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Testosterone and Pair Bonding in Females

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Abstract

Behaviours such as sexual behavior, aggression, guarding and parenting are correlated with reproduction in males its association with the steroid hormone testosterone (T) has been well established. But the role of this male hormone in impacting the behavioural physiology of pair bond formation in females is still vague. We have made an attempt to explore this area. In this study we have analysed the behavioural output of testosterone administration in female Melopsittacus undulatus which has helped to draw the significance of testosterone in females in pair-bond formation.

Keywords: Testosterone, pair-bond, behavior

Introduction

The sexual behavior of vertebrates is strongly influenced by sex steroids. Testosterone (T) is an androgenic, anabolic steroid having the chemical formula $C_{19}H_{28}O_2$ and molecular mass of 288.4gm/mol[1]. The "male hormone", testosterone has several organizational and activational effects in male vertebrates[2]. The gonads, both the testes and ovaries, adrenals and the brain are the tissues concerned with the synthesis of testosterone, where the former serves to be the prime synthesis sites[3].

Behavioural endocrinology has established the relation between the steroid hormone testosterone (T) and male reproductive behaviours such as space use, parenting sexual, aggressive and guarding behaviors, thus revealing the function of this primary male hormone in males [4,5]. Testosterone is a sex-steroid that has close knit connections with the suites of behaviors and physiology that directly affect reproductive succes[6].

Testosterone is well known for its stimulatory effects on aggression[7]. Besides behavioural effects testosterone's effect on muscle system, immune system and moulting has been greatly studied[8]. Testosterone promotes mate acquisition, attractiveness and extra-pair fertilizations in males[9].

The blood plasma of female vertebrates show the presence of testosterone [2,9], hence this hormone cannot be classified as male sex-limited. Across taxas, various behavioural and physiological traits of females are modulated by testosterone[2,10]. Even during adulthood, exogenous steroid hormones have its impact on several male and female traits[11]. But the influence of testosterone on pair bond formation in females hasn't yet received due attention.

A stabile relationship between a pair of breeding animals inhabiting the same territory and sharing parental duties is known as the pair bond. If a compound/ drug/ hormone shows the ability to stimulate partner preference in animals even in the absence of mating, it is suggested to be an inducer of pair-bond formation[12,13]. We, in our study analysed if exogenous testosterone serves as an inducer or facilitator of pair-bond formation.

Plumage colouration and ornamentation are secondary sexual traits that are modulated by sex steroids[14]. These secondary sexual characters serve as a genuine index of the individual's fitness, which aids the female in mate selection[15,16]. The present study assessed if exogenous testosterone administration helped in promoting mate choice through its modulatory effects on plumage colouration.

Methodology

20 males and 20 females of *Melopsittacus undulatus* in their reproductive phase (aged two months) were housed in standard size cages, kept under natural photoperiod and provided with food and water *ad libitum*. The study birds (10 females) were given physiological doses of intramuscular injections of Testosterone (Sigma). During the treatment period, they were observed for 30min period after injection and compared with the control-birds for the difference in time invested for each of the behaviours. The interaction with the conspecifics was also examined.

Results and Discussion

Administration of testosterone to the female budgerigars showed certain behavioural responses different from the control females. Figure 2 shows that the feeding rate reduced (22%) compared to control birds. Testosterone administration has invoked courtship behaviours in the bird, namely, courtship feeding (-1%), bowing (2%), slide switch (2.8%), chirping (0.2%) and pumping (6%). Vocalization increased and so also did the response calls to its con-specifics (21%). Figure 3 points out that the specific male mates spents 33% time in interacting

positively or performing affinitive behaviours with the treated female while the time spent by other conspecifics together comprise only 21% (male conspecifics-12%, female conspecifics-9%). Specific male interaction with control females is not observed. When males spent 5% of their time in positive interaction with the control females, other females set apart 4% of their time in interacting with the control female. The females were found to be more brightly coloured after the treatment period.

Though testosterone activates male specific behavior in vertebrates, but its effects are not restricted to males[17]. Testosterone administration in female *M.undulatus*, evoked courtship behaviours such as courtship feeding, bowing, slide-switch, chirping and pumping (figure 2). Our results are in accord with the findings of Nespor A.A.[18].

Various interactions, visual cues, vocal signals and at times pheromones help an animal in choosing its mate. T-supplemented females in our study showed an increase in the singing rates, which is a auditory cue of mate choice[18,19]. Chirp response calls (calls in response to vocal signals from conspecifics) increased by about 21%, suggesting that the communication between birds increased.

Our results shows that (figure 3), males are more attracted to testosterone-treated female than other females (5%) as they invest their time (12%) in performing various affinitive behaviours like allopreening, cleaning, and vocalizing with them. As, brighter and more ornamented females are more preferred by males [20.21], the testosterone treatment provided the birds with a better possibility of being chosen by their opposite sex.

Partner preference is an authentic behavioural indicator of pair-bond formation in lab conditions and it is inferred when the male-female conspecific spends apparently more time associated with each other[14,22,23]. Figure 3 shows that certain specific males gets more associated with the treated female and spends more time in interacting with them (33%), developing a greater preference. This study shows that testosterone treatment aids in developing this partner preference in an hour which doesn't happen in control females till the conspecifics get familiarized.

The results of our present study suggest that testosterone improves mate-choice and pair-bonding by facilitating courtship behaviours as well as affinitive behaviours between conspecifics. Therefore, it can be concluded that testosterone helped in promoting mate choice through its enhancing effects on plumage colouration and vocalization and thus serves as a facilitator of pair-bond formation.

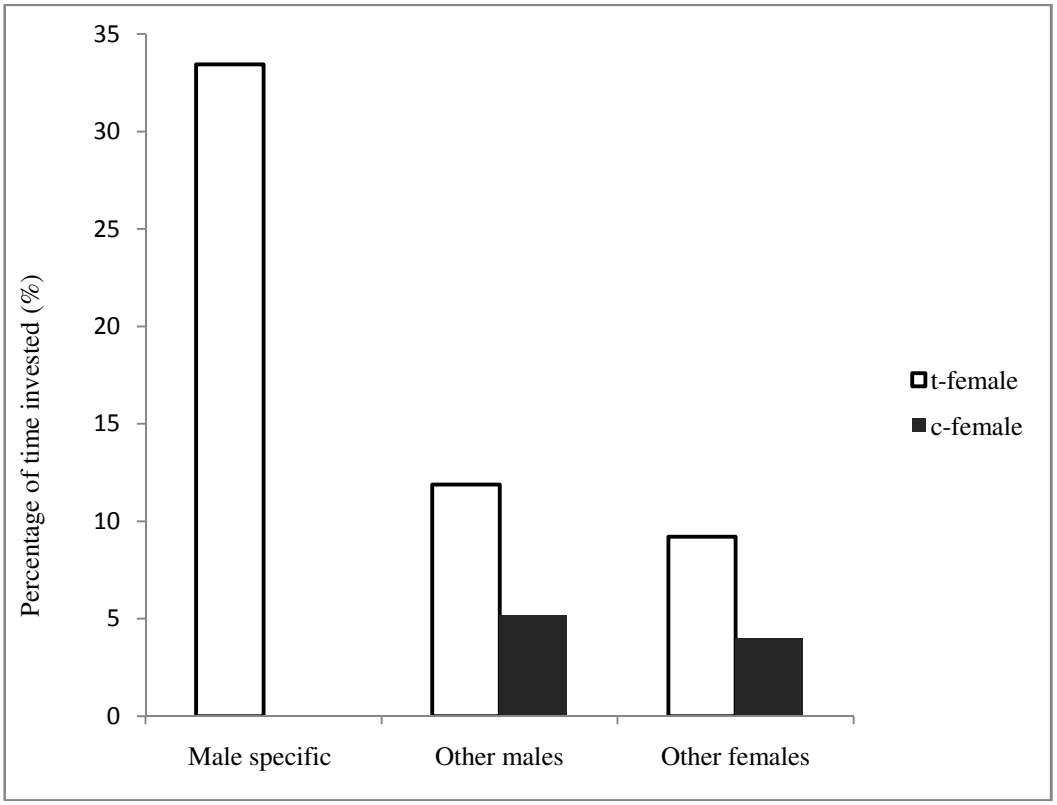

Figure-2
Positive interactions- Treated Vs Control

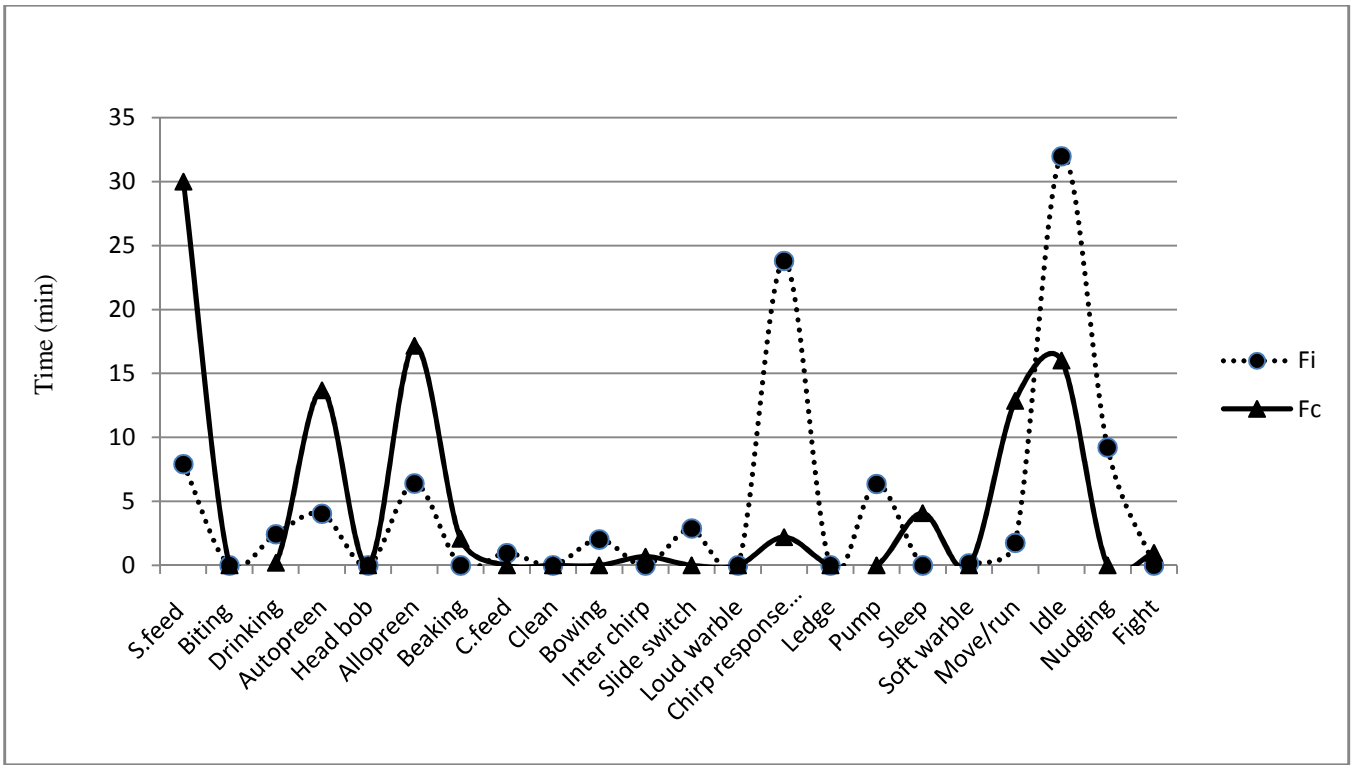

Figure-3
Changes in behaviour- Tested female against control female

Conclusion

Typically a male hormone, testosterone, has several behavioural, organizational and activational effects. The role and behavioural physiology of the hormones in males have been clearly understood. But the effect of exogenous testosterone on female *Melopsittacus undulatus* as well as on the phenomenon of pair-bond formation from a behavioural point of view remained nearly unexplored. Here we have brought out the facilitating role of testosterone in pair-bonding in females.

References

1. Rajani M., Singh S.D., Kumar S.N. and Chhaya B., The Effect of Di-Ethylstilbestriol (DES), Oxytocin and Testosterone on the Content of Carbohydrate, Chlorophyll and Protein in Green Algae, *Int. Res. J. Biological Sci*., **2(1)**, 35-40, **(2013)**

2. Gerlach N.M. and Ketterson E.D., Experimental elevation of testosterone lowers fitness in female dark-eyed juncos, *Hormones and Behavior,* **63**, 782–790 **(2013)**

3. Arnold A.P., Sex chromosomes and brain gender, *Nature Reviews Neuroscience*, **5**, 701-708 **(2004)**

4. Adkins-Regan E., Sexual differentiation in birds, Trends Neurosci, **10**, 517–522 **(1987)**

5. Gleason Erin D. and Catherine A. Marler, A positive Link Between Male Testosterone and Spacing Behavior in Pair-Bonded California Mice, *Ethology*, **118**, 1045–1050 **(2012)**

6. Wingfield J., Lynn S. and Soma K., Avoiding the "costs" of testosterone: ecological bases of hormone–behavior interactions, *Brain Behav. Evol.,* **57**, 239–251 **(2001)**

7. Wingfield J.C., Ball G.F., Dufty Jr. A.M., Hegner R.E. and Ramenofsky M., Testosterone and Aggression in Birds, *American Scientist,* **75(6)**, 602-608 **(1987)**

8. Ros A.F.H., Effects of testosterone on growth, plumage pigmentation and mortality in Blacklheaded Gull chicks, *IbiS*, **141**, 451-459 **(1999)**

9. Zysling D.A., Greives T.J., Breuner C.W., Casto J.M., Demas G.E., Ketterson E.D., Behavioral and physiological responses to experimentally elevated testosterone in female dark eyed juncos (Junco hyemalis carolinensis), *Hormones and Behavior,* **50**, 200–207 **(2006)**

10. Jawor J.M. and McGlothlin J.W., et al., Testosterone response to GnRH in a female songbird varies with stage of reproduction: implications for adult behaviour and maternal effects, *Funct. Ecol.,* **21**, 767–775 **(2007)**

11. De Ridder E., Pinxten R., Mees V., Eens M., Short-and long-term effects ofmale-like concentrations of testosterone on female European starlings (Sturnus vulgaris), *The Auk,* **119**, 487–497 **(2002)**

12. Ketterson E.D., Nolan Jr., V. and Sandell M., Testosterone in females: a constraint on the evolution of sexual dimorphism?, *Am. Nat.,* **166(4)**, S85–S98 **(2005)**

13. Wang H., Duclot F., Liu Y., Wang Z. and Kabbaj M., Histone deacetylase inhibitors facilitate partner preference formation in female prairie voles, *Nature Neuroscience,* **16**, 919–924 **(2013)**

14. Wang Z. and Aragona B.J., Neurochemical regulation of pair bonding in male prairie voles, *Physiology & Behavior,* **83**, 319–328 **(2004)**

15. Adkins-Regan E., Hormonal mechanisms of mate choice, *Am Zool*., **38**, 166–178 **(1998)**

16. Buchanan K.L., Evans M.R., Goldsmith M.R., Bryant D.M. and Rowe L.W., Testosterone influences basal metabolic rate in house sparrows: a new cost of dominance signaling? *Proc R Soc Lond B.,* **268**, 1337–1344 **(2001)**

17. Clotfelter E.D., O'Neal D.M., Gaudioso J.M., Casto J.M., Parker-Renga I.M., Snajdr E.A., Duffy D.L., Nolan Jr., V. and Ketterson E.D., Consequences of elevating plasma testosterone in females of a socially monogamous songbird: evidence of constraints on male evolution? *Hormones and Behavior*, **46**, 171– 178 **(2004)**

18. Nespor A.A., Lukazewicz M.J., Dooling R.J. and Ball G.F., Testosterone induction of male-like vocalizations in female budgerigars (Melopsittacus undulatus), *Horm. Behav*., **30**, 162–169 **(1996)**

19. Adkins-Regan E., Testosterone increases singing and aggression but not male typical sexual partner preference in early estrogen treated male zebra-finches, *Horm. Behav*., **35**, 63–70 **(1999)**

20. Muck C. and Goymann W., Throat patch size and darkness covaries with testosterone in females of a sex-role reversed species, *Behavioral Ecology*, **22(6)**, 1312-1319 **(2011**)

21. Clutton-Brock T., Sexual selection in females, *Anim Behav*., **77**, 3–11 **(2009)**

22. Insel T.R. and Hulihan T.J., A gender-specific mechanism for pair bonding: oxytocin and partner preference formation in monogamous voles, *Behav Neurosci*., **109**, 782–789 **(1995)**

23. Winslow J.T., Hastings N., Carter C.S., Harbaugh C.R. and Insel T.R., Arole for central vasopressin in pair bonding inmonogamous prairie voles, *Nature,* **365**, 545—547 **(1993)**