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Animal Welfare 2021, 30: 381-392
ISSN 0962-7286
doi: 10.7120/09627286.30.4.002

Behavioural diversity as a potential welfare indicator for professionally managed chimpanzees (Pan troglodytes): Exploring variations in calculating diversity using species-specific behaviours

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Abstract

*Behavioural diversity may serve as a positive indicator of animal welfare that can be applied in long-term monitoring schemes in managed settings (eg zoos, laboratories, farms). Behavioural diversity is often higher when animals live in stimulating environments and experience positive events. Unfortunately, welfare researchers have not adopted consistent, standardised approaches to measuring behavioural diversity. The goal of this exploratory study was to utilise data from 41 adult chimpanzees (*Pan troglodytes*) housed across 16 zoological institutions to examine various models of Shannon's Diversity Index. Specifically, we investigated the impact of: combining versus splitting behaviours, including only positive behaviours, including human interaction, and considering recipient behaviours. We evaluate how the inclusion or exclusion of different behaviours impacts the relationship of behavioural diversity with: (i) concentrations of faecal glucocorticoid metabolites (GCM), a common indicator of adrenal activity; (ii) concentrations of immunoglobulin-A (IgA), an indicator of immune function and potential indicator of positive welfare; and (iii) stereotypic behaviour, a validated indicator of poor welfare. Most indices had significant negative relationships with faecal GCM. Animals that express a variety of behaviours from their species-typical repertoire have lower average faecal GCM concentrations and are likely experiencing better welfare. We did not find significant relationships between the behavioural diversity indices and IgA concentrations. Two indices were inversely associated with stereotypic behaviour. Our findings provide additional support for using Shannon's Diversity Index to calculate behavioural diversity as a robust, valid measure of positive welfare. However, future publications must justify the process for including or excluding behaviours from calculations.*

Keywords: *animal welfare, behavioural diversity, chimpanzee, faecal glucocorticoid metabolites, immunoglobulin-A, Shannon diversity index*