

The Effect of Maternal Deprivation and Isolation on Development of Abnormal Behaviour in Laboratory Rhesus Macaques

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Introduction

Mother-infant separation and isolation of offspring are common husbandry practices in laboratory-raised rhesus macaques (Latham & Mason, 2008). Studies have demonstrated a link between these practices and development of fear, aggression and self-injury in offspring (Latham & Mason, 2008). Desensitisation training, pair-housing, and providing active enrichment have proved successful in reducing occurrence of some of these behaviours.

Discussion

Laboratories maximise reproductive efficiency of adult females by separating mothers and infants, reduces costs involved in procuring new research subjects (Reinhardt, 2002). Mother-rearing provides a vital source of comfort and reassurance for offspring, with mother-reared laboratory macaques displaying 34% less abnormal behaviour post-weaning than their human-reared counterparts (Rommeck *et al.*, 2009). Depression and fear associated with separation are attributed to reduced neurotransmitter serotonin production, and serum cortisol elevation (Smotherman *et al.*, 2004). The International Primatological Society recognises the importance of mother-rearing, recommending postponing separation until 18 months of age (Reinhardt, 2002).

Natural responses to fear, including defence or flight, are prevented in the laboratory environment, causing fear to manifest as rocking and cringeing behaviour (Clay *et al.*, 2009). Severe impairment of the physiological stress response and immunosuppression result, both compromising wellbeing of the animal (Clay *et al.*, 2009) and introducing variables that may affect reliability of laboratory experimental results. Altering structural aspects of laboratory environments is not feasible, but remodelling an animal's reaction to fear-provoking stimuli may reduce such effects (Clay *et al.*, 2009).

A study by Clay *et al.* (2009) examined the success of desensitisation, basic behavioural training, and habituation in reducing fear responses in singly-housed rhesus macaques. Desensitisation is the elimination of a response to a phobic stimulus by gradually increasing frequency or magnitude of exposure to the stimulus (Clay *et al.*, 2009). Habituation is the cessation of, or decreased response to, any repeated or prolonged stimulus (Clay *et al.*, 2009). Subjects included 18 adult male macaques between the ages of 3 and 7 that exhibited rocking, freezing and cringeing behaviour (Clay *et al.*, 2009). Subjects were divided equally into desensitisation, basic behavioural training, and habituation groups (Clay *et al.*, 2009). Measurements of degree of fear were based on the frequency of freezing and startle behaviour, and duration of cringeing (Clay *et al.*, 2009). Behaviour was recorded prior to training, and following training 6 weeks later (Clay *et al.*, 2009). Desensitisation minimised duration of cringeing, while frequency of fear-related behaviour remained unchanged in basic behavioural training and control/habituation groups (Clay *et al.*, 2009). Desensitisation could be used as a fear-reduction technique to enhance wellbeing of laboratory rhesus macaques.

Because of their social nature and intelligence, rhesus monkeys require compatible conspecifics and active environmental stimulation (Lutz & Novak, 2005). Frustration associated with isolation in small wire cages and lack of environmental enrichment leads to self-biting, hair-plucking and head-banging (Rommeck *et al.*, 2009). This is verified by a past study in which laboratory macaques were completely isolated, deprived of sight, sound, and interaction with other monkeys, during the first 6 months of life. They exhibited self-clasping and self-injurious behaviours (Harlow *et al.*, 1969).

Compatible pair-housing has been shown to reduce self-injurious behaviour, and promote expression of species-appropriate social behaviour (Lutz & Novak, 2005). The effects on behavioural and physiological wellbeing of introducing compatible conspecifics to singly-housed rhesus macaques have been investigated (Doyle *et al.*, 2008). Subjects included 8 male rhesus macaques between 5 and 6 years old (Doyle *et al.*, 2008), all of whom were mother-raised, then socially housed for 4 years before transfer to single-housing for 4-19 months (Doyle *et al.*, 2008). The success of pair-housing was determined by decreased stress and the presence of species-specific behaviour. Measurement of stress was based on elevations in heart rate and faecal cortisol concentrations, with subjects surgically implanted with heart rate monitoring devices prior to commencement of the study (Doyle *et al.*, 2008). Subject-pairing based on recommendations of previous studies (that a large weight disparity within pairs increases compatibility) (Doyle *et al.*, 2008), produced similar results in a temperament assessment test. Social introduction began with visual contact between pairs through a separating panel of bars spaced 2cm apart (Doyle *et al.*, 2008). Twenty-four hour monitoring of aggression or fighting was conducted before the panel was removed and full contact established (Doyle *et al.*, 2008). Stable elevated heart rates and faecal cortisol concentrations were observed in the first two weeks but a desirable gradual decrease in these levels was noted over the remainder of the study (Doyle *et al.*, 2008). Locomotive activity increased, and grooming was initiated 24 hours after full contact was established (Doyle *et al.*, 2008). Compatible pair-housing should be considered an alternative to single-housing in laboratory macaques to reduce stress and promote species-specific behaviour.

Environmental enrichment has also been studied as a means of reducing incidence of self-injury (Rommeck *et al.*, 2009). Subjects included 231 adult rhesus macaques, of whom 132 exhibited self-injurious behaviour (Rommeck *et al.*, 2009). Enrichment, in the form of perches, mirrors, kong toys and forage boards, was provided daily over a period of 2 years (Rommeck *et al.*, 2009). In addition, puzzle balls were given three times per week, and fruits and vegetables twice per week (Rommeck *et al.*, 2009). In those animals identified as displaying self-injurious behaviour, less overall abnormal behaviour was observed when engaged with the stimulants. However, incidence of self-injury remained unchanged (Rommeck *et al.*, 2009). These findings are consistent with an earlier study, which examined the effectiveness of puzzle feeders in alleviating self-injury in rhesus macaques with a veterinary record of self-harm. Whole body stereotypies, including pacing and rocking, were reduced substantially in all animals while engaged with the puzzle feeder (Novak *et al.*, 1999). However, self-biting behaviour was unchanged, with some rhesus macaques biting themselves while manipulating the feeder (Novak *et al.*, 1999).

Conclusion

The genetic and physiological similarities between rhesus macaques and humans render them favoured subjects for laboratory experimentation. Alternatives to mother-infant separation and isolation, such as allowing mother-rearing and pair-housing, should be implemented to minimise fear, aggression and self-injury. These changes would improve physiological and behavioural wellbeing of subjects, appease animal welfare activists, and improve research quality, since abnormal behaviours are uncontrolled extraneous variables that increase data variability.

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