Biological Basis of Paternal Behavior

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Which animals display paternal care?

- Usually, but not always associated with social monogamy
- Birds – 90% of species
- Mammals – 3% of species
- Including 12% of primate species
Which animals display paternal care?

a) Carnivores

Legend: green — solitary, blue — group living, black — social monogamy

Figure is scalable, species names will become visible with higher zoom
Testosterone is usually, but not always, bad for paternal behavior.
(A) Within-group changes in AM and PM T values between 2005 and 2009.

Gettler L T et al. PNAS 2011;108:16194-16199
Mascaro et al, 2013

Graph A: Correlation between caregiving and testes size with $r(52) = -0.29$ and $p < 0.05$.

Graph B: Correlation between caregiving and testosterone level (ng/dL) with $r(56) = -0.27$ and $p < 0.05$.

Graph C: Correlation between testosterone level (ng/dL) and testes size with $r(51) = 0.26$ and $p = 0.06$. 
The graph illustrates the paternal behavior (in seconds) of different groups of male animals. The x-axis represents two behaviors: 'Huddling' and 'Pup grooming'. The y-axis represents the time in seconds.

- The light grey bars represent the 'Castrated' group.
- The white bars represent the 'Sham' group.
- The dark grey bars represent the 'T replacement' group.

In 'Huddling', the 'Castrated' group shows the shortest duration, followed by the 'Sham' group, and the 'T replacement' group shows the longest duration. In 'Pup grooming', the 'Castrated' group shows a similar duration to the 'Sham' group, while the 'T replacement' group shows a significantly longer duration.

AN INTRODUCTION TO BEHAVIORAL ENDOCRINOLOGY, Third Edition, Figure 7.28 © 2005 Sinauer Associates, Inc.
Paternal care is probably regulated by oxytocin and vasopressin in many species.
Oxytocin and Vasopressin
Bales et al. 2004, Hormones and Behavior
Kenkel et al., 2012
Adapted from Woller et al, 2012
Figure 1  Father and infant salivary oxytocin (OT) levels (pg/mL) in the oxytocin and placebo conditions. Following OT administration to father, father and infant salivary OT levels are markedly increased compared with baseline assessment. In the placebo co...

Omri Weisman, Orna Zagoory-Sharon, Ruth Feldman

Oxytocin Administration to Parent Enhances Infant Physiological and Behavioral Readiness for Social Engagement

Biological Psychiatry Volume 72, Issue 12 2012 982 - 989

http://dx.doi.org/10.1016/j.biopsych.2012.06.011
The dopamine system is probably also involved in male parenting.
Mascaro et al., 2013
Paternal care, like maternal care, can be costly.
Study Design

Unpaired | Newly paired | 1\textsuperscript{st} litter | 2\textsuperscript{nd} litter | 3\textsuperscript{rd} litter

Longitudinal: Body weight, sucrose preference, feeding, activity, social behavior, leptin, corticosterone
Campbell et al., 2009
Stress can affect paternal care.
Stress No Stress

Proportion Displaying Behavior

Huddling
Not huddling

Bales et al. 2006, Physiology & Behavior
What is the animal evidence for paternal involvement in outcomes?
Conclusions

- Males may use SIMILAR but not IDENTICAL mechanisms to females in promoting parental care.

- These mechanisms may differ by species but appear to have co-opted many of the same systems.

- Need more study! Particularly on brain mechanisms, oxytocin, vasopressin, and cortisol in humans.
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