# A comparison of different methods for quantifying stereotypic behaviour patterns in captive European starlings (*Sturnus vulgaris*)

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Stereotypies, defined as behaviour patterns that are repetitive, unvarying and with no apparent function, are common in laboratory animals. For example, many caged birds show route-tracing stereotypies in which an individual repeatedly visits the same locations, and those familiar with the behaviour of caged starlings will have observed the "somersaulting" stereotypy in which birds perform backward aerial flips repeatedly (Figure 1). Such behaviour patterns have been described in a wide range of captive mammalian and avian species including farm, zoo, companion and laboratory animals. They are most common in barren and or spatially restricting cages and are often interpreted as a sign of poor welfare.

Standard techniques for quantifying stereotypies involve counting of individual incidences of a route being traced or a distinctive behaviour pattern such as a somersault. However, defining these complex sequences of behaviour objectively can be difficult, and is likely to fail to capture stages in the development of stereotypies while sequences of behaviour are still flexible[1]. For these reasons we are developing measures of stereotypy that are both more objective and have the potential to capture early developmental stages of stereotypy.

We will present a comparison of three different techniques for quantifying stereotypies from videotapes of the behaviour of caged European starlings (*Sturnus vulgaris*):

1. Manual counting of complete somersaults (the most easily recognized stereotypy observed in caged starlings).
2. Use of Markov chains to quantify the sequential dependency in a sequence of behaviour. This technique is a modification of one described by Haccou[2], and uses the probabilities of one event following another (P(Z/Y) (first order) or another two (P(Z/XY) (second order) to describe and quantify the sequential dependency in a sequence of behaviour. The more repetitive a sequence of events, the more events Y-Z will be preceded by X. We have applied this technique both to sequences of individual behaviour patterns (e.g. hop, preen, probe substrate etc) and to sequences of spatial locations in the cage occupied by the bird (e.g. floor, perch 1, front wall etc). The latter technique proved much simpler and less time consuming to apply than the former, and also has the benefits of being easier to totally automate. We have already demonstrated that this technique picks up significant differences between starlings housed in cages of different sizes and shapes for as little as one week (see Figure 2).
3. A pattern recognition algorithm based on T-pattern analysis implemented in the commercially available software package, Theme. T-pattern analysis is capable of finding patterns in sequences of behaviour that would be invisible to Markov chains analysis, but has the disadvantage of being harder to interpret. This technique has been used to demonstrate significant differences in the pattern of performance on a gambling task in stereotypic human patients suffering from schizophrenia compared with healthy controls[3]. There is also one abstract suggesting that Theme differentiates mice treated with different doses of the dopamine transporter inhibitor GBR-12909, a drug known to induce locomotor stereotypies[4]. To date, the only application of Theme in a welfare context is to compare behavioural complexity in broilers on different feeding regimens[5].

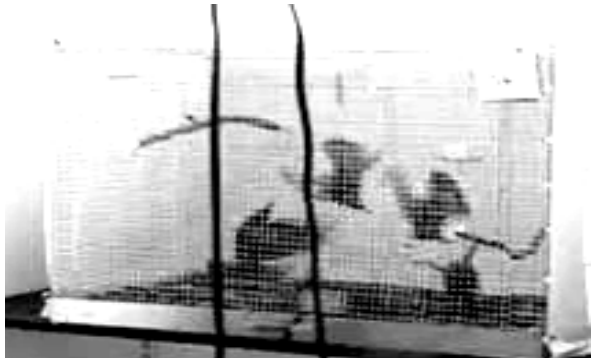

***Figure 1.*** *Composite photo showing a somersaulting starling.*

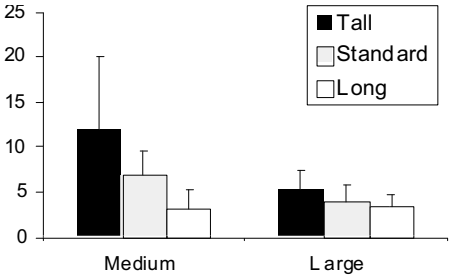


***Figure 2.*** *Pilot data showing the effects of cage size and shape on the degree of stereotypy (sequential dependency derived from Markov chains analysis) in starling behavior.*

Preliminary analyses show that those animals displaying full somersaults are those with high sequential dependency scores[6], suggesting that our Markov chains approach may be effectively detecting birds with higher levels of stereotypy.

We will use the three methods described above to investigate:

1. The initial development of stereotypies in recently-caught starlings transferred to small cages for the first time.
2. The incidence of stereotypies in starlings housed in enriched versus barren cages.

## References

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