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Guest editorial

Fluctuating Asymmetry and Animal Welfare: How Far Are We? And How Far Should We Go?

In the associated review, published in this issue of the *Journal*, Møller and Manning (2003) propose measures of developmental instability, primarily fluctuating asymmetry, for the assessment of animal welfare in agricultural practice. They see the advantages of fluctuating asymmetry in that it provides a single measure of organismal health that "can be used in all kinds of organisms including viruses, plants and animals" and comes with perfect symmetry as a built-in optimum.

Møller and Manning's paper continues a string of publications that have extolled the virtues of fluctuating asymmetry as a measure of individual quality or of the effects of stress. A few haphazard examples will suffice although a comprehensive review can be found in Møller and Swaddle (1997). Manning and Ockenden (1994) reported that racehorses with more symmetric head and foreleg traits have better racing ability than more asymmetric horses, and in a study of human middle distance runners, Manning and Pickup (1998, p. 205) concluded "that symmetry in traits such as nostrils and ears indicates good running ability." Møller *et al.* (1995, p. 217) infer from a study correlating women's breast asymmetry with the number of their children that "Breast fluctuating asymmetry reliably predicts fecundity and may be a cue used directly by males in their choice of fecund and attractive partners." If fluctuating asymmetry correlates with individuals' abilities to cope with stress, as they argue (Thornhill and Møller, 1997, p. 538) then "morphometric analysis of soft tissues may reduce occupational errors in occupations ranging from surgery to flying aircraft."

This research programme has flourished in the last decade, as evidenced by a large number of publications, and has expanded to many new areas of application. Some researchers in the field of fluctuating asymmetry, however, have met claims like those quoted above with scepticism (Houle, 1998; Simmons *et al.*, 1999) or even ridicule (Palmer and Hammond, 2000).

So can fluctuating asymmetry be used as a general means to assess animal health and welfare? And could a technician measuring asymmetry replace the highly skilled veterinarian and costly laboratory tests in this task? A difficulty with fluctuating asymmetry in this context is that it is unspecific. Increased fluctuating asymmetry has been correlated with a variety of stress factors such as non-optimal temperature, insufficient nutrition, various chemicals, high population density and noise, among others (Møller and Swaddle, 1997, ch. 6). Moreover, because fluctuating asymmetry also has a genetic component, genetic differences can be a confounding factor that needs to be considered as well. Therefore, increased asymmetry may be due to any of these or other factors, and a diagnosis of the specific factor responsible must still be made for each case.

This ambiguity in terms of the factors causing increased fluctuating asymmetry relates to another point of criticism: the lack of knowledge of the mechanisms by which these factors influence fluctuating asymmetry. There are many different models of the processes generating developmental instability that are built on very different assumptions, but which can all produce outcomes resembling the patterns found in empirical data (reviewed by Klingenberg, 2002). The same empirical patterns may therefore be consistent with several competing models, even if they make contradictory assumptions, and it is unclear how close any of the models are to reality. Some postulated mechanisms, such as specific signalling between corresponding parts on opposite body sides, seem at odds with mainstream developmental biology. There is an urgent need for tests of this sort of model assumptions by manipulative experiments that can rule out alternative explanations. In general, there is little experimental evidence on mechanisms involved in generating or buffering against fluctuating asymmetry. Therefore, more mechanistic approaches are required to advance the knowledge of fluctuating asymmetry beyond its current state, which is based primarily on correlative studies showing a link between asymmetry levels and some internal or external factor.

In the field of human medicine, Thornhill and Møller (1997, p. 538) claim that "Evidence suggests that fluctuating asymmetry may be comparable to the physicians' thermometer—both are sensitive indicators of departure from homeostasis. Fluctuating asymmetry, however, may be more useful than the thermometer..." Whether fluctuating asymmetry will be similarly useful for veterinarians in the assessment of animal welfare, let alone more useful than current methods, remains open to

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question. At the risk of sounding pessimistic, for the time being, I will follow this research with an attitude of sceptical interest.

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