

to improve their captive experience. It continues the general theme that animals that are treated optimally provide better, more translationally relevant findings. It again provides a condensed and easy-to-read source of material to consider when animal carers attempt to provide an optimal laboratory experience for rats.

The final chapters concern lesser-used animals in terms of total numbers, rabbits, dogs, primates, and pigs. As biomedical researchers, veterinarians and carers, many of us probably feel we already appreciate how complex the behaviour of these species can be. However, I found I was unaware of many of the potential husbandry issues affecting laboratory-housed rabbits; so this chapter was particularly informative; for example, how dominance hierarchy in rabbits can impact upon their welfare. I learned that so long as subordinates have the opportunity to escape it is perfectly acceptable to permit rabbits to display dominance behaviours, and that human intervention in this scenario is more, rather than less, likely to induce aggression and wounding.

Although relatively few biomedical scientists and animal carers will encounter dogs as part of their working lives, no doubt a very great many will have dogs as pets. Chapter 11 focuses on the importance of treating dogs as individuals and how interactions with dogs can provide a unique opportunity to create an especially strong human-animal bond. It explains how this bond can be utilised to enrich both the dog's life as well as their handlers, and so ensure the largest possible numbers can eventually be successfully re-homed. It provides an invaluable source of information about the optimal way to treat dogs whether that be in the laboratory or the home.

Even fewer of us will have experience of research using non-human primates, but in Chapter 12 we find a comprehensive insight into the natural history of various NHPs and an informative description of different primate methods of communication, both with humans and conspecifics. The section describing how to find the perfect partner for a macaque was particularly fascinating. Overall, it continues the theme of welfare refinement by limiting stress exposure, providing the animals with means of controlling their own exposure to it. For example, by providing access to friends as well as the ability to avoid any dominant or unfriendly individuals. It was also excellent to read not only about the many forms of enrichment that act as effective refinements, but also those that do not. The description of how to implement training was precisely what I had hoped to find in Chapter 6; providing a series of real-world step-by-step instructions on how training should proceed.

In Chapter 13 we hear about how social a species pigs are, and how failure to appreciate this can have a very large influence on their behaviour and physiology, thereby impacting on their welfare and the quality of research findings. A detailed description of the ideal housing arrangements for laboratory pigs is provided. The importance of having rigorous habituation and training protocols is reiterated, and a nice clear description is provided about how a training protocol can be developed.

In summary, *Animal-centric Care and Management* is a book that generally strikes an excellent balance between the provision of detailed recommendations concerning methods of welfare enhancement without relying too heavily on the readers' prior knowledge of the basic concepts.

Reference

Russell WMS and Burch RL 1959 *The Principles of Humane Experimental Technique*. Methuen: London, UK
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Asking Animals: An Introduction to Animal Behaviour Testing

BL Nielsen (2020) Published by CABI Publishing, Nosworthy Way, Wallingford, Oxfordshire OX10 8DE, UK. 192 pages Hardback/Paperback (ISBN: 978-1789240610). Price £82.74 (hardback), £32.25 (paperback).

The stated aim in the Preface of this neat little textbook is "...to inspire the animal experimenter to think about what a given behavioural test can be used for and how the results can be interpreted." As such, its focus is on the practicalities of conducting behavioural tests and upon general considerations in experimental design, providing much needed closing of a gap in texts on practice in behavioural testing. The format of Nielsen's book emulates the classic ethologist's 'Bible' on recording behaviour (Martin & Bateson 2007), being purposefully short, digestible and focused in recognition that her audience have limited time, even where intentions are best.

The brief first chapter clearly states the scope of the book, so the reader is very clear what they are getting. Nielsen explains that the text is not intended to be a comprehensive reference for all possible behavioural tests, rather a 'taster menu' with specifically selected examples. She makes no apologies for this, nor the general exclusion of insects to focus on sentient vertebrate species managed by humans in relation to legislated welfare protection. Understandably, given the text's aim, neither does the book cover statistical analysis. Chapter 2 provides background by introducing a sketch of non-test observations of behaviour, covering normal changes in behaviour with time and situation, and some examples associated with locomotor and feeding behaviour. These are all factors which may alter responses during tests if not controlled for and revisited in later chapters as appropriate. In this respect, brief additional mention of spacing, and expansion on social behaviour could also have been valuable here, although these are addressed in later chapters. Chapter 3 focuses broadly on principles affecting test selection, highlighting the advantages and disadvantages of testing compared to non-test observation, the importance of mapping experimental design and test validity to desired goals and constraints that might limit test-use in terms of practicalities, costs and presumably even habit. Chapters 4 to 10 subsequently address a selection of themes of investigation, including

animal characterisation, choice and motivation, detection and discrimination, learning and memory and more. Within themes, various examples of tests which can be used are discussed along with some practicalities and pitfalls. Specific scientific examples covering a breadth of species and disciplines are provided for illustration and to engage even the experienced reader with something potentially new. Whilst potential snares are highlighted throughout these chapters, Nielsen expands upon these and introduces further considerations in Chapter 11, before broadening the narrative into ethical considerations in Chapter 12 and ending with brief discussion of the use of technology in behavioural assessment in Chapter 13.

In terms of the structure and content of the book, the definition of behavioural test might appear quite broad. I didn't feel that all the chapters on behavioural testing themes were equally intuitive, although this may well be my own prejudices showing. The first few chapters and Chapter 9 focused more clearly on specific types of tests, whilst Chapters 7 and 10 felt to me a little more confused between the tests themselves and evidence in general that tests could be affected by age, treatments and genetic aspects. This information is important, but perhaps these chapters could have been sequential and/or incorporated more 'signposting' of intention for the uneducated like me. In the same vein, I was not quite sure how reinforcement and punishment, whilst absolutely essential to understanding the operation of certain tests and their limitations, were tests in of themselves.

Nielsen writes with an engaging and accessible conversational style which unmistakably conveys her self-declared personal fascination with these topics and invites the reader into her perspective. She notes very early on (pp 2–3) "how rarely methods and behaviour knowledge are transferred between scientific disciplines" and that approaches to the same behaviour test across disciplines may be very different, impacting upon respective data interpretation and thus collective synthesis of information. The evident implication is that these existing differences also offer the opportunity, with knowledge exchange, for researchers in different disciplines to think more deeply about how tests are utilised, conducted and interpreted and how they may be refined. Nielsen's style often feels like a chat over coffee and this non-aggressive and authoritarian approach is extremely apposite to achieve the stated intention of opening eyes and minds to possibilities. Each chapter is furnished with a comprehensive reference list so that the initiated can begin to delve further into their new area of interest at their leisure. However, this approach does not mean an absence of critical review. Rather, sharp insight is conveyed in a nicely balanced way without overloading the reader to the point that no test seems worthwhile, instead tending to build across chapters, particularly in relation to experimental design. I find this is particularly important with students who may be prone to initially assume there is only one single way to conduct a study or that any disadvantage associated with a method should result in avoidance of its use. Despite regular disclaimers by the author on comprehensiveness I

did very occasionally find myself wanting a little more. For example, I felt there was scope to include something on the impacts of the animal's control of exposure to stimuli in some of the tests and I would have valued some more depth on validity, reliability and sensitivity. This said, my criticisms of this book are really nit-picking and I feel that overall Nielsen does what she sets out to do very well. The text and style will appeal to undergraduate and postgraduate students and early career researchers, and it is certainly a book I will recommend to my own. It would also be of benefit to more experienced researchers, and its succinct nature facilitates this, but I do wonder how much this will depend on 'preaching to the converted', where some may not feel the need to read a book on what they perceive they are doing daily. For me, this segues nicely into consideration of the animal welfare implications.

Nielsen mentions the '3 Rs' in Chapter 12 and references the National Centre for Replacement, Refinement and Reduction of Animal in Research (NC3Rs) as an excellent resource for further information, which indeed it is. However, the application of the 3Rs to animals was first originated by UFAW-commissioned and funded work (Russell & Burch 1959), so it is fitting to expand a little on the text's relevance to these principles here. In my experience Refinement is often the 'poor relation' of the other 'Rs', with funding emphasis instead increasingly placed on advances in replacement. Whilst few would argue this is incredibly important, it is hard to see any near-future situation where no research involving animals will be conducted. Some research questions the complexities of the whole animal and we are not yet in a position to be able to sufficiently replicate this. As argued by Nielsen, we therefore have a moral responsibility to continue to try to improve the welfare of animals that are still used and she cites the EU Directive which requires just that, "using the latest scientific developments" (EU Directive 2010; p 33, para 6). Refinement of existing procedures is often seen as something that should be done 'in-house' as part of normal procedures, but this can be constrained by time, resource and risk and norms can be hard to challenge when efficient, reliable procedures produce results. Nielsen's text provides a challenge to some well-established procedures which use animal models for research benefitting humans. Likewise, she highlights some examples of ingenious refinements that can support ethical review and regulatory bodies in making recommendations and inspire researchers to change practice although, again, I wanted more. Nielsen's position as a researcher with experience in both neuroscience and welfare science research lends credibility to her voice and her hope that she can effect change. Equally, her cautions on experimental design and traps for the unwary invite the robust behavioural tests needed for effective Reduction. The text also underpins generation of good scientific evidence to influence improvements in welfare more broadly. Although Nielsen avoids much mention of invertebrates, robust behavioural tests are also required to evidence sentience in species outwith current legislative protection, for example the recent interest in decapod crustaceans and whether they

should be protected in the same way as vertebrates. ‘Degree of sentience’ is also of course relevant to Replacement of animals considered more complex with animals considered less complex. The sorts of tests that Nielsen describes could potentially provide evidence to close the complexity gap, as good only as the current knowledge available. Finally, it has been argued that asking the animal, in terms of decision-making tests, could provide the ‘gold standard’ for animal welfare (Barnard 2007), thus the standard against which criterion validation could be determined for all other welfare indicators more feasibly used in the field. Since this standard itself depends on the animal understanding the ‘question’ asked and on the validity of data interpretation, Nielsen’s text may contribute to raising the standard of animal welfare research more broadly by providing guidance on how best to ask questions and gain robust data. One final suggestion I have for future editions is that the text would lend itself nicely to an associated online resource of video-examples on ‘how to’ and ‘top tips’, particularly in view of the increasing move to blended learning strategies in higher education and following the Covid19 pandemic. Certainly, I can imagine using it extensively in my teaching. In conclusion, I would definitely recommend this text as a valuable, accessible and concise launch point for understanding and improving behavioural testing across disciplines and species.

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Dogs: Understanding Your Very Best Friend

J Bradshaw (2021). Published by Andersen Press, 20 Vauxhall Bridge Road, London SW1V 2SA, UK. 128 pages Paperback (ISBN: 978-1839130878). Price £6.15.

It was a funny but interesting book and I loved its character. I especially liked the chapter ‘Walkies’, it was particularly fascinating and amusing. The part about smell and dogs body behaviour was good, interesting and important to know. I would definitely recommend this book to my friends at school and to other children of my age.

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Broiler Chickens: Welfare in Practice

A Butterworth, I de Jong, J Mench, L Berg and M Raj (2021). Published by 5m Publishing, 8 Smithy Wood Drive, Sheffield S35 1QN, UK. 164 pages Paperback (ISBN: 978-1789180152). Price £14.95.

This book is one in a series of practical books on the welfare of farm animals. It sets out to inform broiler farmers, poultry vets, stockworkers, poultry smallholders, and agricultural students about the factors that affect commercially reared broiler chicken welfare. The aim is to produce a book that is useable around the world, although the book is largely based around European laws regarding housing, killing, and welfare monitoring (in part because there are laws in Europe, of course). The authors use evidence from scientific publications, but the information is written in a concise way for the ‘layperson.’ The book is laid out logically, starting with the welfare of broiler parent stock (broiler breeders), to hatching of chicks, housing and management influences, health and disease impacts, on-farm killing of broilers (from embryos to slaughter age), how to assess welfare in broilers, and future improvements to broiler welfare. The authors are all experienced research scientists who have studied broiler welfare first-hand, and are therefore well placed to write such a book. In addition, they provide their email addresses so that anyone can reach them directly, should you so wish!

The first chapter, on broiler breeder welfare, is a great introduction on what is required to produce broiler chicks, and the welfare challenges faced by the parent stock. Production period housing is described, although the section on page 7 about colony cages seems to include a lot of general information about feeding and drinking systems that apply to any type of housing system. The figures are helpful and aid understanding.

The chapter on hatchery welfare provides a good insight into risks to chick welfare at this discrete phase of their lives. Generally, the figures were useful, however their reference in the text is sometimes odd; for example, referring to eggs stored for too long references to Figure 2.8, a photo of chicks in a hatcher tray, and a sentence on food and water deprivation leading to increased mortality references to Figure 2.9, a photo of chicks. Neither of these particularly illustrates the text. The section on dealing with unwanted chicks would have benefitted from cross-referencing with the chapter on on-farm killing, as they overlap. The insights into the effects and risks of automation were eye-opening, but the section on light would have benefitted from telling the reader how providing light during incubation affects fear responses (reduces or increases?)

Chapter 3 describes how housing and management can influence broiler welfare. This is an informative section describing the different methods of broiler housing and key management factors that can influence broiler well-being, such as litter quality, air quality, and environmental enrichment. Again, the figures are useful and clearly illustrate the