

Contribution of genetics to the study of animal personalities: a review of case studies

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(Accepted: 7 June 2005)

Summary

The need for evolutionary studies on quantitative traits that integrate genetics is increasing. Studies on consistent individual differences in behavioural traits provide a good opportunity to do controlled experiments on the genetic mechanisms underlying the variation and covariation in complex behavioural traits. In this review we will highlight the contribution of genetic studies in animal personality research. We will start with reviewing the evidence that shows how much variation in animal personality traits is genetic, and connect this to knowledge from human personality studies. We will continue by considering the nature of that variation, its generation and maintenance. Finally we will point to further possibilities for studying the genetics of animal personalities. We will underline the importance of integrating both proximate and ultimate approaches when studying the evolution of animal personalities.

Keywords: behavioural syndrome, quantitative genetics, genotype environment interaction, reaction norm, phenotypic plasticity, context dependence, *Parus major*.

Introduction

Individual differences in e.g. aggression, neophobia, exploration and boldness in social and non-social conditions have been investigated in behavioural, physiological, psychological, ecological and agricultural studies, and

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have been demonstrated in many domesticated and wild animal species (for reviews see Gosling & John, 1999; Koolhaas et al., 1999; Wilson et al., 1994). Individual differences in a range of correlated behavioural traits have been labelled as temperament (Réale et al., 2000), coping strategies (Benus et al., 1991; Wechsler, 1995), coping styles (Koolhaas et al., 1999), behavioural syndromes (Sih et al., 2004a, b) or animal personalities (Dall et al., 2004; Gosling & John, 1999), comparable with human personalities (Eysenck & Eysenck, 1985; John, 1990; Zuckerman, 1991). The consistency of trait combinations and the resulting high level of correlation between behavioural traits allow this identification of animal personalities.

The idea that individual behavioural differences were only the raw material natural selection acted on gradually changed to the concept that being different might well be adaptive in itself. In that case, behavioural traits are not only characterised by an adaptive mean flanked by non-adaptive variation, but the variation in itself may also be maintained by natural selection (Barnard & Sibley, 1981; Lott, 1984; Wilson, 1998). A rapidly increasing number of studies demonstrate that this thinking may have consequences for many current ecological models (Dall et al., 2004; Sih et al., 2004a) and some have shown that these behavioural differences shape variation in decisions of individual animals and thereby also in life-history traits (see for a review, Dingemanse & Réale, 2005).

Studies on fitness and natural selection in any trait require models that incorporate explicit genetic mechanisms, since the expected response to natural selection depends on the underlying genetic structure. Although genetic approaches have proven to be important to answer questions about adaptive significance and the evolution of life-history traits, the genetic basis of behavioural traits in studies with an ecological or evolutionary context has been neglected (Boake et al., 2002). Most information available on the structure of inheritance of personality traits comes from either human (Benjamin et al., 1997; Ebstein et al., 2000; Bouchard, 2004) or rodent studies (Sluyter et al., 1996). Although genetic studies on human personalities are immensely valuable, the step from describing variation in personality in humans to a more evolutionary approach is a big hurdle (Bouchard, 1994). Animal models have proven to be a useful tool in getting a better grip on the underlying genetic mechanisms of behavioural traits (e.g. Wehner et al., 2001). Unfortunately, most genetic studies on personality traits were performed on populations bred in captivity over a long time (laboratory animals and husbandry)