Preparing for Battle? Potential Intergroup Conflict Promotes Current Intragroup Affiliation

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Supplementary Material

Study Species

In the study population of green woodhoopoes, 57% of groups have at least one nonbreeding helper in addition to the (putative) breeding pair (Radford & du Plessis 2004a). Helpers are related to one or both of the breeders in approximately 90% of cases; helping behaviour is unrelated to natal philopatry, kinship or prior association with breeders (du Plessis 1993). Adults can be sexed using clear-cut differences in bill length (Radford & du Plessis 2003) and vocalisations (Radford 2004). Dominance status can be established during foraging, when the dominant pair displace nonbreeding subordinate helpers (Radford & du Plessis 2003). Extra-pair paternity in the study population is likely to be very low, as no extra-pair young were identified in the breeding attempts of 16 groups (M.A. du Plessis unpub. data).

Intergroup conflicts arise when one group trespasses into the territory of another or when members of two groups meet along a common territory boundary. During conflicts between neighbours, competing groups may be up to 30 m apart and obscured from one another by thick vegetation, making acoustic cues more useful than visual ones. Conflicts therefore involve raucous vocal displays, with all individuals rocking back and forth while cackling loudly; such displays may be given alternately for up to 45 mins, but rarely escalate to physical fighting (Radford & du Plessis 2004b). Although territory holders may be usurped by groups from further afield (Ligon & Ligon 1990), conflicts between neighbouring groups do not tend to result in permanent changes in territory size (Radford & du Plessis 2004a).

However, intruding neighbours that win a conflict do remain on the resident's territory for up to an hour to forage and examine roost/nest holes, before returning to their own territory (Radford & du Plessis 2004b).

Allopreening is a frequently observed affiliative behaviour between group members and involves one individual bringing its bill into firm contact with the feathers of another individual in a preening motion. Allopreening of the head and neck (which cannot be reached by the recipient itself) serves a primarily hygienic function: it occurs at a constant rate throughout the year, it is highly reciprocated and all group members donate and receive similar amounts (Radford & du Plessis 2006). Allopreening of the rest of the body (which the recipient can reach itself) serves a primarily social function: its rate varies seasonally, it occurs more often in larger groups and the frequency with which bouts are received, donated and reciprocated depends on the dominance status of the participants (Radford & du Plessis 2006).

Statistical Analysis

Box-plots were examined to check data for outliers, normality and equality of variance. Normally distributed data with a constant variance were analysed using Linear Mixed Models (LMMs) with an identity link function, while data with a Poisson distribution were analysed using Generalised Linear Mixed Model (GLMMs) with a log link function. In all mixed models, variance components were estimated using the Restricted Maximum Likelihood (REML) method, and random terms were retained in the model unless the variance component was found to be zero (and hence their removal did not influence the findings reported). In each model, all fixed terms were entered and then sequentially dropped until only terms whose elimination would have significantly reduced the explanatory power of the model remained (the minimal model). The significance of eliminated terms was derived by

adding them individually to the minimal model. The significance of each term was determined using the Wald statistic, which approximates the χ^2 distribution. All two-way interactions were tested, but only those that were significant were retained in the minimal model and are presented in the Tables (below). Group identity was included as a random term in all models. Statistical analyses were two-tailed and conducted using Genstat (10^{th} edition, Lawes Agricultural Trust, Rothampstead, UK).

References

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Supplementary Table 1 Summary of two LMMs investigating how the likelihood of intergroup conflict influences current intragroup allopreening (a) rate and (b) bout duration.

model term	estimate ± s.e.m.	Wald statistic (χ^2)	d.f.	*P*
(a) rate				
territory location x body part	0.965 ± 0.394	8.37	1	0.016
territory location				
core area	0 ± 0			
zone of potential conflict	0.607 ± 0.287			
body part				
head	0 ± 0			
body	-0.208 ± 0.326			
group size	0.452 ± 0.156	6.00	1	0.036
month		20.99	6	0.003
January	0 ± 0			
February	0.189 ± 0.078			
March	0.217 ± 0.099			
April	1.047 ± 0.256			
May	1.337 ± 0.332			
November	0.226 ± 0.083			
December	-0.117 ± 0.069			
group identity (random term)	0.026 ± 0.066			
constant	0.886 ± 0.375			
(b) bout duration				
territory location x body part	28.45 ± 12.69	5.02	1	0.028
territory location				
core area	0 ± 0			
zone of potential conflict	24.61 ± 8.87			
body part				
head	0 ± 0			
body	35.50 ± 9.21			
group size		1.82	1	0.181
month		4.86	6	0.566
group identity (random term)	-34.80 ± 27.90			
constant	67.86 ±6.11			

Results based on 152 hourly allopreening rates of the whole group and mean durations of all allopreening bouts within an hour (n=52 hours in core areas, 24 hours in conflict zones) from 12 groups. Mean effect estimates (±s.e.m.) provided for significant terms in minimal model.

Supplementary Table 2 Summary of two LMMs investigating how the likelihood of intergroup conflict influences current preening (a) rate and (b) bout duration.

model term	estimate ± s.e.m.	Wald statistic (χ^2)	d.f.	*P*
(a) rate				
territory location		0.04	1	0.841
group size	1.462 ± 0.542	7.27	1	0.009
month		3.31	6	0.767
group identity (random term)	-0.19 ± 0.80			
constant	7.592 ±0.387			
(b) bout duration				
territory location		1.32	1	0.255
group size		0.69	1	0.441
month		5.02	6	0.558
group identity (random term)	-28.10 ± 12.70			
constant	33.07 ± 1.68			

Results based on 76 hourly preening rates of the whole group and mean durations of all preening bouts within an hour (n=52 hours in core areas, 24 hours in conflict zones) from 12 groups. Mean effect estimates (±s.e.m.) provided for significant terms in minimal model.

Supplementary Table 3 Summary of two GLMMs investigating the influence of dominance status and sex on the change in rate of individual intragroup body allopreening (a) receipt and (b) donation when groups moved into zones of potential intergroup conflict.

model term	estimate ± s.e.m.	Wald statistic (χ^2)	d.f.	*P*
(a) receipt				
dominance status		6.39	1	0.011
breeding pair	0 ± 0			
helpers	0.889 ± 0.352			
sex		0.01	1	0.906
group size		0.28	1	0.637
group identity (random term)	-0.215 ± 0.075			
constant	0.843 ± 0.208			
(b) donation				
dominance status		7.72	1	0.010
breeding pair	0 ± 0			
helpers	-0.991 ± 0.357			
sex		0.24	1	0.630
group size		2.17	1	0.304
group identity (random term)	-0.157 ± 0.079			
constant	-0.063 ± 0.205			

Results based on 30 mean changes in hourly allopreening rate (total rate in conflict zone minus total rate in core area); one value each from 16 dominants and 14 subordinates in eight groups. Mean effect estimates (±s.e.m.) provided for significant terms in minimal model.