

Epigenetic effects on personality traits: early food provisioning and sibling competition

Claudio Carere^{1,2}, Piet J. Drent³, Jaap M. Koolhaas⁴
& Ton G.G. Groothuis^{1,5}

(¹ Department of Animal Behaviour, University of Groningen, The Netherlands; ² Center for Cellular and Molecular Neurobiology, Behavioural Neuroendocrinology Research Group, University of Liege, Belgium; ³ Netherlands Institute of Ecology, Center for Terrestrial Ecology, Heteren, The Netherlands; ⁴ Department of Animal Physiology, University of Groningen, The Netherlands)

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Summary

The relative contribution of genetic and non-genetic factors in shaping personality traits is of fundamental relevance to biologists and social scientists. Individual animals vary in the way they cope with challenges in their environment, comparable with variation in human personalities. This variation has a substantial genetic basis. Here we describe experiments showing the strength of environmental factors (food availability and sibling competition) in shaping personality traits in a passerine bird (*Parus major*). We manipulated the early rearing condition in two lines (F4) bidirectionally selected for different personalities (fast line: high exploration speed and high aggression; slow line: low exploration speed and low aggression) with a food rationing protocol inducing an impairment in growth rate and an enhancement in levels of offspring solicitation (begging behaviour). Growth impairment was more marked in the slow line. In a first experiment each nest contained experimental and control siblings of the same line (within-nests design). Slow chicks became much faster than their parents in the exploration tests regardless of the treatment, whereas fast chicks had scores similar to their parents and showed no treatment effect. As a consequence, the line difference in exploration behaviour of the offspring was not apparent in the juvenile phase. Six months later the offspring of the slow line was still relatively fast, but lines differed in exploration, since the fast line became even more fast. Food-rationed birds of the fast line were more aggressive than both controls and their fathers, while treatment did not affect the slow line. In a second experiment, carried out only in the slow line, each nest contained either control or experimental siblings (between-nests design). Now, only the food-rationed chicks became faster in exploration. We suggest that the shift in the controls in the within-nests design was

⁵) Corresponding author's e-mail address: A.G.G.Groothuis@rug.nl

due to enhanced sibling competition, forced by the experimental chick. Indeed, the control chicks in the first experiment begged more persistently and had higher exploration scores than the control chicks in the between-nests design. Environmental factors during ontogeny modulate the expression of phenotypic traits against the background of the reaction norm allowed by the genome even in selected lines of animals resulting in profound and reliable differences in behaviour.

Keywords: great tit, ontogeny, food availability, personality, exploration, aggression, sibling competition

Introduction

Personalities, coping styles or behavioural syndromes in animals are ‘packages’ of correlated suites of traits that reflect different ways of dealing with environmental challenges. They are influenced by genetic as well as non-genetic factors (Wilson et al., 1994; Koolhaas et al., 1999; Gosling, 2001; Broom, 2001; Sih et al., 2004a, van Oers et al., 2005), but little is known about their precise origin. The few genetic selection lines that have been sufficiently characterized indicate a strong genetic basis in birds and mammals (house mouse, *Mus musculus*: Benus et al., 1991; Koolhaas et al., 1999; farm mink, *Mustela vison*: Malkvist & Hansen, 2003; great tit, *Parus major*: Drent et al., 2003; van Oers et al., 2005). These lines are thought to represent the extremes of response patterns that coexist within populations. The general response patterns can be described as the ‘proactive’ and the ‘reactive’ styles (Koolhaas et al., 1999). Proactive copers are more guided by internal mechanisms than by environmental stimuli and easily develop routines. Reactive copers are more flexible and respond more to environmental stimuli (Benus et al., 1991; Koolhaas et al., 1999; Koolhaas et al., 2001; Carere et al., in press).

Unfortunately, ontogenetic studies rarely consider a sufficiently wide spectrum of behavioural characteristics to show conclusively that the effects of rearing conditions are exerted on a coherent set of traits (Koolhaas et al., 1999). Whether early environmental factors affect a whole profile as a trait characteristic is unknown. Although descriptive studies in the mouse lines revealed differences in the maternal environment (higher levels of maternal care in the more aggressive and proactive line, Mendl & Paul, 1991a; Benus & Røndigs, 1996), handling and cross-fostering, even by means of embryo transfer, produced little or no effect, suggesting low behavioural plasticity