

STEREOTYPIC ANIMAL BEHAVIOUR
Fundamentals and Applications to Welfare

Second Edition

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STEREOTYPIC ANIMAL BEHAVIOUR

Fundamentals and Applications to Welfare

Second Edition

Edited by

Georgia Mason

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and

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A Decade-or-More's Progress in Understanding Stereotypic Behaviour

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Editorial Introduction

To open the book, we review the extent and nature of research into stereotypic behaviour since the first edition was published 13 years ago. We compare the numbers of recent papers on captive animals with those on human clinical subjects or research animals experimentally manipulated to produce abnormal behaviour, and also show some recent meta-analyses of trends within the former group. Contributed boxes present simple overviews of the motivational explanations typically used by ethologists, versus explanations in terms of brain function, and also review how the terms 'coping' and 'pathology' have been used. We then assess the extent to which the research questions raised by the last volume have been answered, and end by introducing this new edition's website and how the following chapters are organized.

GM and JR

1.1. Introduction

In this chapter, we review the scope and layout of the book and its accompanying website, and introduce some key concepts that recur throughout the volume, such as 'coping' and 'pathology'. We also discuss the extent to which this volume addresses the research questions highlighted at the end of the first edition (Lawrence and Rushen, 1993). This was published more than a decade ago, and set out to review what was then known about stereotypic behaviour with particular attention to the implications for animal welfare. Why is a second edition warranted? Presumably there has simply been enough new material on stereotypic

behaviour of animals to convince the publishers, editors and contributors that a new edition was justified. But to what extent have the issues raised in the earlier edition been successfully resolved? What new issues have emerged? And how does this new edition resemble or differ from the old?

1.2. Research on Stereotypies since the First Edition

In the introduction to the first edition, Lawrence and Rushen (1993) reported that a total of 63 papers had been published on the stereotypic behaviour of farm animals over the preceding 27 years. Of these, nearly a third were reviews, while the majority of data-based studies were mainly descriptive, with few studies experimentally manipulating likely causal factors. Lawrence and Rushen (1993) posited an unsurprising list of potential reasons for the low volume of articles at that time. These included a lack of interest, a lack of money, a tendency to 'talk rather than do', as well as some more subtle issues such as seeing animal stereotypic behaviour as a problem to be solved rather than a phenomenon to be understood.

The second and last issues probably remain with us, but there is no doubt that scientific interest in the underlying causes of these behaviours has increased substantially. In fact, a recent search of the ISI Web of Knowledge (<http://isiwebofknowledge.com/>) reveals that since the last edition, an average of 16 papers a year have been published on captive animals' stereotypies – a total of 188 from the start of 1993 to the end of 2004 (see Fig. 1.1). This number is dwarfed by research on the stereotypies of human clinical subjects and of laboratory animals subjected to genetic modification, brain lesion or psychopharmacological challenge (yielding around 120 papers a year – see Fig. 1.1). However, it nevertheless represents a substantial increase in rate, and a substantial volume of new research to assimilate.

Three things are striking about the articles now being published on captive animals' stereotypies. The first is that a growing number – as we will see in this volume (especially Chapters 5–8) – now draw explicitly from those other main sources of research into stereotypic behaviour: neuroscience, clinical psychology and psychiatry. The second is that since the first edition, there is a far greater concentration on trying to understand *why* animals perform these rather bizarre-looking behaviours, i.e. more investigations that unravel the causal factors rather than simply describe what the animals are doing. Although there remains the very practical desire to prevent these behaviours from occurring wherever possible (see e.g. Chapters 9 and 10, this volume), it is thus clear that researchers have recognized the need to base such 'prevention or elimination' strategies upon a greater understanding of why such behaviours occur. Furthermore, there is also a growing realization that such behaviours have much to tell us about how 'normal' behaviour

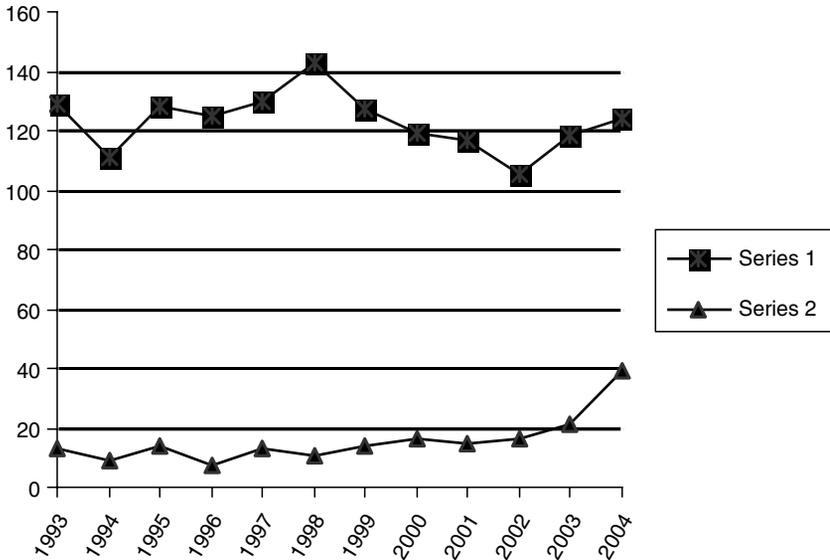


Fig. 1.1. The number of refereed publications on stereotypy, annually over the last 12 years. Records are divided into: Series 1 – papers on human patients, plus lesioned, pharmacologically treated or otherwise manipulated laboratory animals; Series 2 – papers on stereotypies emerging ‘spontaneously’ in captive animals.

is organized and controlled, and even about the likely psychological or neurophysiological normality of many of the millions of animals kept by humans worldwide.

The third change in the last decade or so is that a diverse array of animal species is now being studied. In 1993, most work on stereotypic behaviour focused on farm animals, or on drug-induced stereotypies in laboratory rodents. Although zoo biologists had carried out pioneering work describing these behaviours, and had raised attention (and some alarm) as to what they may mean for welfare, there were few systematic attempts either to understand or to prevent the occurrence of such behaviours in zoos. In the last 12–13 years, however, a great increase in interest in zoo animals is very evident (see e.g. Chapters 3 and 9, this volume). This has been paralleled by more research on ‘spontaneous’ cage stereotypies in laboratory animals (Chapters 4, 5, 7 and 8, this volume), and a growing interest in the ‘problem behaviours’ – including stereotypies – of the cats, dogs and horses that we keep as companion animals (Chapters 2 and 10, this volume). Indeed one reason that we added a website to this new edition (see <http://www.aps.uoguelph.ca/~gmason/StereotypicAnimalBehaviour/>) was to illustrate this new diversity with images and video-clips.

One result of the increased volume and taxonomic diversity of research into cage stereotypies is that it has recently allowed meta-

analyses, in which the data contained in existing papers and reports are pooled for further statistical analysis to look for overall patterns or even test specific hypotheses. Such analyses are useful in revealing broad trends that would not be evident in single studies involving a small number of individuals of a single species, and can even test hypotheses that would be challenging to investigate otherwise. Two nice recent examples are presented in Chapters 3 and 9, this volume. We also give three other instances here, to further help set the scene for this new edition. First, Mason and Latham (2004) were able to estimate the total number of stereotyping animals worldwide. Although approximate, it does illustrate the vast scale of this phenomenon (see Table 1.1). The same authors also investigated the relationships between stereotypic behaviour and other measures of poor welfare. The authors pooled several hundred papers, and sorted them by the control group used as a comparison. In one type of study, animals performing stereotypic behaviour were compared with low- or non-stereotyping animals that had been raised or kept in different conditions. In the other type of study, the low- and high-stereotyping animals under comparison came from the same treatment conditions, but showed spontaneous individual differences in the behaviour. The particular treatments that led to a high incidence of stereotypic behaviour were, as we have long suspected, often linked with other signs

Table 1.1. Estimated total numbers of stereotypers for some major species/production groups (modified from Mason and Latham, 2004). Totals here represent those occurring over a period of approximately 6 months; true annual figures would be larger because of those animals generally kept for less than 12 months (e.g. laboratory mice).

Species (system)	Estimated stereotypy prevalence (% individuals)	Estimated number of stereotypers	Notes (see Mason and Latham, 2004 for details of all data sources)
Pigs (confined sows)	91.5	15,393,000	Estimated for Europe and North and Central America only
Poultry (broiler breeders)	82.6	56,498,000	Estimated for Europe and North America only
Mice (research and breeding establishments)	50.0	7,500,000	Stereotypy prevalence is a conservative guessed estimate; prevalence data are published only for a very high stereotypy strain where almost all individuals are affected; more data on common strains are therefore needed
American mink (breeding females on fur farms)	80.0	4,680,000	Prevalence estimate here ideally needs data from more farms ($N = 2$ in this estimate)
Horses (stables)	18.4	2,724,000	Population size is for the 'developed world'

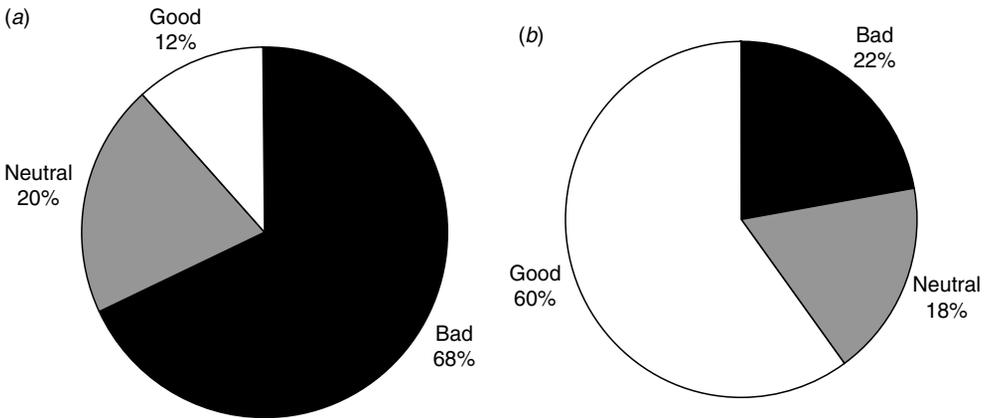


Fig. 1.2. How stereotypes and other welfare measures covary (modified from Mason and Latham, 2004). Accounts reporting additional welfare measures along with stereotypy (e.g. heart-rate changes, approach/avoidance behaviour, corticosteroid outputs) were scored as to whether they linked high stereotypy with decreased ('bad'), unchanged ('neutral') or improved ('good') welfare relative to no-/low-stereotypy controls. (a) Shows results from 196 reports where stereotypers and low-/non-stereotyping controls came from different treatment groups (e.g. different housing conditions or feeding regimens). (b) Shows results from 90 reports where stereotypers and low-/non-stereotyping controls came from within the same population/treatment group. The resulting patterns are significantly different from chance, and also significantly different from each other; see Mason and Latham (2004) for more details.

of poor welfare (see Fig. 1.2a). However, high stereotypy individuals within such environments often seemed 'better off' rather than 'worse off' than low-stereotyping animals (see Fig. 1.2b). This overview shows that the environmental factors that elicit stereotypies are not the same as the individual characteristics that predispose individual animals to develop the behaviours, an issue that recurs throughout this book. The third meta-analysis, also by Mason and colleagues, broke down abnormal behaviours (including stereotypy) by taxon, to show that different orders of mammals typically favour different types (see Fig. 1.3), and highlighting the value of research across a wide range of species.

1.2.1. Clarifying terminologies

One issue of note, as we survey these diverse pieces of work, is that researchers from different fields have, unsurprisingly, different interests, terminologies, assumptions and modes of explanation. Therefore, in an effort to help non-ethologists appreciate motivational explanations of animal behaviour (including stereotypies), both within these primary publications and in the chapters that follow, we present a box at the end of this chapter that gives a basic introduction (see Box 1.1). To follow this, and to likewise help ethologists appreciate how the vertebrate

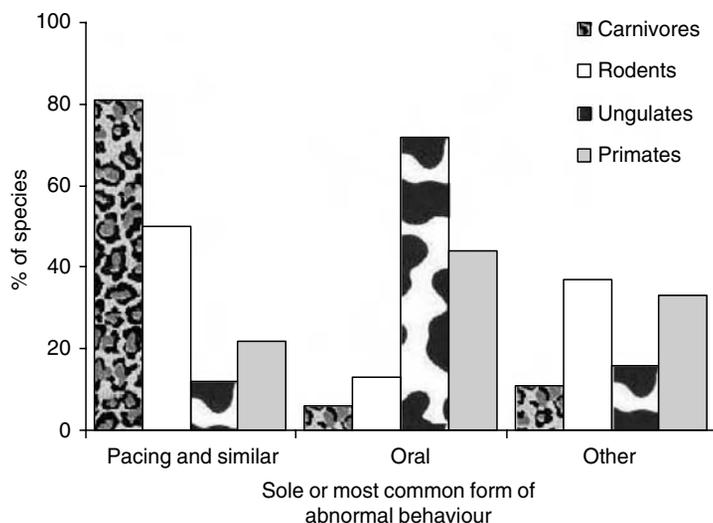


Fig. 1.3. The taxonomic distribution of different forms of abnormal behaviour (from Mason *et al.*, in press). For this survey, abnormal behaviours were defined as not known to occur in the wild, with no obvious goal or function; they thus included stereotypies, but also other behaviours, e.g. overgrooming; regurgitation-and-reingestion. Animals with apparent severe CNS dysfunction (e.g. experimentally treated with psychoactive substances, or performing self-injurious behaviours) were excluded; and husbandry differences between taxa were controlled for as much as possible (see Mason *et al.*, 2006, for details). Abnormal behaviours were categorized as: (i) pacing and similar (i.e. locomotory movements); (ii) oral (e.g. sham-chewing); and (iii) other (e.g. non-locomotory body movements like body-rocking or repetitive jumping). The 61 carnivore, 26 ungulate, 15 rodent and 19 primate species for which reports were obtained were each classified according to their sole or most commonly reported form. The frequency of different typical forms varied significantly with taxon ($\chi^2 = 51.17$ df = 6 $P < 0.001$).

brain generates behaviour (including abnormal behaviour), we give a very simple introduction in Box 1.2.

Furthermore, some terminology is used across multiple disciplines, but has connotations that are either rather vague or that vary between fields. Two such terms particularly relevant to discussions of stereotypy are the concepts of ‘coping’ and of ‘pathology’. Boxes 1.3 and 1.4 therefore review these, to provide a reference definition or level of understanding that many other authors will then refer to in the chapters that follow. Again, these are given at the end of this chapter.

1.3. Issues Resolved since the Last Edition?

At the end of the last edition, Ödberg (1993) summed up some of the main issues concerning stereotypic behaviours that were then taxing the minds of investigators. He also made research recommendations for the future,

as follows (his italics): '(1) Carry out as far as possible *developmental* studies, trying to induce stereotypies and investigating what changes in the organism; (2) Study *individual differences* (high/low, stereotypers/non-stereotypers, between stereotypers, between non-stereotypers), investigating in which aspects they differ *other than in performances of stereotyping*; (3) Use increasingly *interdisciplinary approaches*, especially neuropsychological and biochemical ones, with more attention on cognitive processes; (4) Keep an open mind for different hypotheses' (p. 187). Has his advice been followed? We would have to answer with a resounding 'yes'. For example, Chapter 8 is one nice example of the first recommendation, Chapter 7 of the second, and Chapter 5 of the third; and all the chapters in the book show a desire to put forward and evaluate alternative hypotheses.

Of course, far more could be done, however, and both the overviews above and the chapters that follow reveal a number of omissions or 'blind spots'. First, much relevant literature is still not adequately used or referred to by those seeking to explain stereotypies. For example, the literature search behind Fig. 1.1 threw up a lot of hits (not included in the figure) about naturally stereotyped responding in simple neural systems (e.g. some insect movement patterns), or in what used to be termed 'fixed action patterns' such as some bird songs. These types of phenomena were discussed in the first edition (e.g. Mason, 1993) yet seem to have been forgotten in the last decade, an issue Mason returns to in Chapter 11. Second, the flow of ideas from neuroscience to ethology and related disciplines seems so far to have been one way. Third, research on avian stereotypies, even those of poultry, seems to have all but disappeared. Fourth, researchers using different types of animals have tended to also use different research approaches and techniques; this means that we quite simply do not yet have a complete understanding of the motivational, developmental and neurophysiological underpinnings of *any single model*. Chapter 11 takes this last issue further, but first, let us flag the main issues that were taxing researchers 12–13 years ago, and see to what extent they have been dealt with here.

1.3.1. What is a stereotypy?

The question of how to define or classify stereotypies was an important issue (Mason, 1993), not only because it was evident that different investigators were using different methods to decide which behaviours were included as stereotypies, but also because many of the disputes about the causes and functions of stereotypies arose partly because of a mistaken assumption that the class of stereotypies was homogeneous. Difficulties in interdisciplinary communication about stereotypies were thus thought partly to result from the fact that stereotypy meant different things in different disciplines (Ödberg, 1993). Could we assume that the same causal factors were responsible for stereotypic rocking in maternally deprived

primates, stereotypic pacing in caged lions and stereotypic bar-biting by tethered sows? Should other behaviours, e.g. polydipsia in schedule-fed rodents or non-nutritive sucking by milk-fed calves, be included as stereotypies? Did the occurrence of all forms of stereotypic behaviour have the same implications for welfare across these very different animals?

The decision to classify any given behavioural pattern as a stereotypy depended, primarily, upon the way that the behaviour was performed, i.e. whether in a repetitive and invariant manner. Here, the question focused upon how much the performance of a behaviour actually had to be repetitive and invariant for it to count: detailed studies of stereotypies revealed that there was quite a deal of variability both in the timing of the performance and its repetitiveness. Clarity of the description of each instance of stereotypic behaviour is essential in comparing different studies. However, many 'normal' behaviours are also performed in a stereotypic manner, yet go unremarked. What was striking about the stereotypies being studied was that they appeared to have no function, which implied a certain degree of abnormality (however vaguely defined). It was this quality that focused the minds of researchers interested in animal welfare upon the possibility of using them to assess welfare, and to some extent a suggestion of 'abnormality' was often implicit in the decision as to whether or not any given behaviour would be included in the category of 'stereotypy'.

So, to what extent have we made progress in the way that we describe, measure and classify such behaviours? As we will see, the issue of classification and definition remains a very live one today, indeed one rendered even more important by the growing use of psychopharmacological treatments that might simply be inappropriate if we mistake the true aetiology of a particular behaviour (Chapter 10, this volume). Thus, calls for classificatory schemes are made in Chapters 2 and 4, and responses, in the form of suggested frameworks, are proposed in Chapters 5, 10 and 11. Some of the diverse behaviours that may or may not be included in future schemes are portrayed on this book's website, again to help illustrate the diverse properties of the behaviours discussed by different authors; see <http://www.aps.uoguelph.ca/~gmason/StereotypicAnimalBehaviour/>.

1.3.2. What causes stereotypies?

Lawrence and Rushen (1993) complained of the relative lack of systematic research to understand the causal bases of these behaviours. According to Ödberg (1993), what causal analyses had been undertaken consisted of a list of factors that might affect the occurrence of such behaviours rather than any theoretical framework based on an understanding of the organization of behaviour.

Understanding the basic causes of the behaviours is important, not only to advance fundamental scientific knowledge of how behaviour is organized, but also because the appropriate use of stereotypic behaviours to assess animal welfare requires that we understand why animals per-