



# A Biological Perspective on Parents as Decision-Makers



David F. Westneat  
Margret I. Hatch  
Daniel P. Wetzel  
Amanda L. Ensminger



Department of Biology, University of Kentucky



## Introduction

Parent animals make a variety of decisions when caring for offspring. Such decisions may be based on recent information or could be tendencies that influence the individual through much of its life. The extent to which decisions are flexible (or plastic) or are more fixed but differ between individuals (personality) is not clear.

We examined the relationship between fixed differences in care behavior (personality) and flexible responses (plasticity) in the house sparrow (*Passer domesticus*) in which both parents bring food to dependent young.

## Methods

We observed visits to the nest by individually-marked male and female sparrows over 5 years. Personality and plasticity were assessed using linear mixed models. Random effects terms allow us to estimate between individual differences in intercepts (personality) or slopes (plasticity). Fixed effects allowed us to test for between-individual effects of plasticity or within-individual effects (mean plasticity).

## Results

House sparrows showed fixed differences between individuals in parental care, accounting for ~10% of variation, despite some biases due to plasticity.

House sparrows were flexible to multiple environmental variables--this depended on gender and interaction effects (Table 1).

Table 1. Within-subject fixed effects and interaction terms indicating average plasticity in parental care.

Fixed effect*	Effect ± SE	F(df)	P-value	ΔAIC**
Intercept (Male)	12.1 ± 0.3	-	-	-
Sex (F-M)	-0.1 ± 0.4	1.6 (358)	0.20	-0.3
Brood size	2.5 ± 0.2	112.8(1087)	<0.0001	-
Nestling age	0.6 ± 0.09	149.5 (1103)	<0.0001	-
Date in season	-0.03 ± 0.007	15.0 (1086)	0.0001	-
Time of day	0.2 ± 0.4	3.6 (787)	0.06	-
Parent age	-0.1 ± 0.2	0.3 (1086)	0.6	-
Partner trips	0.07 ± 0.03	5.8 (1097)	0.02	-
Precipitation***	0.04 ± 0.05	0.6 (1085)	0.44	-
Brood size by nestling age	0.4 ± 0.1	5.4 (1207)	0.02	-
Brood size by parent age	0.3 ± 0.09	8.2 (1254)	0.004	-
Partner trips by date	-0.003 ± 0.001	10.6 (1234)	0.001	+8.7
Partner trips by time	0.2 ± 0.09	6.0 (606)	0.01	+4.1
Partner trips by age	0.1 ± 0.04	8.2 (1209)	0.004	+6.2
Partner trips by precipitation	0.02 ± 0.01	4.6 (1254)	0.03	+2.5
Nestling age <sup>2</sup>	-0.1 ± 0.03	15.4 (1260)	0.0001	+13.6
Sex (F-M) by brood size	-1.8 ± 0.3	35.4 (1088)	<0.0001	+33.4
Sex (F-M) by nestling age	0.4 ± 0.1	10.9 (1084)	0.001	+9.0
Sex (F-M) by date	0.03 ± 0.01	8.0 (1085)	0.005	+6.1
Sex (F-M) by time	-2.7 ± 0.9	7.8 (922)	0.005	+6.0
Sex (F-M) by brood size by nestling age	-0.4 ± 0.1	7.9 (1208)	0.005	+6.0
Sex (F-M) by brood size by parent age	-1.1 ± 0.5	5.7 (1257)	0.02	+3.8

Individuals differed in how provisioning changed with nestling age and partner behavior (variation in plasticity).

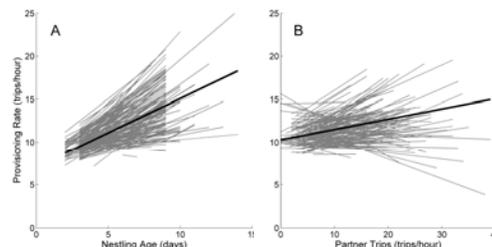


Fig. 1. Estimated individual reaction norms obtained from solution to LMM models with a random slope term either to (A) nestling age or (B) partner trips.

Significant covariance existed between personality (intercept) and plasticity (slope) in response to nestling age (Fig. 1A) and to partner trips (Fig. 1B).

## Discussion

Parental care in sparrows appears influenced by different types of decision-making. **Fixed differences:** Parent sparrows appear to differ in mean level of care over multiple nesting attempts. This suggests either genetic influences or permanent effects arising early in development.

**Flexibility:** Care changes in association with many other variables and such changes may be contingent on fixed individual attributes (e.g., gender) or other labile environmental factors. This suggests integration of information from multiple sources in ways that differ between the sexes.

Despite all the terms in the model, 55% of variance provisioning within individuals is unexplained. An intriguing possibility: **Stochasticity** may lead to decision-making about variance itself. If so, we predict that some parents will be variance averse and others will gamble with their offspring and be variance prone (Fig. 2). Future studies will tackle this hypothesis.

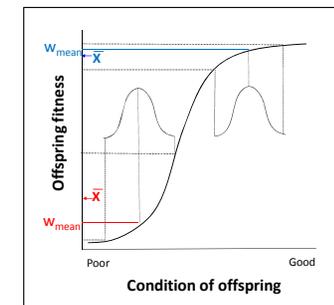


Fig. 2. Conceptual basis for why parents might vary in variance sensitivity. Choice of a variable option has different consequences depending on condition of offspring.

Acknowledgements: We thank the NSF, Department of Biology, and UK for funding, our many field helpers, and colleagues for advice.