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Stress

On most occasions when people say that they are stressed, or that some other individual whether human or not is stressed, they mean that their environment is having an adverse effect on them. The effect may be physical, or mental, or a combination of the two but there is an implication that it will be, or may be, prolonged and harmful. This widespread and long-standing use of the word stress has become confused by the too close linking of the term to one of the responses to adversity, that of the adrenal glands. Hans Selye encouraged research in this area with his many publications but emphasised that the secretion of glucocorticoids from the adrenal cortex is a widespread, non-specific stress response. Detailed analysis of the hormonal response, using assays which were not available to Selye, revealed that the physiological response is much more variable than Selye contended. For example, work by Mason and others showed that exposure to high temperature, haemorrhage, prolonged close confinement, a non-nutritive diet or dehydration elicited no adrenal cortex response or reduced glucocorticoid production. Adaptive, useful activities such as courtship, copulation and hunting for food also elicit glucocorticoid production. Hence it is not useful to define the term stress with reference to increased adrenal activity.

Selye's usage of the word stress for circumstances where the overall effect of the environment on the individual was not at all adverse, for example saying "stress is not something to be avoided .... we can enjoy it by learning more about its mechanisms", led to particular confusion. Scientists used the word stress to refer to even minor perturbations of homeostasis and one defined it as "any displacement from the optimum state" so that stress seemed to be the effect of almost any stimulus. Brief exposure to the warm sun, which elicits simple physiological and behavioural responses, would be called stress using such a definition. To use stress for a

circumstance where such regulatory responses occur is unnecessary and misleading. A better criterion is needed for the extent of consequences of environmental impact in order that stress is a useful scientific concept.

The necessity for consideration of psychological as well as physical effects of the environment on individuals has been emphasised in many discussions of stress. All of the coping methods should be taken into account. It is of interest in this context that many of those discussing stress in domestic or wild animals have tended to emphasise physical problems whilst people discussing themselves concentrate on coping difficulties of a mental nature. At least in the more complex animals, both must be important and stress does not refer to a single coping system.

The writings of Selye on stress have been confusing in another way. Stress has been referred to as an environmental factor which exists irrespective of any animal; as the process by which such a factor affects an individual; and as the long-term consequences of these effects. Physicists use it in the first sense and use strain for the response. However, the biological use is different and it is best to restrict it to meaning an effect on the individual and to use strain for its consequences.

The ultimate measure of adversity for an animal is impairment of biological fitness. If an individual is affected by its environment to such an effect that it is less able to pass on its genes to the next generation because it dies or is unable to produce as many offspring then its fitness is reduced and that environmental effect is adverse. In many cases it is not easy to be sure that fitness is reduced but it can be confidently predicted on the basis of previous knowledge. One important indicator of potential reduction in fitness is what Moberg has called 'pre-pathological state.' Physical and psychosocial factors can have immunosuppressive effects and can lead to increased risk of pathology in the individual.

In order to take account of the functioning of coping systems and each of the points made above, stress is defined as an environmental effect on an individual which overtaxes its control systems and reduces its fitness or appears likely to do so. A distinction is therefore made between a minor disturbance to an individual's equilibrium which may necessitate the use of energy to correct it but has no consequences for fitness and would not be referred to as stress and greater effects which are sufficient to reduce fitness.

Stress may result from a variety of kinds of effects but Selye was right to emphasise that particular changes in physiology and immune system function are common to many individuals and circumstances. A variety of harsh conditions can result in immunosuppression, increased pathology and sometimes in general failure of body function and then death. It is clearly important for each person to consider potential harmful effects of physical conditions and lifestyle when organising their own lives and providing conditions for animals for which they have some responsibility.

There is an overlap between the concept of stress and that of the welfare of an individual. Welfare, according to my definition refers to the state of an individual as regards its attempts to cope with its environment. Hence it can be good or poor and if the individual is stressed its welfare will be poor. However, stress refers to failure to cope with the environment and poor welfare also includes the situation in which the individual has difficulty in coping with its environment without fitness reduction.

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