Sex differences in preening behaviour in the White Stork *Ciconia ciconia*

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ARTICLE INFO

REGULAR RESEARCH PAPER
PUBLISHED IN
Pol. J. Ecol. (2016) 64: 406–410

RECEIVED AFTER REVISION
XXXX 2016

DOI
10.3161/15052249PJE2016.64.3.xxx

KEY WORDS
preening in birds
distance to neighbour,
sex-specific behaviour

ABSTRACT

Preening is a type of feather maintenance behaviour in birds, that fulfils an important role in grooming. Preening may also be important for signalling quality of mates. Therefore we hypothesized that the frequency of preening may be related to sex and population density of White Stork *Ciconia ciconia*. We observed preening activity of 25 pairs in Western Poland at the beginning of incubation, when preening frequency is the highest. Birds were observed on the nest, because most preening behaviour occurs there. We found that being on the nest males spent proportionally more time on preening than females (on average 30% *vs*. 16%). Females spent more time preening when their mate was present at the nest. There was no significant relationship between preening frequency and indirect quality indicators (arrival date, laying date, hatching date, clutch size, brood size) nor between the distance to nearest neighbours and the time males and females spent on preening.

Preening is an important grooming behaviour in birds which can help maintain feather quality by removing dirt and oiling (Zampiga *et al.* 2004, Griggio *et al.* 2010) or reducing number of ectoparasites (Møller 1991, Rózsa 1993, Waite *et al.* 2012). Preening also can play an important role in birds' mating. Males of budgerigars *Melopsittacus undulatus* which preened more often were more attractive for females due to better feathers reflectance which is called "attractive preening" hypothesis (Griggio *et al.* 2010). On the other hand it is found that self-preening (grooming of own feathers) and allo-preening (grooming of feathers of other individual, e.g. a partner) may promote horizontal transfer of bacteria (Kulkarni and Heeb 2007) and viruses (Delogu *et al.* 2010). Therefore an alternative hypothesis has been developed that bird females may avoid too frequent preening males to constraint parasites spread. It is called "preening avoidance" hypothesis (Griggio and Hoi 2006). Moreover, preening behaviour can increase in frequency when flock size increases due to social facilitation (Palestis and Burger 1998) or as a displacement activity resulting from high group density (Mills and Faure 1989, Keeling 1994).

Preening is a type of behaviour described and studied in many bird species, mainly in captivity, like e.g. budgerigars (Zampiga *et al.* 2004, Griggio and Hoi 2006, Griggio *et al.* 2010), domestic canaries *Serinus canaria* (Lenouvel *et al.* 2009), mallards *Anas platyrhynchos* (Delogu *et al.* 2010), feral pigeons *Columba livia* (Rózsa 1993, Waite *et al.* 2012), zebra finches *Taeniopygia guttata* (Kulkarni and Heeb 2007), with only few studies in the wild: swallows *Hirundo rustica* (Møller 1991) and terns *Sterna* spp. (Van Iersel and Bol 1958, Palestis and Burger 1998). All of these birds are known as hosts for mites and lice, which consume feather keratin (Loye and Zuk 1991, Møller 1991). Therefore some authors suggested that preen-

ing frequency may be a proxy for individual fitness which is a predictor for arrival date, clutch size and breeding success (Møller 1991). However the exact role of preening is still being discussed.

The European White Stork *Ciconia ciconia* is an example of long-lived monomorphic bird species. It nests solitary on the top of human made structures like electricity poles, chimneys, roofs or trees, however can form aggregations of several pairs or even colonies (Tryjanowski *et al. 2006*). Also in White Stork assemblages of lice (Fryderyk and Izdebska 2009) and their removal were well described (Clayton and Cotgreave 1994, Bocheński and Jerzak 2006) but preening was not quantified or studied in details. Preening in White Stork occurs mostly on the nest, during incubation and after juveniles have fledged (Bocheński and Jerzak 2006). In contrast to many dimorphic species, there is no suggestion that plumage of stork as a monomorphic bird is important for mate choice (Bocheński and Jerzak 2006). However, in the light of fact that birds can see in Ultraviolet (Benett and Cuthill 1994) preening can play an important role in feather light reflectance and therefore in mate choice. Hence, we hypothesized that male storks preen more frequent than females to attract females and show better reflectance of feathers as an effect of good fitness. Moreover, if the preening frequency is an effect of ectoparasites occurrence it may diminish fitness and finally arrival dates on the breeding ground, clutch size (in females) and final breeding success.

White Stork is also known for its very good eyesight. It can see predator or neighbour from even 2–3 km. Occurrence of other stork can modify its time budget (Bocheński and Jerzak 2006). Feather maintenance is time and energy consuming (Croll and McLaren 1993). Therefore, we hypothesized that in higher densities White Storks have to spend more time on food foraging and defending their nests, so they have less time and energy for preening, especially in the beginning of breeding season when interactions and aggressive behaviour are frequently observed (Bocheński and Jerzak 2006).

Here we attempt to describe the preening behaviour (i.e. self-preening) of the White Stork, and to assess if preening in this species may be an indicator of fitness and related to breeding parameters. We tested if preening is sex related (may play a role in mating or pair display) and also if preening frequency may be modified by the distance to neighbours, which is an indicator of population density and intraspecific interactions. Therefore we put forward following hypotheses: 1) Frequency of preening differs between pair members; 2) Preening behaviour is related to distance to nearest neighbours; and finally 3) Preening (as a proxy for fitness) is related to several breeding parameters like arrival dates, time of breeding and number of egg.

The study was conducted in Western Poland near the town of Leszno (51°51′N, 16°34′E). This is an area of arable fields interspersed with meadows, pastures, human settlements, small river valleys and woods. In this location White Storks generally build isolated nests on electricity poles, chimneys and roofs of buildings. Rarely White Storks also nest on trees far from human settlements (Tobolka *et al.* 2013). In the studied population the mean distance to three nearest active nests was 2.36 km (range: 0.14–5.9) so it can influence time budget of several pairs, i.e. preening behaviour (Bocheński and Jerzak 2006).

Fieldwork was carried out from March to May 2011. Each of 25 pairs was observed once in the beginning of incubation period. Observation lasted for two hours and was conducted only in good weather conditions (no rain or strong wind). During the incubation there is always at least one member of the pair on the nest. For each observed bird we noted time spent on nest and on preening. Because both birds in each pair did not spend the entire two hours observation period on the nest, the percentage of time spent on preening during their presence on the nest was calculated. In addition, we used mean distance to the three nearest neighbours (Clark and Evans 1954), as an index of the density of stork nests around each focal nest. We used QUANTUMGIS with geoportal.gov.pl wms label.

In our study we could not catch adult birds and directly measure individuals' body size or assess the number of ectoparasites. We decided to use indirect indicators of individual condition such as arrival date and brood

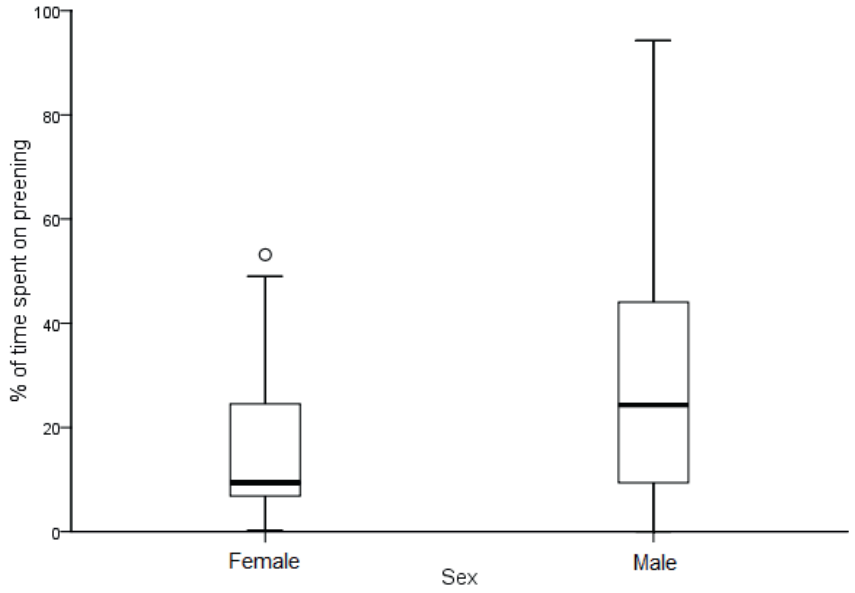

Fig. 1. Differences in time spent on preening between females and males of White Storks *Ciconia ciconia*. Bold line – median, box – 25 and 75 quartile, whiskers – min and max, outlayer.

size (Kosicki *et al.* 2004). Arrival date of the first and the second bird from pair, laying date, hatching date, clutch size and final breeding success were obtained by direct inspections in the nests and special questionnaire forms delivered to farmers living nearby the nests. We defined arrival date as the day when the particular bird occurred on its nest (day 1 = 1 January) (details in Ptaszyk *et al.* 2003 and Tobolka *et al.* 2015). We include in the present study only pairs with detailed and certain arrival dates collected by experienced observers because sometimes, some nest are visited not only by particular breeding pair also by nonbreeders (Wuczyński 2005). We defined date of laying as the day when the first egg was laid in the nest. This was estimated on the basis of direct inspection in nest (details in Tobolka *et al* 2015). Clutch size is a number of eggs in the nest during the first inspection when the clutch was complete. Breeding success was a number of fledglings able to fly (Tryjanowski *et al.* 2006). During the observation the sex of pair members was easily determined by observing the position during copulation, which is a reliable method for this bird species (Chernetsov *et al.* 2006).

We used t paired-test because female behaviour is potentially related to male behaviour and *vice versa* (Bocheński and Jerzak 2006). To explain differences in time spent on preening in comparison to distance to neighbours or breeding parameters we used Pearson correlation. Results are presented as means ± SD. All statistical analyses were prepared using IBM SPSS Statistics 20 for Windows.

Females spent significantly more time on nests than males (respectively, on average. 97 and 66 min during 120 min. of observation, t = -2.84, P = 0.009, n = 25). The percentage of time spent on preening was greater in males (30.1 ± 24.8%) than in females (16.2 ± 15.1%) (t =2.10, P = 0.046, n = 25). We found that an individual's preening activity was unrelated to the preening activity of their mate (r= -0.33, P = 0.11, n = 25). Females' relative time spent on preening was positively correlated with the presence of males (r = 0.49, P = 0.014, n = 25).

We did not find any relationship between time spent on preening by males and females during the 2h observation and the mean distance to three closest nests of neighbours (respectively r = 0.19 P = 0.36, and r = 0.11, P = 0.59, n = 25).

We did not find any statistically significant relationships (P > 0.20 in all cases) between breeding parameters like arrival date, time of egg laying or clutch size and preening of both adults.

We found that male White Storks spent relatively more time on preening at the nest than females. We also found that the time spent on preening by females was positively correlated with male presence at the nest, which may suggest the role of preening in communication between mates. In the light of Griggio and Hoi (2006) who tested if female budgerigars use male preening time ("attractive preening" hypothesis) as a quality signal of males, our results suggest that preening also for White Storks can play a role in pair display. Female budgerigars spent significantly more time near the preened males than unpreened (Zampiga *et al.* 2004). However our results did not allow us to confirm nor to reject the "preening avoidance" hypothesis saying that females should avoid males which spend a lot of time on preening, because of probable high number of ectoparasites on them (Griggio and Hoi 2006). To test this hypothesis appropriately we should take into account more variables and collect more numerous data. In our study there was no relationship between condition indicators we chose (arrival date, laying date, breeding success, clutch size) and time spent on preening. But this issue needs more detailed studies including adults' catching, body condition measurements and detailed ectoparasites analyses.

We did not find a positive correlation between the distance to the nearest neighbours, which may be an indicator of higher density in the local population (Janiszewski *et al.* 2013), and time spent on preening. In contrast, the results of a study conducted on Common Terns show that males that nested close to other males spent more time preening (Palestis and Burger 1998). However, distances between nests in Terns colonies are much shorter then between White Stork nests, especially in Western Poland (Tryjanowski *et al.* 2006). Intraspecific interactions connected with the distance to neighbours in studied White Stork population could modify the time budget to spend more time on nest defending, screening or foraging than preening, especially in the initial period of breeding season. However, aggressive behaviour is more often in the early beginning of the breeding season when hierarchy is establishing (Bocheński and Jerzak 2006). Probably during the egg incubation, even in conditions of high breeding pairs density aggressive interactions are less frequent. Therefore more detailed studies on White Stork behaviour overlapping entire breeding season (each breeding stages) are needed to assess the role of preening in mating and pair display having regard external factors like population density or even natural predators (e.g. White-tailed Eagle) occurrence.

ACKNOWLEDGEMENTS: The study was supported by a grant from the National Science Centre N/NZ8/01186, a scholarship NSC T/NZ8/01001 and a scholarship from the European Social Fund in 2010/2011 (MT). We would like to thank to Tomáš Grim, Daniel Hanley and Piotr Tryjanowski for their helpful comments to manuscript.

REFERENCES

Bennett A.T.D., Cuthill I.C 1994 – Ultraviolet vision in birds: What is its function? – Vision Res. 34: 1471–1478.

Bocheński M., Jerzak J. 2006 – Behaviour of the White Stork *Ciconia ciconia*: a review (In: The White Stork in Poland: studies in biology, ecology and conservation, Eds: P. Tryjanowski, T.H. Sparks, L. Jerzak) – Bogucki Wydawnicte wo Naukowe, Poznan, pp. 295–324.

Chernetsov N., Chromik W., Dolata P.T., Profus P., Tryjanowski P. 2006 – Sex-related natal dispersal of White Storks (*Ciconia ciconia*) in Poland: how far and where to? – The Auk, 123: 1103–1109.

Clark P.J., Evans F.C. 1954 – Distance to nearest neighbor as a measure of spatial relationships in populations – Ecology, 35: 445–453.

Clayton D.H., Cotgreave P. 1994 – Relationship of bill morphology to grooming behaviour in birds – Anim. Behav. 47: 195–201.

Croll D.A., McLaren E. 1993 – Diving metabolism and thermoregulation in common and thick-billed murres – J. Comp. Physiol. B. 163: 160–166.

Delogu M., De Marco M.A., Di Trani L., Raffini E., Cotti C., Puzelli S., Ostanello F., Webster R.G., Cassone A., Donatelli I. 2010 – Can preening contribute to influenza A virus infection in wild waterbirds? – PLoS ONE, 5: e11315.

Fryderyk S., Izdebska J.N. 2009 – Chewing Lice (*Insecta, Phthiraptera*) of the White Stork (*Ciconia ciconia* L.) in Poland – Ann. UMCS, Biol. sec. C, 64: 83–88.

Griggio M., Hoi H. 2006 – Is preening behaviour sexually selected? An experimental approach – Ethology, 112: 1145–1151.

Griggio M., Hoi H., Pilastro A. 2010 – Plumage maintenance affects ultraviolet colour and female preference in the budgerigar – Behav. Process. 84: 739–744.

Janiszewski T., Minias P., Wojciechowski Z. 2013 – Timing of arrival at breeding grounds determines spatial patterns of productivity within the population of White Stork (*Ciconia ciconia*) – Popul. Ecol. 56: 217–225.

Kosicki J., Sparks T., Tryjanowski P. 2004 – Does arrival date influence autumn departure of the White Stork *Ciconia ciconia*? – Ornis Fenn. 81: 91–95.

Keeling L.J. 1994 – Inter-bird distances and behavioural priorities in laying hens: the effect of spatial restriction – Appl. Anim. Behav. Sci. 39: 131–140.

Kulkarni S., Heeb P. 2007 – Social and sexual behaviours aid transmission of bacteria in birds – Behav. Process. 74**:** 88–92.

Lenouvel P., Gomez D., Théry M., Kreutzer M. 2009 – Do grooming behaviours affect visual properties of feathers in male domestic canaries, *Serinus canaria*? – Anim. Behav. 77: 1253–1260.

Loye J.E., Zuk M. 1991 – Bird-parasite interactions: ecology, evolution and behaviour – Oxford University Press, Oxford.

Mills D.A., Faure J.M. 1989 – Social attraction and the feeding behavior of domestic hens – Behav. Process. 18: 71–81.

Møller A.P. 1991 – The preening activity of swallows, *Hirundorustica*, in relationto experimentally manipulated loads of haematophagous mites – Anim. Behav. 42: 251–260.

Palestis B.G., Burger J. 1998 – Evidence for social facilitation of preening in the common tern – Anim. Behav. 56: 1107–1111.

Ptaszyk J., Kosicki J., Sparks T.H., Tryjanowski P. 2003 – Changes in the timing and pattern of arrival of the White Stork (*Ciconia ciconia*) in western Poland – J. Ornithol. 144: 323–329.

Rózsa L. 1993 – An experimental test of the site specificity of preening to control lice in feral pigeons – J. Parasitol. 79**:** 968–970.

Tobolka M., Kuźniak S., Zolnierowicz K.M., Sparks T.H., Tryjanowski P. 2013 – New is not always better: low breeding success and different occupancy patterns in newly built nests of a long-lived species, the White Stork *Ciconia ciconia* – Bird Study, 60**:** 399–403.

Tobolka M., Zolnierowicz K.M., Reeve N.F. 2015 – The effect of extreme weather events on breeding biology of the White Stork *Ciconia ciconia* – Bird Study, 62: 377–385.

Tryjanowski P., Sparks T.H., Jerzak L. 2006 – The White Stork in Poland: studies in biology, ecology and conservation – Bogucki Wydawnictwo Naukowe, Poznan.

Van Iersel J.J.A., Bol A.A.C. 1958 – Preening of two tern species. A study on displacement activity – Behaviour, 13: 1–88.

Waite J.L., Henry A.R., Clayton D.H. 2012 – How effective is preening against mobile ectoparasites? An experimental test with pigeons and hippoboscid flies – Int. J. Parasitol. 42**:** 463–467.

Wuczyński A. 2005 – The turnover of White Storks *Ciconia ciconia* on nests during spring migration – Acta Ornithol. 40: 83–85.

Zampiga E., Hoi H., Pilastro A. 2004 – Preening, plumage reflectance and female choice in budgerigars – Ethol. Ecol. Evol. 16: 339–349.