New Findings regarding the Stereotypic Behaviour of "Regurgitation and Reingestion" in Captive Western Lowland Gorillas

By Chau Bui

Word count: 966

Introduction

"Regurgitation and reingestion" or "R/R" is defined as a retrograde movement of foodstuff from the oesophagus or stomach to the mouth, hand or floor, and its subsequent ingestion (Lukas, 1999). R/R is not part of a gorilla's normal feeding mechanism hence it is regarded as an anomalous behaviour, indicating sub-optimal welfare in captive gorillas (Bloomsmith *et al*., 1991). R/R is regularly seen in captive gorillas (Akers & Schildkraut, 1985) but has not been reported in the wild (Hill, 2009). This paper aims to discuss recent studies that have provided insight into possible pathological consequences, causes, and prevention strategies of R/R in captive western lowland gorillas (*Gorilla gorilla gorilla*).

Discussion

Despite the prevalence of R/R in captive primates, not much is known about this disorder. Lukas (1999) reported no direct health problems associated with R/R. However, a recent investigation by Hill (2009) revealed that regurgitated material contains stomach acid, a potentially injurious substance that can create oral or esophageal pathology during regurgitation or reingestion. The aim of Hill's study was to investigate whether regurgitated food had a lower acidity level than the original ingested meal, and whether this acidity originated from saliva, or stomach acid. A group of captive gorillas at Barcelona Zoo was used with regurgitated material being taken opportunistically from their enclosures. Acidity of saliva was obtained by encouraging gorillas to lick pH indicators through cage bars. Gorillas had not been trained to lick pH indicators so samples were limited. Results merely showed that stomach acid is present in regurgitated material, but further investigation is needed to determine any pathological significance.

Nevertheless, it is still important to determine the factors that contribute to R/R, in order to create a strategy for prevention. Shyne (2006) states that stereotypy can arise from frustration caused by an animal's inability to carry out particular goal-directed behaviours. It has been suggested that captive gorillas resort to R/R because there is no substrate with which to engage foraging ("goal-directed" meal-seeking) behaviour, an essential species-specific activity of wild gorillas (Hill, 2009). This suggestion is supported by recently published field observations by Masi *et al.* (2009), which documented activities of habituated western lowland gorillas in their natural environment, on a daily basis, systematically, over a one-year period. The aim of the study was to quantify the activity budgets of wild western lowland gorillas. The results revealed that due to a patchy distribution of fruit in their natural habitat wild gorillas spend most of their time (67%) feeding and foraging (i.e., engaging in "goal-directed", species-specific behaviour). In captivity, however, time spent foraging is limited, due to limited enclosure space and a fixed feeding schedule (Hill & Broom, 2009; Hosey *et al.*, 2009). Consequently, it is possible to prevent R/R by providing environmental enrichment aimed at encouraging foraging behaviour. In 1986, a study by Gould and Bres demonstrated that R/R could be reduced by feeding browse and, similarly, in 2004, Hill managed to significantly reduce R/R by creating complex feeding environments to encourage foraging behaviour. It is therefore likely that lack of substrate for species-typical foraging behaviour is a major cause of R/R.

It is not essential that environmental enrichment be focused on foraging behaviour. Despite reports by Masi *et al*. (2009) showing that wild gorillas devoted very little time (0.5%) to social activity, encouraging play and social behaviour has been shown to reduce anomalous, stereotypic behaviour in a recent study conducted by Carrasco *et al*. (2009) at Barcelona Zoo. A group of captive gorillas were trialled with positive reinforcement training (PRT)/playing therapy. The aim of this study was to assess whether moderate human interaction with the

captive gorillas is a useful handling tool to increase their wellbeing. Playing sessions involved encouraging species-specific playing behaviours (striking the chest with half-closed eyes, running from one place to another). PRT involved encouraging play by rewarding gorillas with food, sticks and clothing for copying certain play-associated actions. Frequency and duration of certain activities were recorded and compared.

Results show PRT/playing therapy decreased the duration and frequency of anomalous behaviours such as:

licking the glass
self-hugging
licking up vomit of conspecifics
self-stimulation
biting of nails
sucking of fingers
sticking the tongue out
R/R

There was also increased duration and frequency of positive, species-specific, social behaviour among conspecifics (acrobatic, instrumental, and social play, social grooming and affiliative behaviours). Additionally, a decrease in duration of agonistic behaviours (submissiveness, watching another conspecific) was seen, indicating reduced social tension and anxiety. Furthermore, PRT allowed development of relationships between zookeeper/trainer and gorilla, resulting in reduced anxiety during human contact. Hill (2009) suggests that anxiety due to a poor relationship with the zookeeper/trainer could be a major causative agent in R/R, as in the case of *Human Rumination Syndrome,* where R/R in mentally disturbed patients is caused by a poor relationship with his/her care-giver (Thame *et al*., 2000). However, the study cannot conclude whether it was the reduced anxiety levels (from improved social stability, or reduced fear of humans), or encouragement of play behaviour (to offset an inability to engage in foraging behaviour) that contributed to the reduction in R/R. It is likely that both factors contributed to the reduction in R/R.

Another implication of PRT is its usefulness in aiding scientific investigations. For example, in Hill's investigation (2009), samples of regurgitated material and saliva were difficult to obtain in sufficient numbers, as it was often unsafe to approach certain gorillas for collection. Using PRT, gorillas could be trained to safely provide regurgitated samples or lick pH indicators, allowing for larger-scale investigations of this behaviour.

Conclusion

These new findings provide sufficient information and incentive for zoos to implement environmental enrichment for captive gorillas, targeting either encouragement of foraging behaviour and/or play. By doing so, pervasive problematic behaviours such as R/R in captive gorillas could potentially be eliminated.

References

Akers, J.S., Schildkraut, D.S. (1985) Regurgitation/reingestion and coprophagy in captive gorillas. *Zoo Biology* 4, 99-109.

Bloomsmith, M.A., Brent, L.Y., Schapiro, S.J. (1991) Guidelines for developing and managing an environmental enrichment program for nonhuman primates. *Laboratory Animal Science* 4, 372-377.

Carrasco, L., Colell, M., Calvo, M., Abello, M.T., Velasco, M., Posada, S. (2009) Benefits of training/playing therapy in a group of captive lowland gorillas (*Gorilla gorilla gorilla*). *Animal Welfare* 18, 9-19.

Gould, E., Bres, M. (1986) Regurgitation and reingestion in captive gorillas: description and intervention. *Zoo Biology* 5, 241-250.

Hill, S.P. (2004) *Behavioural and physiological investigations of welfare in captive western lowland gorillas* (*Gorilla gorilla gorilla*). PhD thesis, University of Cambridge, UK.

Hill, S.P. (2009) Do gorillas regurgitate potentially injurious stomach acid during regurgitation and reingestion? *Animal Welfare* 18, 123-127.

Hill, S.P., Broom, D.M. (2009) Measuring Zoo Animal Welfare: Theory and Practice. *Zoo Biology* 28, 531-544.

Hosey, G., Melfi, V., Pankhurst, S. (2009) *Zoo animals: behaviour, management, and welfare*. Oxford University Press, Oxford.

Lukas, K.E. (1999) A review of the nutritional and motivational factors contributing to the performance of regurgitation and reingestion in captive lowland gorillas (*Gorilla gorilla gorilla*). *Applied Animal Behaviour Science* 63, 237-249.

Masi, S., Cipolleta, C., Robbins, M.M. (2009) Western lowland gorillas (*Gorilla gorilla gorilla*) change their activity patterns in response to frugivory. *American Journal of Primatology* 71, 91-100.

Shyne, A. (2006) Meta-analytic review of the effects of enrichment on stereotypic behavior in zoo mammals. *Zoo Biology* 25, 317-337.

Thame, M.M., Burton, K.A., Forrester, T.E. (2000) The human ruminant. *West Indian Medical Journal* 49, 172-174.