

## Box 6.2. Maternal Deprivation and Stereotypy in Animals other than Primates

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Social deprivation profoundly affects primate abnormal behaviour (*cf.* this chapter, and recent complementary reviews by Sackett *et al.*, 1999; Sanchez *et al.*, 2001; Gilmer and McKinney, 2003). But what about other taxa? Most animals kept by humans are removed from their mothers earlier than would happen naturally: for instance, horses, farmed mink and laboratory mice are separated from their mothers before natural dispersal age; piglets are removed while still dependent on milk; and more extreme still, dairy calves and hatchery-raised poultry have respectively minimal maternal contact (separated on day 1) and none at all (e.g. Mason, 1995; Roden and Wechsler, 1998; Latham and Mason, 2004; and *cf.* Chapters 2 and 4, this volume). So could standard husbandry practices be predisposing animals to abnormal behaviour?

In many instances, this early separation promotes the rapid emergence of stereotypies, whose 'source behaviours' (see Box 1.1, Chapter 1 this volume) appear to be frustrated suckling or escape attempts. Dairy calves thus show intense non-nutritive sucking, which seems to have similar physiological effects (e.g. on insulin) to normal teat-sucking following milk let-down (de Passillé *et al.*, 1993); early weaned kittens 'wool-suck' (e.g. Morris, 1987); and piglets rub their snouts on the floor and 'belly-nose' the flanks of their fellow-piglets – behaviours typically more frequent the younger the piglets were weaned (e.g. Bøe, 1997; Worobec *et al.*, 1999; Widowski *et al.*, 2003). In mice, gerbils and black rats, back-flips and bar-mouthing similarly develop rapidly when young are moved from the natal cage (see Chapter 4, this volume; Callard *et al.*, 2000; Waiblinger and König, 2004). In mice (at least) these seem to begin as escape attempts; and in both mice and gerbils, individuals with the youngest developmental ages at separation go on to develop the most frequent stereotypies. Pacing the enclosure can even occur in young pygmy hippopotamuses after removal from the mother – and very intensely, albeit transiently (Stroman and Slaughter, 1972; see also the transient pacing of briefly maternally-separated primate infants, this chapter).

However, such stereotypies can persist long after frustration should have waned. Thus mouse stereotypies do not decline once natural dispersal age passes, but instead persist or even increase (e.g. Latham, 2005), and more anecdotally, the same seems true for oral stereotypies in a subset of early weaned cats, pigs and cattle (Fry *et al.*, 1981; Morris, 1987; T. Widowski, personal communication, Guelph, 2005). Indeed sometimes maternal deprivation has effects that are latent until young adulthood. Thus mink separated from their mothers around natural dispersal age (11 weeks) are no less active over the following 2 months than animals separated at 7 weeks, but when pacing and similar appear 3–4 months later, the late-separated animals start to differ, developing stereotypies that are both less frequent and more variable (Mason, 1992, 1996; see also Mason, 1995 and Jeppesen *et al.*, 2000). Likewise, poultry chicks reared with their mothers show no less feather-pecking at 2 months than chicks reared with peers alone (Roden and Wechsler, 1998), but once they are 3–7-month old pullets, they then emerge as less likely to be feather-peckers, and spend less time in the behaviour (Perré *et al.*, 2002).

Such effects are not deterministic – many factors other than maternal deprivation affect both the development and the continued performance of the stereotypies discussed here, including individual differences and the physical environment post-weaning (e.g. Mason, 1996; Bøe, 1997; Jeppesen *et al.*, 2000; Widowski *et al.*, 2003). However, these data do suggest that early maternal deprivation can have long-term effects in taxa other than primates. In species as diverse as mice, pigs and poultry, maternal deprivation also affects immediate stress levels (see Chapter 4, this volume), later anxiety and stress responsiveness (e.g. Adriani and Laviola, 2002; Perré *et al.*, 2002) and brain dopaminergic (Fry *et al.*, 1981; Sharman *et al.*, 1982; Adriani and Laviola, 2002) and serotonergic (Sumner *et al.*, 2002) systems (*cf.* similar findings for primates) – although such data are somewhat patchy. Exactly how such effects are mediated thus looks a fascinating, practically important area for future research.