

## Supplementary online material

**Title: Male characteristics as predictors of genital color and display variation in vervet monkeys**

Journal: Behavioral Ecology and Sociobiology

Mirjam M. I. Young<sup>1,2,3</sup>, Sandra Winters<sup>4</sup>, Christopher Young<sup>3,5,6</sup>, Brigitte M. Weiß<sup>1,2</sup>, Jolyon Troscianko<sup>7</sup>, André Ganswindt<sup>6,8,9</sup>, Louise Barrett<sup>3,5</sup>, S. Peter Henzi<sup>3,5</sup>, James P. Higham<sup>4</sup>, Anja Widdig<sup>1,2</sup>

<sup>1</sup>Research Group Primate Behavioural Ecology, Department of Human Behavior, Ecology and Culture, Max-Planck-Institute for Evolutionary Anthropology, Deutscher Platz 6, 04103 Leipzig, Germany, <sup>2</sup>Behavioural Ecology, Institute of Biology, Faculty of Life Sciences, Leipzig University, Talstr. 33, 04103 Leipzig, Germany, <sup>3</sup>Applied Behavioural Ecology and Ecosystems Research Unit, University of South Africa, Christiaan de Wet Road & Pioneer Avenue, Florida, 1709, Gauteng, South Africa, <sup>4</sup>Department of Anthropology, New York University, 25 Waverly Place, New York, NY 10003, USA, <sup>5</sup>Department of Psychology, University of Lethbridge, 4401 University Drive, Lethbridge, Alberta, T1K 3M4, Canada, <sup>6</sup>Mammal Research Institute, Department of Zoology and Entomology, Faculty of Natural and Agricultural Science, University of Pretoria, Private Bag X20, Hatfield 0028, South Africa, <sup>7</sup>Science and Engineering Research Support Facility (SERSF), University of Exeter, Penryn Campus, Penryn, Cornwall, TR10 9FE, UK, <sup>8</sup>Endocrine Research Laboratory, Department of Anatomy and Physiology, Faculty of Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa, <sup>9</sup>Centre for Veterinary Wildlife Studies, Faculty of

Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa.

Address correspondence to Mirjam M. I. Young at the address above, or e-mail:

[mirjam\\_young@eva.mpg.de](mailto:mirjam_young@eva.mpg.de)

Statistical analysis

#### Factor analysis

The factor analysis was checked for adequacy using the Kaiser-Meyer-Olkin measure (0.419) and Bartlett's test of sphericity ( $\chi^2 = 466.27$ ,  $df = 21$ ,  $p < 0.001$ ). All response variables included in the factor analysis and the model were checked for normality. LUM\_R and CONTRAST\_RW were log- and square root-transformed, respectively, before inclusion in the factor analysis to fulfill assumptions of normality.

#### Interaction terms in color models

In the full data set models we included the interaction male dominance \* group mating activity as it is likely that males of varying dominance rank invest differently in color over the course of the mating season, and hence at different intensities of the group mating activity.

In the models using a subset of the data, we included the interaction between fGCM concentration \* group mating activity as it is likely that genital color varies between males with differing fGCM concentrations depending on the intensities of the group mating

activity. The interaction between fGCM concentration \* dominance was included as we expected male genital color to differ between males of higher dominance rank depending on their fGCM concentration compared to low ranking males. We included a 3-way interaction between these terms as genital color could be dependent on dominance rank, fGCM concentration and group mating activity, for example, due to individuals of different dominance ranks varying in their coping mechanism during high mating activity (Cheney and Seyfarth 2009; Gesquiere et al. 2011; see review Sapolsky 2005).

#### Random slopes in color models

By including random slopes, we aimed to keep the type I error at the nominal level of 5% (Schielzeth and Forstmeier 2009; Barr et al. 2013). As models without correlations between random intercepts and random slope terms did not perform worse than when these were included, we ran models without correlation parameters (Schielzeth and Forstmeier 2009; Barr et al. 2013) to reduce model complexity and increase model power.

For the set of models on the full data set, we included male dominance, tenure, injuries, group mating activity, and the interaction dominance \* group mating activity as random slopes within male ID and male dominance, age, tenure, injuries, group mating activity, and the interaction dominance \* group mating activity as random slopes within group ID.

In the set of models based on a subset of the data, we included male fGCM concentration, dominance, group mating activity, the interaction fGCM concentration \* group mating activity, the interaction fGCM concentration \* dominance, and the interaction fGCM concentration \* dominance \* group mating activity as random slopes within male ID and fGCM concentration, dominance, group mating activity, interaction fGCM concentration \* group mating activity, the interaction fGCM concentration \* dominance,

and the interaction fGCM concentration \* dominance \* group mating activity as random slopes within group ID.

#### Autocorrelation term

For the calculation of the autocorrelation terms we followed Kulik et al. (2015). In brief, we extracted the residuals from the previously described models and averaged the residuals of all data points separately for each recording day and weighed the residuals by the difference in the number of days to the specific recording day. The weights were normally distributed and had a mean of zero. Using an R function written by Roger Mundry, we maximized the likelihood of the model with the integrated autocorrelation term to define the standard deviation. We used the R function *optimize* from the package *stats* (version 3.2.3, R Core Team 2015) to get the best fitting standard deviation of the weighted function for the autocorrelation term by minimizing the Akaike's Information Criterion (AIC, Burnham and Anderson 2002). We included autocorrelation terms in models only when the estimate of the autocorrelation term was positive as a negative estimate is probably an artefact due to infrequent interactions. All calculated autocorrelation terms were z-transformed to a mean of zero and a standard deviation of one before inclusion in the models (Schielezeth 2010).

#### Results

##### RWB genital display context

We found a significant difference in the relative frequency of RWB genital displays across all contexts (Friedman rank sum test:  $\chi^2 = 60.692$ ,  $df=5$ ,  $p<0.001$ ), with the display being shown on average in 4.1% of all dominance interactions, in 4.0% of all mating

interactions, in 2.2% of all grooming scans, in 1.4% of all inter-troop encounters, in 0.7% of all locomotion scans, and in 0.1% of foraging scans (see supplemental Fig. S2).

#### Reduced RWB genital display frequency

When repeating the RWB genital display model with the definition of the original described RWB displays (i.e. only including displays shown during male-male dominance context) and excluding all color variables and factors as predictors, the full model was highly significantly different from the null model (LRT:  $\chi^2 = 15.13$ ,  $df=2$ ,  $p<0.001$ ). Notably, the effect of dominance rank remained highly similar to the model including displays shown during all other contexts (LRT: only male-male dominance context: estimate=1.425, SE=0.250,  $\chi^2 = 11.567$ ,  $df=1$ ,  $p<0.001$ ; with all contexts: estimate=0.475, SE=0.104,  $\chi^2 = 7.235$ ,  $df=1$ ,  $p=0.007$ ), indicating that the effect of dominance rank was robust irrespective of the context in which the display was shown.

## Supplemental tables

Table S1 Results of the factor analysis

|                            | Factor1      | Factor2      | Factor3       | Factor4      |
|----------------------------|--------------|--------------|---------------|--------------|
| RED                        | 0.047        | -0.031       | <b>-0.682</b> | 0.075        |
| BLUE                       | <b>0.873</b> | -0.203       | -0.050        | 0.144        |
| LUM_R <sup>(a)</sup>       | 0.180        | 0.152        | <b>0.933</b>  | 0.263        |
| LUM_W                      | 0.079        | <b>0.510</b> | 0.065         | 0.280        |
| LUM_B                      | 0.040        | <b>0.992</b> | 0.094         | 0.038        |
| CONTRAST_RW <sup>(b)</sup> | 0.117        | 0.161        | 0.070         | <b>0.975</b> |
| CONTRAST_RB                | <b>0.857</b> | 0.447        | 0.152         | 0.193        |
| CONTRAST_WB                | <b>0.666</b> | 0.537        | 0.090         | -0.184       |
| Eigenvalue                 | 1.997        | 1.823        | 1.387         | 1.197        |
| Variance (%)               | 25.0         | 22.8         | 17.3          | 15.0         |

Factor loadings of the eight color predictors, as well as Eigenvalues and percent variance explained. Bold text marks largest loadings per predictor. <sup>(a)</sup> log-transformed, original mean±SD = 0.117±0.061; <sup>(b)</sup> square root transformed, original mean±SD = 0.053±0.023

107 Table S2 Overview of model terms and response and predictor transformations per model data set

| <b>model</b>    | <b>RWB genital display frequency<br/>(N=2 model)</b> |                                        | <b>inter-and intra-individual<br/>(N=14 models)</b> | <b>inter- and intra-individual<br/>(N=14 models)</b> |
|-----------------|------------------------------------------------------|----------------------------------------|-----------------------------------------------------|------------------------------------------------------|
| <b>data set</b> | <b>all context data<br/>set</b>                      | <b>reduced<br/>context data set</b>    | <b>full data set</b>                                | <b>data subset</b>                                   |
| RED             | in FA_R                                              | /                                      | response                                            | response                                             |
| BLUE            | in FA_B                                              | /                                      | response                                            | response                                             |
| LUM_R           | in FA_R <sup>(a)</sup>                               | /                                      | response (inter-individual <sup>(a)</sup> )         | response (inter-individual <sup>(a)</sup> )          |
| LUM_W           | in FA_LUM                                            | /                                      | /                                                   | /                                                    |
| LUM_B           | in FA_LUM                                            | /                                      | response                                            | response (inter-individual <sup>(a)</sup> )          |
| CONTRAST_RW     | test predictor <sup>(b)</sup>                        | /                                      | response (inter-individual <sup>(a)</sup> )         | response (inter-individual <sup>(a)</sup> )          |
| CONTRAST_RB     | in FA_B                                              | /                                      | response                                            | response                                             |
| CONTRAST_WB     | in FA_B                                              | /                                      | response (inter-individual <sup>(b)</sup> )         | response <sup>(b)</sup>                              |
| FA_B            | test predictor                                       | /                                      | /                                                   | /                                                    |
| FA_LUM          | test predictor                                       | /                                      | /                                                   | /                                                    |
| FA_R            | test predictor <sup>(c)(d)</sup>                     | /                                      | /                                                   | /                                                    |
| tenure          | test<br>predictor <sup>(a)(c)(d)</sup>               | test<br>predictor <sup>(a)(c)(d)</sup> | test predictor <sup>(a)(c)(d)</sup>                 | /                                                    |
| age             | /                                                    | /                                      | test predictor <sup>(d)</sup>                       | /                                                    |

|                                                   |                                  |                                           |                                        |                                        |
|---------------------------------------------------|----------------------------------|-------------------------------------------|----------------------------------------|----------------------------------------|
| injury                                            | /                                | /                                         | test predictor <sup>(c)(d)</sup>       | /                                      |
| dominance rank                                    | test predictor <sup>(c)(d)</sup> | test predictor <sup>(c)(d)</sup>          | test predictor <sup>(c)(d)</sup>       | control predictor <sup>(c)(d)</sup>    |
| group mating activity                             | control predictor<br>(b)(c)(d)   | control<br>predictor <sup>(b)(c)(d)</sup> | control predictor <sup>(b)(c)(d)</sup> | control predictor <sup>(b)(c)(d)</sup> |
| dominance rank*group mating<br>activity           | /                                | /                                         | test predictor <sup>(b)(c)(d)</sup>    | control predictor <sup>(b)</sup>       |
| mean fGCM                                         | /                                | /                                         | /                                      | test predictor <sup>(a)(c)(d)</sup>    |
| mean fGCM*dominance rank                          | /                                | /                                         | /                                      | test predictor <sup>(a)(c)(d)</sup>    |
| mean fGCM*group mating<br>activity                | /                                | /                                         | /                                      | test predictor <sup>(a)(b)(c)(d)</sup> |
| mean fGCM*dominance<br>rank*group mating activity | /                                | /                                         | /                                      | test predictor <sup>(a)(b)(c)(d)</sup> |
| male ID                                           | random effect                    | random effect                             | random effect                          | random effect                          |
| group ID                                          | random effect                    | random effect                             | random effect                          | random effect                          |

108 <sup>(a)</sup> log-transformed; <sup>(b)</sup> square root-transformed; <sup>(c)</sup> random slope within male ID; <sup>(d)</sup> random slope within group ID; \* between predictor terms  
109 indicating an included interaction;

110 Table S3 Variance and standard deviation (SD) of the random effects of the RWB genital  
 111 display full model (GLMM with Poisson distribution)

| random effect | term                  | variance              | SD                    |
|---------------|-----------------------|-----------------------|-----------------------|
| maleID        | intercept             | 0.0898                | 0.300                 |
| maleID        | dominance rank        | $4.22 \times 10^{-6}$ | $2.06 \times 10^{-3}$ |
| maleID        | group mating activity | $1.13 \times 10^{-6}$ | $1.06 \times 10^{-3}$ |
| maleID        | FA_B                  | $1.35 \times 10^{-6}$ | $1.16 \times 10^{-3}$ |
| maleID        | tenure                | $3.63 \times 10^{-8}$ | $1.90 \times 10^{-4}$ |
| groupID       | intercept             | $7.33 \times 10^{-9}$ | $8.56 \times 10^{-5}$ |
| groupID       | dominance rank        | $6.73 \times 10^{-8}$ | $2.59 \times 10^{-4}$ |
| groupID       | group mating activity | $4.13 \times 10^{-6}$ | $2.03 \times 10^{-3}$ |
| groupID       | FA_B                  | $9.11 \times 10^{-7}$ | $9.55 \times 10^{-4}$ |
| groupID       | tenure                | $3.46 \times 10^{-8}$ | $1.86 \times 10^{-4}$ |

112 'term' states whether random effect is a random intercept (intercept) or slope for a  
 113 predictor by stating the predictor.

114 Table S4 Confidence intervals (CI, 95%) of estimates for RWB genital display model

|                                      | <b>estimate</b> | <b>lCI</b> | <b>uCI</b> |
|--------------------------------------|-----------------|------------|------------|
| intercept                            | 0.009           | -0.252     | 0.207      |
| CONTRAST_RW <sup>(a)</sup>           | 0.053           | -0.157     | 0.243      |
| FA_B                                 | -0.183          | -0.354     | -0.018     |
| FA_LUM                               | -0.077          | -0.247     | 0.082      |
| FA_R                                 | 0.033           | -0.138     | 0.233      |
| dominance rank <sup>(b)</sup>        | 0.475           | 0.289      | 0.697      |
| tenure <sup>(c)</sup>                | -0.186          | -0.370     | 0.052      |
| group mating activity <sup>(d)</sup> | -0.156          | -0.304     | 0.015      |

115 Estimate - estimated coefficients for the predictors, lCI - lower CI (2.5%), uCI - upper CI  
116 (97.5%). <sup>(a)</sup> square root-transformed and z-transformed, original  
117 mean±SD = 0.053±0.023; <sup>(b)</sup> z-transformed, original mean±SD = 0.495±0.326;  
118 <sup>(c)</sup> log-transformed and z-transformed, original mean±SD = 599.701±637.354; <sup>(d)</sup> square  
119 root-transformed and z-transformed, original mean±SD = 0.043±0.031 .

Table S5 Results of the reduced RWB genital display frequency model (GLMM with Poisson distribution) only including displays within male-male dominance context. Estimate - estimated coefficients for the predictors, SE - standard error, lCI – lower confidence interval, uCI - upper confidence interval,  $\chi^2$  – Chi-square test value, p – p-value. No autocorrelation term was needed

| <b>term</b>                   | <b>estimate</b> | <b>SE</b> | <b>lCI</b> | <b>uCI</b> | <b><math>\chi^2</math><sup>(a)</sup></b> | <b>p</b>          |
|-------------------------------|-----------------|-----------|------------|------------|------------------------------------------|-------------------|
| intercept                     | -2.406          | 0.320     | -3.377     | -1.957     | NA <sup>(b)</sup>                        | NA <sup>(b)</sup> |
| dominance rank <sup>(c)</sup> | 1.425           | 0.250     | 1.015      | 2.086      | 11.567                                   | <0.001            |
| tenure <sup>(d)</sup>         | -0.249          | 0.184     | -0.679     | 0.169      | 1.7721                                   | 0.183             |
| <b>group mating</b>           |                 |           |            |            |                                          |                   |
| activity <sup>(e)</sup>       | -0.098          | 0.161     | -0.409     | 0.212      | 0.3711                                   | 0.542             |

<sup>(a)</sup> degrees of freedom are 1; <sup>(b)</sup> not shown due to limited interpretability; <sup>(c)</sup> z-transformed, original mean±SD = 0.495±0.326; <sup>(d)</sup> log-transformed and z-transformed, original mean±SD = 599.701±637.354; <sup>(e)</sup> square root-transformed and z-transformed, original mean±SD = 0.043±0.031; \* significant p-value; \* p-value indicating a trend.

130 Table S6 Individual range of normalized color variables RED and BLUE with min – lowest value, max – highest value, mean – average  
 131 and SD – standard deviation

|        | RED   |       |       |       | BLUE  |       |       |       |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| maleID | min   | max   | mean  | SD    | min   | max   | mean  | SD    |
| M1     | 0.658 | 0.835 | 0.740 | 0.067 | 0.229 | 0.540 | 0.404 | 0.111 |
| M2     | 0.556 | 0.784 | 0.697 | 0.085 | 0.206 | 0.786 | 0.457 | 0.199 |
| M3     | 0     | 0.642 | 0.362 | 0.210 | 0.360 | 1     | 0.629 | 0.271 |
| M4     | 0.149 | 0.635 | 0.382 | 0.244 | 0.588 | 0.769 | 0.661 | 0.095 |
| M5     | 0.298 | 0.822 | 0.650 | 0.180 | 0.287 | 0.597 | 0.395 | 0.138 |
| M6     | 0.090 | 0.406 | 0.270 | 0.163 | 0.416 | 0.744 | 0.569 | 0.165 |
| M7     | 0.433 | 0.612 | 0.523 | 0.073 | 0.393 | 0.900 | 0.639 | 0.256 |
| M8     | 0.211 | 0.323 | 0.264 | 0.057 | 0     | 0.847 | 0.512 | 0.410 |
| M9     | 0.005 | 0.922 | 0.400 | 0.390 | 0.240 | 0.525 | 0.407 | 0.162 |
| M10    | 0.284 | 0.641 | 0.479 | 0.128 | 0.328 | 0.914 | 0.645 | 0.217 |
| M11    | 0.242 | 0.741 | 0.545 | 0.158 | 0.110 | 0.698 | 0.555 | 0.169 |
| M12    | 0.330 | 0.572 | 0.451 | 0.171 | 0.451 | 0.742 | 0.597 | 0.206 |
| M13    | 0.478 | 0.992 | 0.647 | 0.242 | 0.407 | 0.841 | 0.694 | 0.198 |
| M14    | 0.578 | 0.807 | 0.718 | 0.115 | 0.494 | 0.603 | 0.537 | 0.043 |
| M15    | 0.483 | 0.865 | 0.652 | 0.152 | 0.244 | 0.644 | 0.358 | 0.165 |
| M16    | 0.486 | 0.839 | 0.661 | 0.130 | 0.177 | 0.908 | 0.581 | 0.223 |
| M17    | 0.415 | 1     | 0.679 | 0.296 | 0.257 | 0.364 | 0.328 | 0.062 |
| M18    | 0.285 | 0.444 | 0.375 | 0.062 | 0.261 | 0.764 | 0.479 | 0.174 |
| M19    | 0.437 | 0.694 | 0.555 | 0.130 | 0.329 | 0.502 | 0.437 | 0.094 |
| M20    | 0.125 | 0.445 | 0.240 | 0.178 | 0.511 | 0.915 | 0.701 | 0.203 |

142 Table S7 Individual range of normalized color variables LUM\_R and LUM\_B with min – lowest value, max – highest value, mean –  
 143 average and SD – standard deviation

|        | LUM_R |       |       |       | LUM_B |       |       |       | 144 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| maleID | min   | max   | mean  | SD    | min   | max   | mean  | SD    |     |
| M1     | 0.032 | 0.424 | 0.163 | 0.159 | 0.190 | 0.508 | 0.330 | 0.144 |     |
| M2     | 0.029 | 0.178 | 0.126 | 0.058 | 0.288 | 0.647 | 0.442 | 0.148 | 145 |
| M3     | 0.048 | 1     | 0.496 | 0.337 | 0     | 0.497 | 0.306 | 0.183 |     |
| M4     | 0.020 | 0.282 | 0.154 | 0.131 | 0.241 | 0.341 | 0.293 | 0.050 | 146 |
| M5     | 0.060 | 0.465 | 0.184 | 0.143 | 0.236 | 0.802 | 0.517 | 0.202 |     |
| M6     | 0     | 0.955 | 0.363 | 0.517 | 0.249 | 0.512 | 0.344 | 0.146 | 147 |
| M7     | 0.122 | 0.271 | 0.200 | 0.079 | 0.279 | 0.368 | 0.315 | 0.041 |     |
| M8     | 0.190 | 0.412 | 0.293 | 0.112 | 0.230 | 0.644 | 0.455 | 0.180 |     |
| M9     | 0.116 | 0.642 | 0.348 | 0.246 | 0.409 | 1     | 0.644 | 0.254 | 148 |
| M10    | 0.025 | 0.439 | 0.274 | 0.178 | 0.176 | 0.623 | 0.343 | 0.175 |     |
| M11    | 0.083 | 0.583 | 0.297 | 0.185 | 0.222 | 0.624 | 0.391 | 0.139 | 149 |
| M12    | 0.131 | 0.419 | 0.275 | 0.204 | 0.267 | 0.492 | 0.380 | 0.159 |     |
| M13    | 0.015 | 0.088 | 0.047 | 0.030 | 0.226 | 0.444 | 0.288 | 0.105 | 150 |
| M14    | 0.010 | 0.128 | 0.063 | 0.051 | 0.213 | 0.609 | 0.354 | 0.163 |     |
| M15    | 0.044 | 0.417 | 0.189 | 0.147 | 0.349 | 0.580 | 0.438 | 0.089 | 151 |
| M16    | 0.023 | 0.382 | 0.210 | 0.129 | 0.078 | 0.434 | 0.308 | 0.119 |     |
| M17    | 0.032 | 0.305 | 0.125 | 0.155 | 0.178 | 0.380 | 0.304 | 0.110 |     |
| M18    | 0.156 | 0.545 | 0.304 | 0.139 | 0.346 | 0.637 | 0.477 | 0.105 | 152 |
| M19    | 0.066 | 0.175 | 0.112 | 0.057 | 0.452 | 0.629 | 0.567 | 0.099 |     |
| M20    | 0.264 | 0.475 | 0.351 | 0.111 | 0.267 | 0.276 | 0.272 | 0.004 | 153 |

154 Table S8 Individual range of normalized color variables CONTRAST\_RW, CONTRAST\_RB and CONTRAST\_WB with min – lowest  
 155 value, max – highest value, mean – average and SD – standard deviation

|            | CONTRAST_RW |       |       |       | CONTRAST_RB |       |       |       | CONTRAST_WB <sup>156</sup> |       |       |       |
|------------|-------------|-------|-------|-------|-------------|-------|-------|-------|----------------------------|-------|-------|-------|
| maleID     | min         | max   | mean  | SD    | min         | max   | mean  | SD    | min                        | max   | mean  | SD    |
| <b>M1</b>  | 0.175       | 0.649 | 0.464 | 0.187 | 0.052       | 0.408 | 0.281 | 0.152 | 0.239                      | 0.449 | 0.293 | 0.088 |
| <b>M2</b>  | 0.216       | 0.883 | 0.379 | 0.284 | 0.255       | 0.844 | 0.405 | 0.253 | 0.160                      | 0.941 | 0.401 | 0.308 |
| <b>M3</b>  | 0.043       | 0.743 | 0.396 | 0.211 | 0           | 1     | 0.475 | 0.329 | 0.060                      | 1     | 0.510 | 0.293 |
| <b>M4</b>  | 0.207       | 0.925 | 0.647 | 0.385 | 0.272       | 0.543 | 0.385 | 0.141 | 0                          | 0.435 | 0.246 | 0.523 |
| <b>M5</b>  | 0.150       | 0.646 | 0.378 | 0.146 | 0.164       | 0.829 | 0.408 | 0.240 | 0.175                      | 0.972 | 0.420 | 0.283 |
| <b>M6</b>  | 0.050       | 0.543 | 0.277 | 0.249 | 0.212       | 0.580 | 0.372 | 0.189 | 0.173                      | 0.578 | 0.353 | 0.207 |
| <b>M7</b>  | 0.144       | 0.710 | 0.401 | 0.235 | 0.225       | 0.569 | 0.413 | 0.171 | 0.247                      | 0.449 | 0.345 | 0.087 |
| <b>M8</b>  | 0.223       | 0.283 | 0.255 | 0.030 | 0.080       | 0.410 | 0.283 | 0.178 | 0.049                      | 0.416 | 0.271 | 0.195 |
| <b>M9</b>  | 0.275       | 0.661 | 0.486 | 0.161 | 0.244       | 0.572 | 0.399 | 0.150 | 0.371                      | 0.596 | 0.484 | 0.096 |
| <b>M10</b> | 0           | 0.712 | 0.382 | 0.293 | 0.067       | 0.720 | 0.486 | 0.249 | 0.131                      | 0.632 | 0.383 | 0.209 |
| <b>M11</b> | 0.238       | 0.975 | 0.520 | 0.260 | 0.140       | 0.687 | 0.478 | 0.153 | 0.251                      | 0.652 | 0.423 | 0.115 |
| <b>M12</b> | 0.018       | 0.688 | 0.353 | 0.474 | 0.184       | 0.781 | 0.483 | 0.422 | 0.252                      | 0.579 | 0.416 | 0.231 |
| <b>M13</b> | 0.061       | 1     | 0.429 | 0.423 | 0.255       | 0.451 | 0.361 | 0.084 | 0.141                      | 0.506 | 0.380 | 0.164 |
| <b>M14</b> | 0.109       | 0.274 | 0.216 | 0.066 | 0.168       | 0.669 | 0.351 | 0.202 | 0.193                      | 0.742 | 0.450 | 0.199 |
| <b>M15</b> | 0.114       | 0.672 | 0.400 | 0.233 | 0.161       | 0.492 | 0.296 | 0.122 | 0.117                      | 0.368 | 0.216 | 0.100 |
| <b>M16</b> | 0.196       | 0.530 | 0.326 | 0.132 | 0.104       | 0.628 | 0.401 | 0.231 | 0.103                      | 0.718 | 0.407 | 0.236 |
| <b>M17</b> | 0.104       | 0.254 | 0.191 | 0.078 | 0.101       | 0.221 | 0.179 | 0.068 | 0.134                      | 0.212 | 0.182 | 0.042 |
| <b>M18</b> | 0.142       | 0.490 | 0.263 | 0.131 | 0.180       | 0.870 | 0.481 | 0.241 | 0.234                      | 0.867 | 0.499 | 0.235 |
| <b>M19</b> | 0.216       | 0.579 | 0.344 | 0.203 | 0.350       | 0.539 | 0.430 | 0.097 | 0.489                      | 0.583 | 0.527 | 0.049 |
| <b>M20</b> | 0.143       | 0.513 | 0.302 | 0.191 | 0.336       | 0.599 | 0.448 | 0.136 | 0.330                      | 0.472 | 0.408 | 0.072 |

Table S9 Full-null model comparisons of inter-individual differences models (LMMs) for the full data sets and the data subsets. N – number of data points (recording days),  $\chi^2$  – Chi-square test value, df – degrees of freedom, p – p-value, at – autocorrelation term included (yes/no),  $R^2_{\text{mar}}$  – marginal  $R^2$  value for the fixed effects,  $R^2_{\text{con}}$  – conditional  $R^2$  value for the whole model

| <b>full data</b>   |                 |          |                            |           |          |           |                                      |                                      |
|--------------------|-----------------|----------|----------------------------|-----------|----------|-----------|--------------------------------------|--------------------------------------|
| <b>set</b>         | <b>response</b> | <b>N</b> | <b><math>\chi^2</math></b> | <b>df</b> | <b>p</b> | <b>at</b> | <b><math>R^2_{\text{mar}}</math></b> | <b><math>R^2_{\text{con}}</math></b> |
|                    | RED             | 93       | 3.023                      | 5         | 0.697    | no        | 0.133                                | 0.538                                |
|                    | BLUE            | 95       | 3.260                      | 5         | 0.660    | no        | 0.049                                | 0.249                                |
|                    | LUM_R           | 93       | 3.250                      | 5         | 0.662    | yes       | 0.091                                | 0.272                                |
|                    | LUM_B           | 95       | 6.711                      | 5         | 0.243    | no        | 0.111                                | 0.295                                |
|                    | CONTRAST_RW     | 92       | 6.909                      | 5         | 0.228    | no        | 0.088                                | 0.097                                |
|                    | CONTRAST_RB     | 93       | 5.614                      | 5         | 0.346    | no        | 0.082                                | 0.187                                |
|                    | CONTRAST_WB     | 92       | 3.832                      | 5         | 0.574    | no        | 0.094                                | 0.243                                |
| <b>data subset</b> |                 |          |                            |           |          |           |                                      |                                      |
| <b>subset</b>      | RED             | 77       | 5.512                      | 4         | 0.239    | no        | 0.157                                | 0.542                                |
|                    | BLUE            | 78       | 5.422                      | 4         | 0.247    | no        | 0.195                                | 0.302                                |
|                    | LUM_R           | 77       | 1.912                      | 4         | 0.752    | yes       | 0.126                                | 0.294                                |
|                    | LUM_B           | 78       | 3.931                      | 4         | 0.416    | no        | 0.135                                | 0.405                                |
|                    | CONTRAST_RW     | 76       | 0.729                      | 4         | 0.948    | no        | 0.088                                | 0.125                                |
|                    | CONTRAST_RB     | 77       | 4.544                      | 4         | 0.337    | no        | 0.096                                | 0.096                                |
|                    | CONTRAST_WB     | 76       | 3.190                      | 4         | 0.527    | no        | 0.103                                | 0.304                                |

Table 10 Full-null model comparisons of intra-individual variation models (LMMs) for the full data sets and the data subsets. N – number of data points (recording days),  $\chi^2$  – Chi-square test value, df – degrees of freedom, p – p-value, at – autocorrelation term included (yes/no),  $R^2_{\text{mar}}$  – marginal  $R^2$  value for the fixed effects,  $R^2_{\text{con}}$  – conditional  $R^2$  value for the whole model

| set         | full data   |    |          |    |       |     |                    |                    |
|-------------|-------------|----|----------|----|-------|-----|--------------------|--------------------|
|             | response    | N  | $\chi^2$ | df | p     | at  | $R^2_{\text{mar}}$ | $R^2_{\text{con}}$ |
| full data   | RED         | 93 | 2.344    | 5  | 0.800 | no  | 0.158              | 0.220              |
|             | BLUE        | 95 | 2.378    | 5  | 0.795 | no  | 0.024              | 0.219              |
|             | LUM_R       | 93 | 0.733    | 5  | 0.981 | yes | 0.045              | 0.115              |
|             | LUM_B       | 95 | 3.721    | 5  | 0.590 | no  | 0.056              | 0.056              |
|             | CONTRAST_RW | 92 | 6.974    | 5  | 0.223 | no  | 0.107              | 0.107              |
|             | CONTRAST_RB | 93 | 6.712    | 5  | 0.243 | no  | 0.083              | 0.132              |
|             | CONTRAST_WB | 92 | 3.418    | 5  | 0.636 | no  | 0.081              | 0.155              |
|             |             |    |          |    |       |     |                    |                    |
| data subset | data        |    |          |    |       |     |                    |                    |
|             | RED         | 77 | 5.371    | 4  | 0.251 | no  | 0.236              | 0.236              |
|             | BLUE        | 78 | 1.242    | 4  | 0.871 | no  | 0.069              | 0.126              |
|             | LUM_R       | 77 | 3.525    | 4  | 0.474 | yes | 0.125              | 0.125              |
|             | LUM_B       | 78 | 3.360    | 4  | 0.499 | no  | 0.072              | 0.072              |
|             | CONTRAST_RW | 76 | 3.306    | 4  | 0.508 | no  | 0.122              | 0.122              |
|             | CONTRAST_RB | 77 | 1.866    | 4  | 0.760 | no  | 0.083              | 0.125              |
|             | CONTRAST_WB | 76 | 4.603    | 4  | 0.331 | no  | 0.122              | 0.158              |

177 Table S11 RED model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation models  
 178 (full data set)

| <b>response: RED</b>                                                   | <b>inter-individual</b> |           |                |            |            | <b>intra-individual</b> |           |                |            |            |
|------------------------------------------------------------------------|-------------------------|-----------|----------------|------------|------------|-------------------------|-----------|----------------|------------|------------|
|                                                                        | <b>estimate</b>         | <b>SE</b> | <b>t-value</b> | <b>ICI</b> | <b>uCI</b> | <b>estimate</b>         | <b>SE</b> | <b>t-value</b> | <b>ICI</b> | <b>uCI</b> |
| intercept                                                              | 0.217                   | 0.012     | 18.475         | 0.183      | 0.246      | -0.001                  | 0.004     | -0.131         | -0.012     | 0.008      |
| tenure <sup>(a)</sup>                                                  | 0.005                   | 0.008     | 0.596          | -0.013     | 0.023      | 0.004                   | 0.005     | 0.939          | -0.005     | 0.014      |
| age (young)                                                            | -0.012                  | 0.027     | -0.457         | -0.086     | 0.065      | 0.009                   | 0.010     | 0.878          | -0.012     | 0.034      |
| injury (yes)                                                           | -0.007                  | 0.015     | -0.497         | -0.049     | 0.041      | 0.000                   | 0.013     | -0.015         | -0.040     | 0.056      |
| dominance rank <sup>(b)</sup>                                          | 0.012                   | 0.009     | 1.352          | -0.007     | 0.030      | 0.002                   | 0.005     | 0.441          | -0.008     | 0.012      |
| group mating activity <sup>(c)</sup>                                   | 0.017                   | 0.005     | 3.059          | -0.001     | 0.029      | 0.018                   | 0.004     | 4.027          | 0.003      | 0.027      |
| autocorrelation                                                        | /                       | /         | /              | /          | /          | /                       | /         | /              | /          | /          |
| dominance rank <sup>(b)</sup> *group<br>mating activity <sup>(c)</sup> | -0.004                  | 0.005     | -0.879         | -0.016     | 0.007      | -0.004                  | 0.004     | -1.027         | -0.014     | 0.005      |

179  
 180 Reference levels of categorical factors are ‘prime’ (age) and ‘no’ (injury). Estimate - estimated coefficients for the predictors with estimates  
 181 for categorical factors representing effects relative to reference level, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%),  
 182 uCI - upper CI (97.5%), \* between predictor terms indicating an included interaction. <sup>(a)</sup> inter-individual: log-transformed and z-transformed,  
 183 intra-individual: square root-transformed and z-transformed, original mean±SD = 605.719±637.924; <sup>(b)</sup> z-transformed, original  
 184 mean±SD = 0.495±0.327; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.058±0.056

185 Table S12 BLUE model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation models  
 186 (full data set)

| response: BLUE                                                         | inter-individual |       |         |        |       | intra-individual |       |         |        |       |
|------------------------------------------------------------------------|------------------|-------|---------|--------|-------|------------------|-------|---------|--------|-------|
|                                                                        | estimate         | SE    | t-value | ICI    | uCI   | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                              | 0.151            | 0.007 | 21.069  | 0.134  | 0.169 | 0.002            | 0.006 | 0.284   | -0.012 | 0.015 |
| tenure <sup>(a)</sup>                                                  | -0.008           | 0.008 | -0.961  | -0.025 | 0.013 | 0.000            | 0.007 | 0.014   | -0.014 | 0.014 |
| age (young)                                                            | -0.016           | 0.016 | -1.017  | -0.051 | 0.027 | 0.004            | 0.014 | 0.284   | -0.026 | 0.035 |
| injury (yes)                                                           | 0.012            | 0.028 | 0.431   | -0.056 | 0.088 | 0.004            | 0.024 | 0.167   | -0.061 | 0.071 |
| dominance rank <sup>(b)</sup>                                          | -0.008           | 0.008 | -0.989  | -0.030 | 0.014 | 0.006            | 0.007 | 0.930   | -0.010 | 0.021 |
| group mating activity <sup>(c)</sup>                                   | 0.003            | 0.009 | 0.332   | -0.030 | 0.030 | 0.002            | 0.006 | 0.302   | -0.014 | 0.016 |
| autocorrelation                                                        | /                | /     | /       | /      | /     | /                | /     | /       | /      | /     |
| dominance rank <sup>(b)</sup> *group<br>mating activity <sup>(c)</sup> | -0.007           | 0.006 | -1.087  | -0.022 | 0.007 | -0.007           | 0.005 | -1.334  | -0.020 | 0.004 |

187  
 188 Reference levels of categorical factors are ‘prime’ (age) and ‘no’ (injury). Estimate - estimated coefficients for the predictors with estimates  
 189 for categorical factors representing effects relative to reference level, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%),  
 190 uCI - upper CI (97.5%), \* between predictor terms indicating an included interaction. <sup>(a)</sup> inter-individual: log-transformed and z-transformed,  
 191 intra-individual: square root-transformed and z-transformed, original mean±SD = 605.719±637.924; <sup>(b)</sup> z-transformed, original  
 192 mean±SD = 0.495±0.327; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.058±0.056

193 Table S13 LUM\_R model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation  
 194 models (full data set)

| response: LUM_R                                                        | inter-individual |       |         |        |        | intra-individual |       |         |        |       |
|------------------------------------------------------------------------|------------------|-------|---------|--------|--------|------------------|-------|---------|--------|-------|
|                                                                        | estimate         | SE    | t-value | ICI    | uCI    | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                              | -2.259           | 0.059 | -38.138 | -2.445 | -2.074 | 0.001            | 0.005 | 0.173   | -0.009 | 0.012 |
| tenure <sup>(a)</sup>                                                  | -0.035           | 0.058 | -0.614  | -0.156 | 0.143  | -0.001           | 0.006 | -0.261  | -0.013 | 0.011 |
| age (young)                                                            | 0.023            | 0.130 | 0.174   | -0.301 | 0.429  | -0.001           | 0.012 | -0.063  | -0.028 | 0.024 |
| injury (yes)                                                           | 0.165            | 0.130 | 1.270   | -0.122 | 0.645  | 0.005            | 0.016 | 0.299   | -0.029 | 0.050 |
| dominance rank <sup>(b)</sup>                                          | 0.046            | 0.059 | 0.777   | -0.088 | 0.191  | 0.001            | 0.006 | 0.098   | -0.011 | 0.012 |
| group mating activity <sup>(c)</sup>                                   | -0.112           | 0.046 | -2.466  | -0.210 | -0.101 | -0.009           | 0.005 | -1.823  | -0.020 | 0.002 |
| autocorrelation                                                        | 0.049            | 0.044 | 1.103   | -0.041 | 0.142  | 0.003            | 0.005 | 0.526   | -0.008 | 0.014 |
| dominance rank <sup>(b)</sup> *group<br>mating activity <sup>(c)</sup> | -0.039           | 0.039 | -1.001  | -0.121 | 0.047  | -0.003           | 0.004 | -0.730  | -0.012 | 0.008 |

195  
 196 Reference levels of categorical factors are ‘prime’ (age) and ‘no’ (injury). Estimate - estimated coefficients for the predictors with estimates  
 197 for categorical factors representing effects relative to reference level, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%),  
 198 uCI - upper CI (97.5%), \* between predictor terms indicating an included interaction. <sup>(a)</sup> inter-individual: log-transformed and z-transformed,  
 199 intra-individual: square root-transformed and z-transformed, original mean±SD = 605.719±637.924; <sup>(b)</sup> z-transformed, original  
 200 mean±SD = 0.495±0.327; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.058±0.056

Table S14 LUM\_B model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation models (full data set)

| response: LUM_B                                                     | inter-individual |       |         |        |       | intra-individual |       |         |        |       |
|---------------------------------------------------------------------|------------------|-------|---------|--------|-------|------------------|-------|---------|--------|-------|
|                                                                     | estimate         | SE    | t-value | ICI    | uCI   | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                           | 0.342            | 0.014 | 23.828  | 0.309  | 0.381 | 0.001            | 0.010 | 0.143   | -0.019 | 0.023 |
| tenure <sup>(a)</sup>                                               | -0.007           | 0.016 | -0.414  | -0.049 | 0.041 | -0.003           | 0.011 | -0.248  | -0.024 | 0.021 |
| age (young)                                                         | 0.045            | 0.032 | 1.394   | -0.048 | 0.126 | -0.009           | 0.023 | -0.372  | -0.054 | 0.037 |
| injury (yes)                                                        | 0.053            | 0.031 | 1.677   | -0.018 | 0.133 | 0.047            | 0.026 | 1.762   | -0.006 | 0.099 |
| dominance rank <sup>(b)</sup>                                       | 0.034            | 0.021 | 1.619   | -0.023 | 0.099 | 0.007            | 0.011 | 0.622   | -0.016 | 0.028 |
| group mating activity <sup>(c)</sup>                                | -0.015           | 0.012 | -1.258  | -0.041 | 0.013 | -0.016           | 0.010 | -1.544  | -0.037 | 0.005 |
| autocorrelation                                                     | /                | /     | /       | /      | /     | /                | /     | /       | /      | /     |
| dominance rank <sup>(b)</sup> *group mating activity <sup>(c)</sup> | -0.007           | 0.010 | -0.722  | -0.031 | 0.016 | -0.005           | 0.008 | -0.537  | -0.021 | 0.015 |

Reference levels of categorical factors are 'prime' (age) and 'no' (injury). Estimate - estimated coefficients for the predictors with estimates for categorical factors representing effects relative to reference level, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%), \* between predictor terms indicating an included interaction. <sup>(a)</sup> inter-individual: log-transformed and z-transformed, intra-individual: square root-transformed and z-transformed, original mean±SD = 605.719±637.924; <sup>(b)</sup> z-transformed, original mean±SD = 0.495±0.327; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.058±0.056

209 Table S15 CONTRAST\_RW model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual  
 210 variation models (full data set)

| response:<br>CONTRAST_RW                                                | inter-individual |       |         |        |        | intra-individual |       |         |        |        |
|-------------------------------------------------------------------------|------------------|-------|---------|--------|--------|------------------|-------|---------|--------|--------|
|                                                                         | estimate         | SE    | t-value | ICI    | uCI    | estimate         | SE    | t-value | ICI    | uCI    |
| intercept                                                               | -3.030           | 0.045 | -66.987 | -3.140 | -2.936 | 0.000            | 0.002 | 0.104   | -0.004 | 0.004  |
| tenure <sup>(a)</sup>                                                   | -0.009           | 0.049 | -0.189  | -0.130 | 0.097  | -0.003           | 0.002 | -1.116  | -0.007 | 0.004  |
| age (young)                                                             | -0.080           | 0.103 | -0.769  | -0.298 | 0.168  | -0.002           | 0.005 | -0.337  | -0.015 | 0.012  |
| injury (yes)                                                            | 0.139            | 0.147 | 0.943   | -0.207 | 0.783  | 0.006            | 0.006 | 1.063   | -0.005 | 0.034  |
| dominance rank <sup>(b)</sup>                                           | 0.066            | 0.050 | 1.334   | -0.047 | 0.197  | 0.002            | 0.002 | 0.769   | -0.003 | 0.007  |
| group mating activity <sup>(c)</sup>                                    | 0.013            | 0.047 | 0.283   | -0.089 | 0.121  | 0.002            | 0.002 | 0.998   | -0.002 | 0.007  |
| autocorrelation                                                         | /                | /     | /       | /      | /      | /                | /     | /       | /      | /      |
| dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup> | -0.092           | 0.040 | -2.318  | -0.181 | -0.005 | -0.005           | 0.002 | -2.609  | -0.008 | -0.001 |

211  
 212 Reference levels of categorical factors are ‘prime’ (age) and ‘no’ (injury). Estimate - estimated coefficients for the predictors with estimates  
 213 for categorical factors representing effects relative to reference level, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%),  
 214 uCI - upper CI (97.5%), \* between predictor terms indicating an included interaction. <sup>(a)</sup> inter-individual: log-transformed and z-transformed,  
 215 intra-individual: square root-transformed and z-transformed, original mean±SD = 605.719±637.924; <sup>(b)</sup> z-transformed, original  
 216 mean±SD = 0.495±0.327; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.058±0.056

Table S16 CONTRAST\_RB model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation models (full data set)

| response:<br>CONTRAST_RB                                               | inter-individual |       |         |        |       | intra-individual |       |         |        |       |
|------------------------------------------------------------------------|------------------|-------|---------|--------|-------|------------------|-------|---------|--------|-------|
|                                                                        | estimate         | SE    | t-value | ICI    | uCI   | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                              | 0.149            | 0.006 | 25.599  | 0.137  | 0.162 | 0.001            | 0.005 | 0.216   | -0.011 | 0.013 |
| tenure <sup>(a)</sup>                                                  | -0.002           | 0.006 | -0.366  | -0.015 | 0.012 | -0.001           | 0.006 | -0.130  | -0.013 | 0.013 |
| age (young)                                                            | -0.007           | 0.014 | -0.548  | -0.042 | 0.025 | -0.002           | 0.013 | -0.135  | -0.034 | 0.028 |
| injury (yes)                                                           | 0.036            | 0.018 | 1.950   | -0.006 | 0.040 | 0.030            | 0.016 | 1.825   | -0.006 | 0.034 |
| dominance rank <sup>(b)</sup>                                          | 0.006            | 0.009 | 0.614   | -0.019 | 0.031 | 0.008            | 0.006 | 1.165   | -0.010 | 0.009 |
| group mating activity <sup>(c)</sup>                                   | -0.001           | 0.007 | -0.164  | -0.023 | 0.018 | -0.002           | 0.006 | -0.414  | -0.016 | 0.009 |
| autocorrelation                                                        | /                | /     | /       | /      | /     | /                | /     | /       | /      | /     |
| dominance rank <sup>(b)</sup> *group<br>mating activity <sup>(c)</sup> | -0.008           | 0.005 | -1.477  | -0.020 | 0.004 | -0.008           | 0.005 | -1.698  | -0.021 | 0.002 |

Reference levels of categorical factors are ‘prime’ (age) and ‘no’ (injury). Estimate - estimated coefficients for the predictors with estimates for categorical factors representing effects relative to reference level, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%), \* between predictor terms indicating an included interaction. <sup>(a)</sup> inter-individual: log-transformed and z-transformed, intra-individual: square root-transformed and z-transformed, original mean±SD = 605.719±637.924; <sup>(b)</sup> z-transformed, original mean±SD = 0.495±0.327; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.058±0.056

Table S17 CONTRAST\_WB model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation models (full data set)

| response:<br>CONTRAST_WB                                               | inter-individual |       |         |        |       | intra-individual |       |         |        |       |
|------------------------------------------------------------------------|------------------|-------|---------|--------|-------|------------------|-------|---------|--------|-------|
|                                                                        | estimate         | SE    | t-value | ICI    | uCI   | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                              | 0.346            | 0.009 | 38.900  | 0.324  | 0.370 | 0.002            | 0.005 | 0.284   | -0.010 | 0.014 |
| tenure <sup>(a)</sup>                                                  | -0.002           | 0.010 | -0.192  | -0.024 | 0.022 | 0.001            | 0.006 | 0.085   | -0.013 | 0.013 |
| age (young)                                                            | 0.022            | 0.020 | 1.099   | -0.050 | 0.076 | -0.002           | 0.013 | -0.135  | -0.033 | 0.026 |
| injury (yes)                                                           | 0.031            | 0.026 | 1.179   | -0.040 | 0.091 | 0.028            | 0.018 | 1.600   | -0.013 | 0.067 |
| dominance rank <sup>(b)</sup>                                          | 0.020            | 0.012 | 1.597   | -0.017 | 0.063 | 0.007            | 0.006 | 1.083   | -0.011 | 0.024 |
| group mating activity <sup>(c)</sup>                                   | -0.019           | 0.018 | -1.083  | -0.075 | 0.033 | -0.011           | 0.006 | -1.991  | -0.026 | 0.003 |
| autocorrelation                                                        | /                | /     | /       | /      | /     | /                | /     | /       | /      | /     |
| dominance rank <sup>(b)</sup> *group<br>mating activity <sup>(c)</sup> | 0.003            | 0.008 | 0.318   | -0.020 | 0.032 | -0.002           | 0.005 | -0.363  | -0.017 | 0.010 |

Reference levels of categorical factors are 'prime' (age) and 'no' (injury). Estimate - estimated coefficients for the predictors with estimates for categorical factors representing effects relative to reference level, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%), \* between predictor terms indicating an included interaction. <sup>(a)</sup> inter-individual: log-transformed and z-transformed, intra-individual: square root-transformed and z-transformed, original mean±SD = 605.719±637.924; <sup>(b)</sup> z-transformed, original mean±SD = 0.495±0.327; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.058±0.056

233 Table S18 RED model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation models  
 234 (reduced data set)

| response: RED                                                                                       | inter-individual |       |         |        |       | intra-individual |       |         |        |       |
|-----------------------------------------------------------------------------------------------------|------------------|-------|---------|--------|-------|------------------|-------|---------|--------|-------|
|                                                                                                     | estimate         | SE    | t-value | ICI    | uCI   | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                                                           | 0.228            | 0.012 | 18.616  | 0.194  | 0.257 | 0.001            | 0.005 | 0.139   | -0.009 | 0.010 |
| mean fGCM <sup>(a)</sup>                                                                            | -0.004           | 0.007 | -0.601  | -0.022 | 0.011 | -0.002           | 0.005 | -0.383  | -0.017 | 0.010 |
| dominance rank <sup>(b)</sup>                                                                       | 0.009            | 0.009 | 0.947   | -0.011 | 0.028 | 0.004            | 0.005 | 0.733   | -0.007 | 0.014 |
| group mating activity <sup>(c)</sup>                                                                | 0.019            | 0.007 | 2.680   | 0.004  | 0.035 | 0.018            | 0.005 | 3.299   | 0.006  | 0.029 |
| autocorrelation term                                                                                | /                | /     | /       | /      | /     | /                | /     | /       | /      | /     |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup>                                         | -0.011           | 0.006 | -1.771  | -0.025 | 0.002 | -0.009           | 0.005 | -1.828  | -0.022 | 0.001 |
| mean fGCM <sup>(a)</sup> * group<br>mating activity <sup>(c)</sup>                                  | 0.002            | 0.005 | 0.420   | -0.009 | 0.015 | -0.001           | 0.004 | -0.233  | -0.010 | 0.008 |
| dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup>                             | 0.004            | 0.006 | 0.619   | -0.010 | 0.017 | 0.003            | 0.005 | 0.584   | -0.008 | 0.013 |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup> group<br>mating activity <sup>(c)</sup> | -0.004           | 0.004 | -0.913  | -0.013 | 0.005 | -0.004           | 0.004 | -1.080  | -0.011 | 0.003 |

235  
 236 Estimate - estimated coefficients for the predictors, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%),  
 237 \* between predictor terms indicating an included interaction. <sup>(a)</sup> log-transformed and z-transformed, original mean±SD = 47.289±45.115;  
 238 <sup>(b)</sup> z-transformed, original mean±SD = 0.551±0.316; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.060±0.059

239 Table S19 BLUE model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation models  
 240 (reduced data set)

| response: BLUE                                                                                        | inter-individual |       |         |        |        | intra-individual |       |         |        |       |
|-------------------------------------------------------------------------------------------------------|------------------|-------|---------|--------|--------|------------------|-------|---------|--------|-------|
|                                                                                                       | estimate         | SE    | t-value | ICI    | uCI    | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                                                             | 0.155            | 0.008 | 19.341  | 0.136  | 0.176  | 0.005            | 0.006 | 0.828   | -0.008 | 0.018 |
| mean fGCM <sup>(a)</sup>                                                                              | 0.016            | 0.008 | 1.984   | -0.005 | 0.032  | 0.001            | 0.010 | 0.049   | -0.032 | 0.027 |
| dominance rank <sup>(b)</sup>                                                                         | -0.008           | 0.011 | -0.754  | -0.033 | 0.018  | 0.004            | 0.006 | 0.661   | -0.010 | 0.021 |
| group mating activity <sup>(c)</sup>                                                                  | 0.008            | 0.008 | 1.036   | -0.012 | 0.026  | 0.005            | 0.007 | 0.764   | -0.010 | 0.019 |
| autocorrelation term                                                                                  | /                | /     | /       | /      | /      | /                | /     | /       | /      | /     |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup>                                           | -0.008           | 0.008 | -1.049  | -0.026 | 0.010  | -0.002           | 0.007 | -0.328  | -0.020 | 0.015 |
| mean fGCM <sup>(a)</sup> * group<br>mating activity <sup>(c)</sup>                                    | -0.012           | 0.007 | -1.808  | -0.026 | 0.001  | -0.005           | 0.006 | -0.813  | -0.017 | 0.007 |
| dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup>                               | -0.017           | 0.007 | -2.320  | -0.034 | -0.002 | -0.012           | 0.006 | -1.923  | -0.025 | 0.001 |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup> | 0.003            | 0.005 | 0.641   | -0.009 | 0.016  | 0.003            | 0.005 | 0.690   | -0.006 | 0.013 |

241  
 242 Estimate - estimated coefficients for the predictors, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%),  
 243 \* between predictor terms indicating an included interaction. <sup>(a)</sup> log-transformed and z-transformed, original mean±SD = 47.289±45.115;  
 244 <sup>(b)</sup> z-transformed, original mean±SD = 0.551±0.316; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.060±0.059

245 Table S20 LUM\_R model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation  
 246 models (reduced data set)

| response: LUM_R                                                                                       | inter-individual |       |         |        |        | intra-individual |       |         |        |       |
|-------------------------------------------------------------------------------------------------------|------------------|-------|---------|--------|--------|------------------|-------|---------|--------|-------|
|                                                                                                       | estimate         | SE    | t-value | ICI    | uCI    | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                                                             | -2.295           | 0.064 | -35.878 | -2.454 | -2.100 | 0.000            | 0.005 | 0.073   | -0.009 | 0.009 |
| mean fGCM <sup>(a)</sup>                                                                              | 0.032            | 0.052 | 0.612   | -0.077 | 0.160  | 0.006            | 0.005 | 1.247   | -0.004 | 0.016 |
| dominance rank <sup>(b)</sup>                                                                         | 0.058            | 0.060 | 0.968   | -0.072 | 0.213  | 0.002            | 0.005 | 0.347   | -0.008 | 0.011 |
| group mating activity <sup>(c)</sup>                                                                  | -0.113           | 0.054 | -2.102  | -0.254 | 0.013  | -0.010           | 0.005 | -2.050  | -0.021 | 0.000 |
| autocorrelation term                                                                                  | 0.034            | 0.043 | 0.777   | 0.023  | 0.127  | 0.002            | 0.004 | 0.344   | -0.007 | 0.010 |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup>                                           | 0.034            | 0.049 | 0.688   | -0.021 | 0.071  | 0.006            | 0.005 | 1.265   | -0.005 | 0.016 |
| mean fGCM <sup>(a)</sup> * group<br>mating activity <sup>(c)</sup>                                    | -0.011           | 0.041 | -0.264  | -0.032 | 0.022  | 0.001            | 0.004 | 0.250   | -0.008 | 0.010 |
| dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup>                               | -0.082           | 0.049 | -1.657  | -0.102 | -0.026 | -0.009           | 0.005 | -1.889  | -0.019 | 0.001 |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup> | 0.024            | 0.034 | 0.716   | 0.007  | 0.067  | 0.002            | 0.003 | 0.552   | -0.005 | 0.008 |

247  
 248 Estimate - estimated coefficients for the predictors, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%),  
 249 \* between predictor terms indicating an included interaction. <sup>(a)</sup> log-transformed and z-transformed, original mean±SD = 47.289±45.115;  
 250 <sup>(b)</sup> z-transformed, original mean±SD = 0.551±0.316; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.060±0.059

251 Table S21 LUM\_B model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation  
 252 models (reduced data set)

| response: LUM_B                                                                                       | inter-individual |       |         |        |        | intra-individual |       |         |        |       |
|-------------------------------------------------------------------------------------------------------|------------------|-------|---------|--------|--------|------------------|-------|---------|--------|-------|
|                                                                                                       | estimate         | SE    | t-value | ICI    | uCI    | estimate         | SE    | t-value | ICI    | uCI   |
| intercept                                                                                             | -1.118           | 0.037 | -29.839 | -1.202 | -1.018 | 0.006            | 0.011 | 0.532   | -0.017 | 0.028 |
| mean fGCM <sup>(a)</sup>                                                                              | -0.061           | 0.038 | -1.589  | -0.159 | 0.057  | 0.002            | 0.012 | 0.184   | -0.027 | 0.025 |
| dominance rank <sup>(b)</sup>                                                                         | 0.089            | 0.087 | 1.032   | -0.152 | 0.351  | 0.008            | 0.012 | 0.692   | -0.015 | 0.034 |
| group mating activity <sup>(c)</sup>                                                                  | 0.013            | 0.047 | 0.281   | -0.116 | 0.026  | -0.012           | 0.012 | -0.998  | -0.041 | 0.012 |
| autocorrelation term                                                                                  | /                | /     | /       | /      | /      | /                | /     | /       | /      | /     |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup>                                           | 0.033            | 0.037 | 0.893   | -0.046 | 0.140  | 0.017            | 0.011 | 1.483   | -0.005 | 0.041 |
| mean fGCM <sup>(a)</sup> * group<br>mating activity <sup>(c)</sup>                                    | -0.040           | 0.043 | -0.936  | -0.167 | 0.064  | -0.011           | 0.010 | -1.121  | -0.032 | 0.009 |
| dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup>                               | -0.062           | 0.054 | -1.158  | -0.177 | 0.073  | -0.009           | 0.011 | -0.844  | -0.033 | 0.012 |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup> | -0.008           | 0.036 | -0.234  | -0.102 | 0.068  | -0.008           | 0.008 | -0.925  | -0.024 | 0.009 |

253  
 254 Estimate - estimated coefficients for the predictors, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%),  
 255 \* between predictor terms indicating an included interaction. <sup>(a)</sup> log-transformed and z-transformed, original mean±SD = 47.289±45.115;  
 256 <sup>(b)</sup> z-transformed, original mean±SD = 0.551±0.316; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.060±0.059

257 Table S22 CONTRAST\_RW model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual  
 258 variation models (reduced data set)

| <b>response:<br/>CONTRAST_RW</b>                                                                      | <b>inter-individual</b> |           |                |            |            | <b>intra-individual</b> |           |                |            |            |
|-------------------------------------------------------------------------------------------------------|-------------------------|-----------|----------------|------------|------------|-------------------------|-----------|----------------|------------|------------|
|                                                                                                       | <b>estimate</b>         | <b>SE</b> | <b>t-value</b> | <b>ICI</b> | <b>uCI</b> | <b>estimate</b>         | <b>SE</b> | <b>t-value</b> | <b>ICI</b> | <b>uCI</b> |
| intercept                                                                                             | -3.037                  | 0.057     | -52.883        | -3.184     | -2.914     | -0.001                  | 0.002     | -0.207         | -0.005     | 0.005      |
| mean fGCM <sup>(a)</sup>                                                                              | 0.012                   | 0.065     | 0.184          | -0.120     | 0.158      | 0.002                   | 0.003     | 0.727          | -0.004     | 0.008      |
| dominance rank <sup>(b)</sup>                                                                         | 0.074                   | 0.060     | 1.222          | -0.048     | 0.223      | 0.002                   | 0.003     | 0.946          | -0.003     | 0.008      |
| group mating activity <sup>(c)</sup>                                                                  | -0.008                  | 0.061     | -0.130         | -0.137     | 0.007      | 0.000                   | 0.003     | -0.121         | -0.006     | 0.005      |
| autocorrelation term                                                                                  | /                       | /         | /              | /          | /          | /                       | /         | /              | /          | /          |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup>                                           | -0.018                  | 0.067     | -0.272         | -0.158     | 0.122      | 0.002                   | 0.003     | 0.721          | -0.004     | 0.008      |
| mean fGCM <sup>(a)</sup> * group<br>mating activity <sup>(c)</sup>                                    | 0.021                   | 0.047     | 0.448          | -0.090     | 0.116      | 0.002                   | 0.002     | 0.746          | -0.003     | 0.006      |
| dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup>                               | -0.076                  | 0.057     | -1.317         | -0.189     | 0.053      | -0.004                  | 0.003     | -1.439         | -0.009     | 0.001      |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup> | -0.020                  | 0.040     | -0.511         | -0.104     | 0.070      | -0.003                  | 0.002     | -1.427         | -0.006     | 0.001      |

259  
 260 Estimate - estimated coefficients for the predictors, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%),  
 261 \* between predictor terms indicating an included interaction. <sup>(a)</sup> log-transformed and z-transformed, original mean±SD = 47.289±45.115;  
 262 <sup>(b)</sup> z-transformed, original mean±SD = 0.551±0.316; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.060±0.059

263 Table S23 CONTRAST\_WB model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual  
 264 variation models (reduced data set)

| response:<br>CONTRAST_WB                                                                              | inter-individual |       |         |        |       | intra-individual |       |         |        |        |
|-------------------------------------------------------------------------------------------------------|------------------|-------|---------|--------|-------|------------------|-------|---------|--------|--------|
|                                                                                                       | estimate         | SE    | t-value | ICI    | uCI   | estimate         | SE    | t-value | ICI    | uCI    |
| intercept                                                                                             | 0.346            | 0.010 | 33.338  | 0.320  | 0.370 | 1.002            | 0.003 | 334.099 | 0.996  | 1.009  |
| mean fGCM <sup>(a)</sup>                                                                              | -0.003           | 0.012 | -0.270  | -0.030 | 0.023 | -0.003           | 0.005 | -0.579  | -0.019 | 0.010  |
| dominance rank <sup>(b)</sup>                                                                         | 0.023            | 0.017 | 1.351   | -0.023 | 0.075 | 0.003            | 0.003 | 0.936   | -0.004 | 0.014  |
| group mating activity <sup>(c)</sup>                                                                  | -0.004           | 0.020 | -0.186  | -0.062 | 0.001 | -0.001           | 0.003 | -0.204  | -0.010 | 0.006  |
| autocorrelation term                                                                                  | /                | /     | /       | /      | /     | /                | /     | /       | /      | /      |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup>                                           | 0.007            | 0.012 | 0.531   | -0.021 | 0.033 | 0.001            | 0.004 | 0.391   | -0.007 | 0.011  |
| mean fGCM <sup>(a)</sup> * group<br>mating activity <sup>(c)</sup>                                    | -0.015           | 0.010 | -1.491  | -0.043 | 0.007 | -0.005           | 0.003 | -1.907  | -0.005 | 0.001  |
| dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup>                               | -0.008           | 0.013 | -0.594  | -0.038 | 0.029 | -0.004           | 0.003 | -1.396  | -0.005 | -0.004 |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup> | -0.008           | 0.008 | -0.893  | -0.027 | 0.019 | 0.002            | 0.002 | 0.731   | -0.004 | 0.006  |

265  
 266 Estimate - estimated coefficients for the predictors, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%),  
 267 \* between predictor terms indicating an included interaction. <sup>(a)</sup> log-transformed and z-transformed, original mean±SD = 47.289±45.115;  
 268 <sup>(b)</sup> z-transformed, original mean±SD = 0.551±0.316; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.060±0.059

Table S24 CONTRAST\_RB model results and confidence intervals (CI, 95%) of the inter-individual differences and intra-individual variation models (reduced data set)

| <b>response:<br/>CONTRAST_RB</b>                                                                      | <b>inter-individual</b> |           |                |            |            | <b>intra-individual</b> |           |                |            |            |
|-------------------------------------------------------------------------------------------------------|-------------------------|-----------|----------------|------------|------------|-------------------------|-----------|----------------|------------|------------|
|                                                                                                       | <b>estimate</b>         | <b>SE</b> | <b>t-value</b> | <b>ICI</b> | <b>uCI</b> | <b>estimate</b>         | <b>SE</b> | <b>t-value</b> | <b>ICI</b> | <b>uCI</b> |
| intercept                                                                                             | 0.154                   | 0.007     | 23.312         | 0.140      | 0.170      | 0.005                   | 0.006     | 0.777          | -0.008     | 0.017      |
| mean fGCM <sup>(a)</sup>                                                                              | 0.004                   | 0.007     | 0.616          | -0.013     | 0.021      | 0.001                   | 0.009     | 0.088          | -0.026     | 0.024      |
| dominance rank <sup>(b)</sup>                                                                         | 0.000                   | 0.007     | -0.029         | -0.015     | 0.018      | 0.006                   | 0.006     | 0.986          | -0.007     | 0.023      |
| group mating activity <sup>(c)</sup>                                                                  | 0.007                   | 0.007     | 0.995          | -0.011     | 0.023      | 0.001                   | 0.007     | 0.193          | -0.014     | 0.015      |
| autocorrelation term                                                                                  | /                       | /         | /              | /          | /          | /                       | /         | /              | /          | /          |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup>                                           | -0.003                  | 0.007     | -0.476         | -0.016     | 0.011      | 0.002                   | 0.007     | 0.243          | -0.014     | 0.017      |
| mean fGCM <sup>(a)</sup> * group<br>mating activity <sup>(c)</sup>                                    | -0.012                  | 0.006     | -2.038         | -0.024     | 0.000      | -0.007                  | 0.006     | -1.321         | -0.019     | 0.005      |
| dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup>                               | -0.011                  | 0.007     | -1.644         | -0.026     | 0.003      | -0.013                  | 0.006     | -2.034         | -0.026     | 0.000      |
| mean fGCM <sup>(a)</sup> *<br>dominance rank <sup>(b)</sup> * group<br>mating activity <sup>(c)</sup> | 0.002                   | 0.005     | 0.458          | -0.007     | 0.012      | 0.001                   | 0.004     | 0.270          | -0.008     | 0.010      |

Estimate - estimated coefficients for the predictors, SE - standard error, t-value – test statistics, ICI - lower CI (2.5%), uCI - upper CI (97.5%),

\* between predictor terms indicating an included interaction. <sup>(a)</sup> log-transformed and z-transformed, original mean±SD = 47.289±45.115;

<sup>(b)</sup> z-transformed, original mean±SD = 0.551±0.316; <sup>(c)</sup> square root-transformed and z-transformed, original mean±SD = 0.060±0.059

**Supplemental figures**

Figure caption

**ESM2 - Fig. S1** RWB genital display with female social partner (standardized for lighting)

**ESM3- Fig. S2** Frequency of RWB genital display shown per context in relation to total frequency of context behavior (dominance, grooming, inter-troop encounter, mating, locomotion, foraging)

**ESM4- Fig. S3** Color value variation between six RWB genital display contexts. a) RED of perianal area, b) BLUE of scrotum, c) Luminance of red (LUM\_R), d) Luminance of blue (LUM\_B). Each circle indicates a RWB genital display event of one male

**ESM5 - Fig. S4** Color value variation between six RWB genital display contexts. a) CONTRAST\_RW, b) CONTRAST\_RB, c) CONTRAST\_WB. Each circle indicates a RWB genital display event of one male

**ESM6 - Fig. S5** Non-metric multidimensional scaling (NMDS) plot of color variable similarities between RWB genital display contexts. Each dot indicates a RWB genital display event of one male. Each RWB genital display context is represented by one color. Axes are non-dimensional

**ESM7 - Fig. S6** Absolute color value variation between and within males. a) RED of perianal area, b) BLUE of scrotum. RED and BLUE range from -1 to 1. The box indicates the 25th and 75th percentiles, the bars the minimum and maximum values, the bold line the median and the circles indicate outliers. Number of recording days per individual (N) is indicated in parenthesis, when more than one number of recording days is stated the first number is for figure a) and second for b)

**ESM8 - Fig. S7** Absolute color value variation between and within males. a) Luminance of red (LUM\_R), b) Luminance of blue (LUM\_B). LUM\_R and LUM\_B range from 0 to 1. The box indicates the 25th and 75th percentiles, the bars the minimum and maximum values, the bold line the median and the circles indicate outliers. Number of recording days per individual (N) is indicated in parenthesis, when more than one number of recording days is stated the first number is for figure a) and second for b)

**ESM9 - Fig. S8** Absolute color value variation between and within males. a) CONTRAST\_RW, b) CONTRAST\_RB, c) CONTRAST\_WB. CONTRAST\_RW, \_RB and \_WB range from 0 to infinity. The box indicates the 25th and 75th percentiles, the bars the minimum and maximum values, the bold line the median and the circles indicate outliers. Number of recording days per individual (N) is indicated in parenthesis, when more than one number of recording days is stated the first number is for figure a), second for b) and third for c)

**ESM10 - Fig. S9** Color variation of perianal area a) redder and b) less red; and color variation of the scrotum c) bluer and d) less blue. Photos are standardized for lighting

## References

- Barr DJ, Levy R, Scheepers C, Tily HJ. 2013. Random effects structure for confirmatory hypothesis testing: Keep it maximal. *J Mem Lang*. 68(3):255–278. doi:10.1016/j.jml.2012.11.001.
- Burnham KP, Anderson DR. 2002. *Model selection and multimodel inference: a practical information-theoretic approach*. New York: Springer US.
- Cheney DL, Seyfarth RM. 2009. Chapter 1 Stress and Coping Mechanisms in Female Primates. In: H. Jane Brockmann TJR, editor. *Advances in the Study of Behavior*. Vol. Volume 39. Academic Press. p. 1–44. [accessed 2013 Mar 4]. <http://www.sciencedirect.com/science/article/pii/S0065345409390014>.

- 324 Gesquiere LR, Learn NH, Simao MCM, Onyango PO, Alberts SC, Altmann J. 2011.  
325 Life at the top: rank and stress in wild male baboons. *Science*. 333(6040):357–  
326 360. doi:10.1126/science.1207120.
- 327 Kulik L, Amici F, Langos D, Widdig A. 2015. Sex differences in the development of  
328 social relationships in rhesus macaques (*Macaca mulatta*). *Int J Primatol*.  
329 36(2):353–376. doi:10.1007/s10764-015-9826-4.
- 330 R Core Team. 2015. A language and environment for statistical computing. Vienna,  
331 Austria: R Foundation for Statistical Computing,.
- 332 Sapolsky RM. 2005. The influence of social hierarchy on primate health. *Science*.  
333 308(5722):648–652. doi:10.1126/science.1106477.
- 334 Schielzeth H. 2010. Simple means to improve the interpretability of regression  
335 coefficients. *Methods Ecol Evol*. 1(2):103–113. doi:10.1111/j.2041-  
336 210X.2010.00012.x.
- 337 Schielzeth H, Forstmeier W. 2009. Conclusions beyond support: overconfident  
338 estimates in mixed models. *Behav Ecol*. 20(2):416–420.  
339 doi:10.1093/beheco/arn145.
- 340