POST-ALLOGROOMING REDUCTIONS IN SELF-DIRECTED BEHAVIOUR ARE AFFECTED BY ROLE AND STATUS IN THE GREEN WOODHOOPOE

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Electronic Supplementary Material

Study Species

Green woodhoopoes are facultative cooperative breeders found throughout sub-Saharan Africa [S1]. In the study population in South Africa, 57% of groups have at least one nonbreeding, subordinate helper in addition to the (putative) dominant breeding pair [S2]. 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 [S3]. Adults can be sexed using clear-cut differences in bill length [S4] and vocalisations [S5]. Dominance status can be established during foraging, when the dominant pair displace subordinate helpers [S4]. 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).

Grooming, or preening, woodhoopoes search and stroke feathers with soft jabs of the bill and sometimes run the feathers through the bill. Allogrooming, or 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 grooming motion [S6]. Because juvenile woodhoopoes rarely allogroom [S6], I only considered interactions between adult individuals (>11 months since fledging; nestling period lasts 1 month; [S7]); juveniles

were identified by their predominantly black bills [S7]. Allogrooming 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 [S6]. Allogrooming 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 [S6].

Data Collection

Throughout the data collection period, the composition of each group and the dominance status of each individual remained constant. Data were not collected from groups when they were engaged in obvious breeding activities (i.e. when they were incubating eggs or feeding young), which means that dominant group members were unlikely to have been in reproductive condition for at least the majority, if not all, of the relevant period. Groups in the study population have only one breeding attempt per year [S8]; breeding attempts were detected by listening for the food-solicitation calls given by breeding females in the vicinity of the nest during the incubation and early nestling phases [S7] or by following birds returning with food for the breeding female [S9] or nestlings [S10].

Data collection was based on the comparison of self-grooming behaviour in post-allogrooming periods (PAs) and matched control periods (MCs). As well as being commonly employed in studies of post-conflict behaviour, MCs have been successfully utilised when researching allogrooming effects on both recipients [S11] and donors [S12]. Both PAs and MCs were during periods of group foraging [S4], and an MC was at approximately the same time of day as its PA; MCs and their PAs were therefore matched for both general activity and time (in case of unknown circadian patterns). There were no biases in the dataset in terms

of the time of day at which different individuals were observed: the likelihood of observing donors in the morning and the afternoon was the same as that for recipients (chi-square test: χ^2=0.943, df=1, p=0.331), and the same was true for dominants and subordinates (χ^2=0.047, df=1, p=0.829), and for males and females (χ^2=1.011, df=1, p=0.315).

PAs and MCs lasted for 10 min each, but the thick canopy prevented constant monitoring of the focal individual throughout that period. However, there was no significant difference in the duration of time birds were observed during PAs and MCs (see main paper). Moreover, there was no significant difference in the observation time of donors and recipients (paired t-test: t=1.191, n=46, p=0.240), of dominants and subordinates (two-sample t-test: t=1.154, n_1=27, n_2=20, p=0.254), or of males and females (two-sample t-test: t=0.443, n_1=21, n_2=26, p=0.660). Thus, there are no significant biases in the dataset that are likely to confound the results.

Statistical Analysis

I used mixed models for analyses when it was necessary to take account of repeated measures from the same group and individual, because these allow the inclusion of random, as well as fixed, terms. Box-plots were examined to check data for outliers, normality and equality of variance and then the normally distributed datasets with a constant variance were analysed using Linear Mixed Models (LMMs) with an identity 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 (beginning with the least significant) 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). Individual and group identity were initially included as random terms in all models. Statistical analyses were two-tailed and conducted using Genstat (13th edition, Lawes Agricultural Trust, Rothampstead, UK).

References

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Supplementary Table 1 Summary of LMM investigating the reduction in self-grooming shown by green woodhoopoes following participation in all allogrooming bouts. Analysed were the differences in percentage time spent self-grooming between post-allogrooming periods (PA) and matched-control periods (MC).

model term	*estimate ± s.e.m.*	*Wald statistic (χ^2)*	*d.f.*	*P*
minimal model				
bout duration	-0.008 ± 0.005	11.12	1	0.001
role		10.98	1	0.001
- donor	0 ± 0			
- recipient	-1.085 ± 0.317			
bout duration x role	-0.017 ± 0.008	5.13	1	0.025
dominance status		8.12	1	0.007
- dominant	0 ± 0			
- subordinate	-0.923 ± 0.324			
constant	-0.826 ± 0.263			
eliminated terms				
group size		0.62	1	0.437
year		0.20	1	0.660
sex		0.13	1	0.724
month		2.12	7	0.952

Results based on 215 PA-MC pairs from 47 individuals in 20 groups. Mean effect estimates (±s.e.m.) provided for significant terms in minimal model. Individual identity (variance ± s.e. = 0.019 ± 0.284) was included as a random term; group identity not included as the variance component was zero.

Supplementary Table 2 Summary of a LMM investigating the reduction in self-grooming shown by green woodhoopoes following participation in head allogrooming bouts. Analysed were the differences in percentage time spent self-grooming between post-allogrooming periods (PA) and matched-control periods (MC).

model term	*estimate ± s.e.m.*	*Wald statistic (χ^2)*	*d.f.*	*P*
minimal model				
bout duration	-0.015 ± 0.006	18.05	1	<0.001
role		6.95	1	0.010
- donor	0 ± 0			
- recipient	-0.098 ± 0.324			
bout duration x role	-0.121 ± 0.011	5.80	1	0.018
dominance status		4.87	1	0.037
- dominant	0 ± 0			
- subordinate	-0.562 ± 0.448			
constant	-0.651 ± 0.338			
eliminated terms				
group size		0.34	1	0.565
year		1.59	1	0.215
sex		0.54	1	0.467
month		3.58	7	0.826

Results based on 108 PA-MC pairs from 27 individuals in 17 groups. Mean effect estimates (±s.e.m.) provided for significant terms in minimal model. Individual identity (variance ± s.e. = 0.717 ± 0.510) was included as a random term; group identity not included as the variance component was zero.