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Human parallel to voluntary wheel running: exercise

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Sherwin (1998) is to be complimented on an accurate and remarkably complete review of voluntary wheel running in animals. The explanation suggested for wheel running is that it is a multidetermined, self-reinforcing, behaviour and its excessive nature may be an artefact of the laboratory environment. Why wheel running should be so excessive and prove self-reinforcing are questions that can be addressed at several levels from neurological to ethological. In addressing the reasons for wheel running, a human parallel, voluntary exercise, may provide a useful framework within which to develop an explanation for it. Humans voluntarily engage in frequent physical exertions that, like wheel running, have no obvious immediate goals, although both may result in long-term health benefits. Many similarities exist between this intrinsically motivated human exercise and the wheel running seen in animals, so analysing them together may lead to theories explaining both. Human and animal studies are also complementary as each may answer different aspects of the same question.

It is interesting that both voluntary exercise and voluntary wheel running occur in situations where energy expenditure is very low. Animals in laboratory environments need to engage in very little activity to survive, while in western society many humans in their day-to-day life are very inactive. The concern with obesity in today's society is also a concern with inactivity. Rats with wheel access maintain a body weight that is lower than inactive control animals (Collier 1970), suggesting that inactive animals are obese. Thus, both from a weight regulation and an activity perspective the relation between voluntary wheel running and voluntary exercise may be an important research area.

Voluntary, intrinsically motivated exercise has many long-term benefits for the individual's physical health (especially if they are otherwise inactive). Very few, however, would regularly engage in this behaviour if it had no psychological benefits. While there may be social and other extrinsic benefits for some cases of exercise, often it occurs in the apparent absence of these rewards. It has been suggested that physical exercise has positive consequences for mood and mental health (Raglin 1990; Gauvin & Spence 1996; Scully et al. 1998). A regular exercise programme helps depressed individuals, and it also improves other negative mood states. Exercise deprivation has adverse effects on well-being and mood (Szabo 1995; Mondin et al. 1996). Regular sustained exercise seems to produce a positive affective state and not exercising for some period results in a negative affective state. Some aspect of exercise's physical effects must ultimately mediate these psychological results of exercise. There is no reason to suggest that humans are unique in these psychoactive physical consequences. The mood-elevating effects of exercise in humans should also be evident in animals. Thus, the human studies suggest a psychological basis for the wheel running seen in animals.

One explanation for the mood-influencing effects of voluntary exercise in both humans and animals that has received some attention is the suggestion that exercise results in changes in the brain endorphins and monoamines (Chaouloff 1989; Dishman 1997; Goldfarb & Jamurtas 1997). These neurotransmitters are important in regulating positive affect in the brain: drugs that act on the dopamine and endorphin systems, stimulants and opiates, have a high addiction liability; drugs used clinically to treat depression also have their effect on serotonin and norepinephrine synapses. There is therefore considerable interest to see whether, and exactly how, voluntary exercise produces changes in these systems. Ethical restrictions limit human studies, and animal studies using voluntary wheel running provide a model that may elucidate the neural basis of the psychological benefits of exercise.

A further parallel between the human and the animal literature is that sometime exercise and wheel running are harmful. If animals are fed 1 h a day and given wheel

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access (a procedure called activity-based anorexia) their food consumption is down and their running is elevated, compared with controls, and most will die unless the experiment is terminated (Epling et al. 1983). Humans who engage in regular sustained exercise sometimes suffer from exercise addiction; they seem unable to stop exercising even when it is medically necessary (De Coverley Veale 1987; Pierce 1994; Annett el al. 1997). This is interesting as exercise and addictive drugs may activate similar brain systems. Anorexia nervosa has excessive exercise as a secondary symptom and has been linked to exercise addiction and to activity-based anorexia in animals (Davis 1997). A better understanding of voluntary wheel running and exercise may have relevance for both eating disorders and drug addictions. Clearly more work exploring these parallels would be very profitable.

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