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What is the “Least Bad” Control in Comparative Thanatology Studies? A Comment on Arlet *et al.*, 2023

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We were excited to read a recent article adding to the growing field of comparative thanatology, a field that aims to understand the cognitive and emotional responses of animals to the deaths of others. The authors describe the behavioural responses of 18 bonnet macaque (*Macaca radiata*) mothers to the deaths of their infants (Arlet *et al.*, 2023). While the high number of infant deaths is a lamentable occurrence, we commend the authors for using these data to explore the question of maternal grief.

The Arlet *et al.* (2023) data raise a question about what makes an appropriate control in thanatological studies. The authors compared the mothers' behaviour before and after their infants' deaths, focussing on social behaviour, vocalisations, and indicators of acute stress. The authors found that, after their infants' deaths, females spent less time in the centre of the group, had fewer neighbours, and were groomed less frequently than before. The authors argue that these data are indicative of social withdrawal, analogous to a symptom of grief in humans. Additionally, the authors report that females vocalised more when bereaved and performed more self-directed behaviours than before losing their infant.

We argue that, in the case of group-living female primate social behaviour, the reported findings on social behaviour could be predicted by the presence of an infant, rather than grief. For example, most primates find infants attractive (Silk *et al.*, 2003), and many studies have shown that females with infants are groomed more frequently than females without (Frank & Silk, 2009). Indeed, the data from Arlet *et al.* (2023) show this: bereaved females *initiated* the same amount of grooming both before and after their infants' deaths but *received* significantly less. We would predict that, if the females were socially withdrawn because of grief, they would *initiate* significantly less grooming but *receive* the same amount. These data seem to be better explained by females' attraction as a

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social partner and does not support social withdrawal as the explanation. Similar predictions could be made for mother and nonmother spatial position and numbers of neighbours. Because females without infants are not as attractive as social partners, we would predict that they would more often be peripheral and have fewer neighbours *because they do not have an infant*.

We find the vocalisation and acute stress data to be more convincing and potentially in-line with predictions about grief. However, these data raise the question of what makes an appropriate control. While in some situations an individual can be considered its own control, such an approach is not adequate for all research questions. In the case discussed here, internal changes in the bereaved mother, such as the potential emotional consequences of grief, are confounded with external changes caused by the immediate social environment, such as the presence of an infant or the attitudes of other group members towards the mother. To detect internal changes in the mother, such external changes must be controlled for.

Taken together with the above example of natal attraction in primates, we argue that a better control in cases of bereaved mothers would be an unrelated groupmate with no infant, matched for age and rank as closely as possible to the bereaved mother, and observed in the same group over the same time period as the bereaved mother to control for broader ecological (e.g., food availability) and social (e.g., hierarchical instability) sources of stress as much as possible. This way, one could test whether the bereaved mother seems less social, more vocal, and expresses more stress-related behaviour than a groupmate female of her age and rank that does not have an infant and thus is equally attractive socially. In a previous thanatological study, this was the approach taken: in the month after the death of a groupmate, the faecal glucocorticoid (fGC) levels of a closely bonded and matched control were compared, showing that bereaved females had higher fGCs than controls (Engh *et al.*, 2006). Such an approach is not immune to weaknesses, of course. For example, it can be difficult to identify appropriate matches in small groups. It also requires twice as many observations (for the bereaved mother plus the matched individual). It may, however, provide a more accurate picture of the behavioural changes expected after the death of an infant.

Our goal with this comment is not to suggest that primates do not grieve or that opportunistic studies do not provide insights into the behaviour of bereaved individuals. Our goal is the opposite: a rallying call for a more systematic field of study. Overall, we wish to highlight that, although the field of comparative thanatology is relatively young, we are now at a point where more care needs to be taken. We are acutely aware that thanatological data are difficult to collect and most are collected opportunistically, and we see value in these reports. But given that field experiments regarding reactions to deaths are unethical to perform, this field depends, more than any other, on the quality and rigour of observational investigations. We encourage more prospective, systematic data collection and careful consideration of appropriate controls, as emphasized here. Additionally, we emphasize the importance of careful interpretation of data considering alternative explanations and careful formulation of predictions through thoughtful, cross-disciplinary conversations.

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