetic GLS models is conservative as associations between biological traits tend

245   to be stronger in non-phylogenetic models (29). All analyses reported VIFs <5, far below

246   the threshold (>10) suggested to indicate strong collinearity (28).

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251 **TABLES**
252
253
254 Table S1. Social learning and brain volume
255
256 (i) social learning and absolute brain volume
257

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	150	0.36	0.61	Brain volume	1.77	0.20
				Research effort	3.38	0.00
Without great apes	146	0.45	0.61	Brain volume	1.90	0.35
				Research effort	3.33	0.00

258
259 (ii) social learning and relative brain volume
260

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	150	0.38	0.58	Brain volume	1.46	3.05
				Body mass	0.27	25.00
				Research effort	3.35	0.00
Without great apes	146	0.47	0.63	Brain volume	1.56	3.00
				Body mass	0.32	19.25
				Research effort	3.31	0.00

261
262 *Results of models predicting social learning from brain volume and research effort (i) without, and (ii) with*
263 *control for body mass. In all tables, N=N species, h²=heritability (phylogenetic signal), Ps-R²=pseudo-R²,*
264 *Parameter=fixed effects, mean β=mean β coefficient from posterior distribution, % β = percentage of β*
265 *estimates crossing zero in the opposite direction to that predicted for each effect (here all associations are*
266 *predicted to be positive). Results for all models are shown for both the full sample of primate species (top*
267 *rows), and for analyses removing great ape species (bottom rows).*
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290 Table S2A: social learning and longevity
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292 (i) social learning and longevity
293

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	117	0.43	0.79	Longevity	5.46	0.15
				Body mass	0.44	9.00
				Research effort	3.10	0.00
Without great apes	113	0.40	0.50	Longevity	5.33	0.10
				Body mass	0.59	4.45
				Research effort	3.20	0.00

294
295 (ii) social learning and longevity, maternal investment
296

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	87	0.43	0.84	Longevity	4.38	2.30
				Mat. investment	0.73	35.00
				Body mass	0.34	19.75
				Research effort	3.28	0.00
Without great apes	83	0.42	0.42	Longevity	4.18	2.35
				Mat. investment	0.83	31.30
				Body mass	0.44	14.20
				Research effort	3.43	0.00

297
298 (iii) social learning and longevity, absolute brain volume
299

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	111	0.39	0.80	Longevity	5.17	0.45
				Brain volume	0.56	22.65
				Research effort	3.14	0.00
Without great apes	107	0.39	0.66	Longevity	4.46	1.50
				Brain volume	1.02	9.65
				Research effort	3.30	0.00

300
301 (iv) social learning and longevity, relative brain volume
302

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	111	0.41	0.78	Longevity	5.51	0.70
				Brain volume	-0.01	51.30
				Body mass	0.44	14.35
				Research effort	3.05	0.00
Without great apes	107	0.38	0.36	Longevity	5.09	0.90
				Brain volume	0.37	34.05
				Body mass	0.49	10.35
				Research effort	3.19	0.00

303
304 *Results of models predicting social learning from longevity, controlling for (i) body mass and research effort,*
305 *(ii) maternal investment, body mass and research effort, (iii) brain volume and research effort, (iv) brain*
306 *volume, body mass and research effort.*
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310   <u>Table S2B: social learning and juvenile period</u>

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312   (i) social learning and juvenile period

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Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	101	0.39	0.70	Juvenile period	-0.22	57.65
				Body mass	0.62	5.40
				Research effort	4.00	0.00
Without great apes	97	0.51	0.63	Juvenile period	-0.33	56.55
				Body mass	0.64	5.85
				Research effort	3.89	0.00

314

315 *Results of models predicting social learning from juvenile period, controlling for (i) body mass and research*
316 *effort. As juvenile period failed to predict social learning in this model, no further analyses with additional*
317 *potentially confounding variables are included.*

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320   <u>Table S2C: social learning and reproductive lifespan</u>

321

322   (i) social learning and reproductive lifespan

323

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	92	0.40	0.75	Rep. lifespan	6.09	0.00
				Body mass	0.29	18.75
				Research effort	3.14	0.00
Without great apes	88	0.40	0.51	Rep. lifespan	5.71	0.00
				Body mass	0.43	9.80
				Research effort	3.23	0.00

324

325   (ii) social learning and reproductive lifespan, maternal investment

326

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	82	0.44	0.89	Rep. lifespan	6.04	0.05
				Mat. investment	0.42	40.60
				Body mass	0.27	23.10
				Research effort	3.14	0.00
Without great apes	78	0.46	0.50	Rep. lifespan	5.71	0.10
				Mat. investment	0.48	39.00
				Body mass	0.40	15.30
				Research effort	3.26	0.00

327

328   (iii) social learning and reproductive lifespan, absolute brain volume

329

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	89	0.38	0.78	Rep. lifespan	5.98	0.20
				Brain volume	0.31	32.80
				Research effort	3.16	0.00
Without great apes	85	0.39	0.42	Rep. lifespan	5.18	0.40
				Brain volume	0.74	15.65
				Research effort	3.32	0.00

330

331

332   (iv) social learning and reproductive lifespan, relative brain volume
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Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	89	0.39	0.80	Rep. lifespan	6.37	0.05
				Brain volume	-0.10	54.75
				Body mass	0.32	21.65
				Research effort	3.05	0.00
Without great apes	85	0.43	0.50	Rep. lifespan	5.62	0.20
				Brain volume	0.31	35.45
				Body mass	0.39	16.75
				Research effort	3.18	0.00

334
335   *Results of models predicting social learning from reproductive lifespan, controlling for (i) body mass and*
336   *research effort, (ii) maternal investment, body mass and research effort, (iii) brain volume and research*
337   *effort, (iv) brain volume, body mass and research effort.*
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341   <u>Table S3: social learning and group size</u>
342
343   (i) social learning and group size
344

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	167	0.31	0.84	Group size	1.32	0.80
				Research effort	3.96	0.00
Without great apes	163	0.44	0.63	Group size	2.40	0.00
				Research effort	3.32	0.00

345
346   (ii.a) social learning, group size and longevity
347

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	111	0.36	0.84	Longevity	4.72	0.30
				Group size	0.91	3.70
				Body mass	0.22	26.65
				Research effort	3.48	0.00
Without great apes	107	0.39	0.59	Longevity	3.69	1.75
				Group size	2.09	0.05
				Body mass	0.05	45.00
				Research effort	3.37	0.00

348
349   (ii.b) social learning, group size and reproductive lifespan
350

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	89	0.40	0.85	Rep. lifespan	6.11	0.05
				Group size	0.81	4.80
				Body mass	0.19	29.15
				Research effort	3.18	0.00
Without great apes	85	0.48	0.39	Rep. lifespan	4.81	0.15
				Group size	1.88	0.50
				Body mass	0.07	43.45
				Research effort	3.09	0.00

351

352 (iii) social learning, group size and absolute brain volume
353

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	140	0.32	0.80	Group size	0.93	3.75
				Brain volume	1.34	1.55
				Research effort	3.56	0.00
Without great apes	136	0.46	0.62	Group size	2.37	0.15
				Brain volume	0.51	25.50
				Research effort	3.18	0.00

354
355 (iv) social learning, group size and relative brain volume
356

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	140	0.33	0.71	Group size	0.95	3.25
				Brain volume	1.17	7.05
				Body mass	0.15	35.90
				Research effort	3.56	0.00
Without great apes	136	0.48	0.44	Group size	2.45	0.15
				Brain volume	0.51	27.70
				Body mass	0.00	51.25
				Research effort	3.20	0.00

357
358 *Results of models predicting social learning from group size, controlling for (i) research effort only, (ii.a)*
359 *longevity, body mass and research effort, (ii.b) reproductive lifespan, body mass and research effort, (iii)*
360 *brain volume and research effort, (iv) brain volume, body mass and research effort.*
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368 Table S4. Predictors of absolute brain volume
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370 (i) absolute brain volume and group size
371

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	151	1.00	0.48	Group size	0.07	3.45
Without great apes	147	0.99	0.53	Group size	0.09	1.65

372
373 (ii.a) absolute brain volume and longevity
374

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	112	1.00	0.56	Longevity	0.36	0.05
Without great apes	108	1.00	0.50	Longevity	0.31	0.30

375
376 (ii.b) absolute brain volume and juvenile period
377

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	98	0.99	0.83	Juvenile period	0.49	0.00
Without great apes	94	0.99	0.80	Juvenile period	0.48	0.00

378 (ii.c) absolute brain volume and reproductive lifespan
379

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	90	0.99	0.47	Rep. lifespan	0.39	0.15
Without great apes	86	0.99	0.41	Rep. lifespan	0.36	0.25

380
381 (iii.a) absolute brain volume, longevity and maternal investment
382

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	84	0.98	0.84	Longevity	0.41	0.45
				Mat. investment	0.69	0.00
Without great apes	80	0.99	0.82	Longevity	0.38	0.75
				Mat. investment	0.65	0.00

383
384 (iii.b) absolute brain volume, juvenile period and maternal investment
385

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	86	0.98	0.85	Juvenile period	0.43	0.20
				Mat. investment	0.62	0.00
Without great apes	82	0.98	0.83	Juvenile period	0.43	0.25
				Mat. investment	0.56	0.00

386
387 (iii.c) absolute brain volume, reproductive lifespan and maternal investment
388

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	79	0.98	0.82	Rep. lifespan	0.37	0.25
				Mat. investment	0.70	0.00
Without great apes	75	0.98	0.79	Rep. lifespan	0.34	0.95
				Mat. investment	0.66	0.00

389
390 (iv.a) absolute brain volume, group size and longevity
391

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	106	0.99	0.69	Group size	0.06	9.25
				Longevity	0.40	0.05
Without great apes	102	0.99	0.69	Group size	0.09	4.50
				Longevity	0.34	0.45

392
393 (iv.b) absolute brain volume, group size and juvenile period
394

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	95	0.99	0.85	Group size	0.12	0.95
				Juvenile period	0.54	0.00
Without great apes	91	0.99	0.85	Group size	0.17	0.10
				Juvenile period	0.57	0.00

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401   (iv.c) absolute brain volume, group size and reproductive lifespan
402

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	87	0.99	0.62	Group size	0.08	6.65
				Rep. lifespan	0.44	0.00
Without great apes	83	0.99	0.62	Group size	0.10	4.05
				Rep. lifespan	0.38	0.55

403
404   *Results of models predicting absolute brain volume from (i) group size, (ii.a) longevity, (ii.b) juvenile period,*
405   *(ii.c) reproductive lifespan, (iii.a) longevity, controlling for maternal investment, (iii.b) juvenile period,*
406   *controlling for maternal investment, (iii.c) reproductive lifespan, controlling for maternal investment, (iv.a)*
407   *group size and longevity, (iv.b) group size and juvenile period, (iv.c) group size and reproductive lifespan.*
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411   Table S5. Predictors of relative brain volume

412

413   (i) relative brain volume and group size

414

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	151	0.99	0.69	Group size	0.07	3.65
				Body mass	0.04	0.10
Without great apes	147	0.99	0.69	Group size	0.08	2.45
				Body mass	0.04	0.75

415

416   (ii.a) relative brain volume and longevity

417

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	112	0.99	0.75	Longevity	0.37	0.00
				Body mass	0.07	0.00
Without great apes	108	0.99	0.71	Longevity	0.33	0.15
				Body mass	0.06	0.15

418

419   (ii.b) relative brain volume and juvenile period

420

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	98	0.99	0.87	Juvenile period	0.55	0.00
				Body mass	0.10	0.00
Without great apes	94	0.99	0.86	Juvenile period	0.55	0.00
				Body mass	0.09	0.00

421

422   (ii.c) relative brain volume and reproductive lifespan

423

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	90	0.99	0.68	Rep. lifespan	0.36	0.20
				Body mass	0.08	0.05
Without great apes	86	0.99	0.63	Rep. lifespan	0.34	0.50
				Body mass	0.07	0.40

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426

427 (iii.a) relative brain volume, longevity and maternal investment
428

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	84	0.98	0.88	Longevity	0.42	0.20
				Body mass	0.07	0.25
				Mat. investment	0.63	0.00
Without great apes	80	0.98	0.86	Longevity	0.39	0.35
				Body mass	0.03	0.60
				Mat. investment	0.67	0.00

429
430 (iii.b) relative brain volume, juvenile period and maternal investment
431

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	86	0.98	0.89	Juvenile period	0.46	0.05
				Body mass	0.04	0.00
				Mat. investment	0.52	0.05
Without great apes	82	0.98	0.88	Juvenile period	0.47	0.05
				Body mass	0.03	0.10
				Mat. investment	0.49	0.00

432
433 (iii.c) relative brain volume, reproductive lifespan and maternal investment
434

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	79	0.98	0.86	Rep. lifespan	0.35	0.50
				Body mass	0.03	0.10
				Mat. investment	0.63	0.00
Without great apes	75	0.98	0.84	Rep. lifespan	0.33	0.85
				Body mass	0.03	0.30
				Mat. investment	0.61	0.00

435
436 (iv.a) relative brain volume, group size and longevity
437

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	106	0.99	0.79	Group size	0.05	15.45
				Longevity	0.42	0.05
				Body mass	0.07	0.20
Without great apes	102	0.99	0.77	Group size	0.07	9.45
				Longevity	0.36	0.20
				Body mass	0.06	0.50

438
439 (iv.b) relative brain volume, group size and juvenile period
440

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	95	0.98	0.89	Group size	0.10	2.60
				Juvenile period	0.59	0.00
				Body mass	0.10	0.00
Without great apes	91	0.98	0.88	Group size	0.14	0.50
				Juvenile period	0.61	0.00
				Body mass	0.08	0.05

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443   (iv.c) relative brain volume, group size and reproductive lifespan
444

Sample	N	h²	Ps-R²	Parameter	Mean β	% β
All species	87	0.99	0.73	Group size	0.06	12.75
				Rep. lifespan	0.40	0.10
				Body mass	0.07	0.20
Without great apes	83	0.99	0.71	Group size	0.08	7.55
				Rep. lifespan	0.36	0.60
				Body mass	0.06	1.05

445
446 *Results of models predicting relative brain volume from (i) group size, (ii.a) longevity, (ii.b) juvenile period,*
447 *(ii.c) reproductive lifespan, (iii.a) longevity, controlling for maternal investment, (iii.b) juvenile period,*
448 *controlling for maternal investment, (iii.c) reproductive lifespan, controlling for maternal investment and*
449 *(iv.a) group size and longevity, (iv.b) group size and juvenile period, (iv.c) group size and reproductive*
450 *lifespan.*
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