In this study, we only contacted the corresponding author with the data request. This was because the International Committee of Medical Journal Editors (ICMJE) journal guidelines [12] recommends that it is the corresponding author who responds to data requests, and because this field can be automatically harvested from reference databases and most likely used by researchers undertaking multiple study data collections. Here, we found that the corresponding author of 85.9% of the 771 manuscripts was the primary author and most likely to have collected the data. It could be argued that the corresponding author does not have the final say whether the manuscripts' research data were to be shared, and even if an ECR was the corresponding author, he or she would still need to gain permission from the senior author. We agree that this may have been a factor that prevented some of the data from manuscripts with ECRs as corresponding authors from being published. However, it did not appear to apply to the majority of studies, and career stage of the corresponding author remained a significant factor in determining whether or not the data were submitted for public data archiving.

Concluding Remarks

This study demonstrated that there are still considerable barriers to public data archiving in the field of animal biotelemetry research. Furthermore, these barriers were not overcome by negating much of the researcher concerns reported from questionnaire-type surveys [1,6,7,9]. These surveys however have primarily focused upon senior scientists, and this study suggests the views of senior scientists around data sharing differ from that of ECRs. We argue that fear of data misuse [3] and perceived lack of benefit still play significant roles in a researchers' decision to not publicly archive data. To counter this, we suggest the community to develop clear rules around the sharing and reuse of data. These could include (i) notification to the data custodian when and by whom data are downloaded; (ii) clear guidelines around coauthorship or acknowledgement, depending upon the way the data have been reused and the percentage of data used within the overall analysis; and (iii) rules set by journals at the time of submission, similar to that currently used for conflict of interest and other ethical issues. We also make a plea to senior researchers that they allow their ECRs to go as corresponding authors on manuscripts, because this results in a significantly greater likelihood of research data being publicly archived.

Acknowledgments

We acknowledge all corresponding authors who responded to our requests. We thank Peggy Newman for public data archiving the data sets.

Supplemental Information

Supplemental information associated with this article can be found online at https://doi.org/10.1016/j.tree.2018.11.010.

[1]Research Institute for the Environment & Livelihoods, Charles Darwin University, Darwin, NT, 0810, Australia
[2]Australian Institute of Marine Science, Darwin, NT, 0810, Australia

*Correspondence:
hamish.campbell@cdu.edu.au (H.A. Campbell).

https://doi.org/10.1016/j.tree.2018.11.010

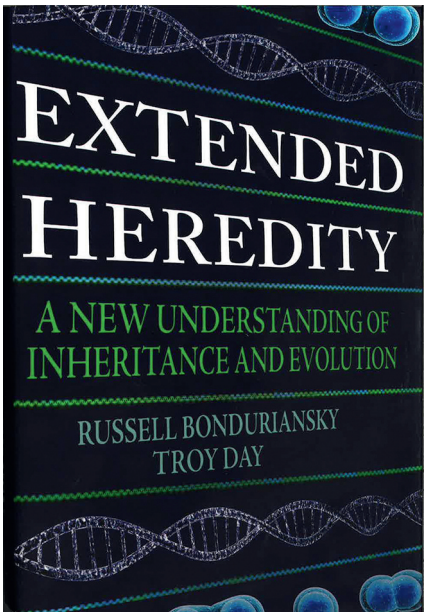
References

1. Kim, Y. and Stanton, J.M. (2012) Institutional and individual influences on scientists' data sharing practices. *J. Comput. Sci. Educ.* 3, 47–56
2. McNutt, M. *et al.* (2016) Liberating field science samples and data. *Science* 351, 1024–1026
3. Tenopir, C. *et al.* (2011) Data sharing by scientists: practices and perceptions. *PLoS One* 6, 21
4. Reichman, O.J. *et al.* (2011) Challenges and opportunities of open data in ecology. *Science* 331, 703–705
5. Piwowar, H.A. and Vision, T.J. (2013) Data reuse and the open data citation advantage. *PeerJ* 1, e175
6. Nguyen, V.M. *et al.* (2017) To share or not to share in the emerging era of big data: perspectives from fish telemetry researchers on data sharing. *Can. J. Fish. Aquat. Sci.* 74, 1260–1274
7. PARSE.Insigh (2009) *First Insights into Digital Preservation of Research Output in Europe,* PARSE.Insight
8. Roche, D.G. *et al.* (2015) Public data archiving in ecology and evolution: how well are we doing? *PLoS Biol.* 13, 12
9. Mills, J.A. *et al.* (2016) Solutions for archiving data in long-term studies: a reply to Whitlock *et al. Trends Ecol. Evol.* 31, 8587
10. Campbell, H.A. *et al.* (2015) Finding our way: on the sharing and reuse of animal telemetry data in Australasia. *Sci. Total Environ.* 534, 79–84
11. Vines, T.H. *et al.* (2014) The availability of research data declines rapidly with article age. *Curr. Biol.* 24, 94–97
12. International Committee of Medical Journal Editors (2017) Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals. http://www.icmje.org/recommendations/

Book Review

Domestication of Extended Heredity

Heikki Helanterä[1,*]



The existence of inheritance not based on DNA is fact. However, the implications of such 'extended inheritance' for evolutionary biology are under intense debate. This book by Bondurianskyand Day (hereafter B&D) is both an illuminating summary of key findings and a balanced take on the debate [1]. The conceptual issues play a minor role; this is a book written by evolutionary biologists with a biological message and audience in mind, and biologists from diverse fields, as well as any scholars

interested in modern evolutionary biology, should find the book accessible and interesting.

B&D chart the diversity on nongenetic inheritance, from epigenetic marks through cellular inheritance and parental effects to cultural. They do this through plentiful examples that range from modern [2] to nearly forgotten [3]. They visualize a simple theoretical framework for illustrating the evolutionary consequences of such diversity, based on the Price equation [4]. They look ahead and briefly explain some potential implications of extended heredity for perennial themes in evolutionary biology, such as the evolution of mate choice, aging, and speciation, all with a healthy balance of enthusiasm and critique that sets them apart from both the boldest proponents and the most resolute critics of extended heredity as a fundamentally important phenomenon.

Setting the debates into context is greatly helped by how B&D unravel the sidelining of nongenetic inheritance from the modern synthesis. Some reasons for this are explicable, such as the overwhelming success of gene-centric explanations, model organism-based biases and methodological limitations of the time, and powerful if sometimes slightly naïve demonstrations of how acquired characteristics (like amputated tails) are not inherited. But some are truly puzzling for a modern reader, such as the insistence on one 'true' mechanism of inheritance only, and most curiously the exclusion of nongenetic inheritance because it was not compatible with what was known about genes. This B&D rightly rank 'among the most influential circular arguments in the history of science'.

This is not just fascinating history but resonates importantly with the current debate. Even if exclusive emphasis on genetic transmission has proved an immensely successful method in evolutionary biology, making gene transmission an exclusive determinant of how organisms get their traits can be problematic outside evolutionary biology. This is vivid in the account of how effects of maternal alcohol consumption on fetuses were neglected as incompatible with the central dogma of molecular biology. With more and more genomic information at hand, it is all the more important to remember that each organism is more than its genes, even if genes have a special standing in evolutionary explanation.

The history of pitting Mendelian transmission genetics against other forms on inheritance as a 'one or the other' choice still seems to burden research on nongenetic inheritance. There is a temptation to bring extended inheritance into the fold of modern synthesis, by claiming either that extended inheritance has evolved as an adaptation of the genome or that it is under genetic control [5]. However, B&D make it abundantly clear that the exciting science lies in the interactions of inheritance mechanisms, rather than insisting on demonstrations that nongenetic inheritance works without any genetic element whatsoever involved.

Nongenetic inheritance may help populations reach adaptive peaks faster, and different forms of nongenetic inheritance vary in their implications for phenotypic change and their importance across organisms and traits. B&D discuss this diversity in the urgent context of understanding the future of life under rapid environmental change. However, this diversity is also a model system for how the conditions for evolution evolve [6]. An inheritance system may help populations reach adaptive peaks in certain kinds of environments, but this does not tell us how the system arose and spread. Similar to, for example, the recombination and mutation rates and genome complexity that underlie evolvability [7], we need a comprehensive, critical look at the possible adaptive origins and distribution of nongenetic inheritance mechanisms. Such a synthesis, while still a distant goal, requires theoretical understanding, broad comparative and experimental work, and an understanding of the relative features of environmental variation.

I adapt terminology from Ullica Segerstråle's wonderful history of sociobiology [8] to summarize the status of extended inheritance that B&D present (without implying any further similarities between the two debates). The story of nongenetic inheritance can be seen as a story of planters with novel ideas and weeders, who critically defend the current way of doing science from ideas seen as unorthodox, poorly empirically supported, or outright impossible. This book shows that if at some point ideas of nongenetic inheritance were weeds in the garden of the modern evolutionary synthesis, they can be domesticated. We should look forward to what they have to offer to us under further breeding.

Extended Heredity – A New Understanding of Inheritance and Evolution by Russell Bonduriansky and Troy Day, Princeton University Press, 2018. US$29.95/£24.00, hbk (279 pp.) ISBN 978-0-691-157672

[1]Ecology and Genetics Research Unit, University of Oulu, Oulu, Finland

*Correspondence: heikki.helantera@oulu.fi (H. Helanterä).

https://doi.org/10.1016/j.tree.2018.10.008

References

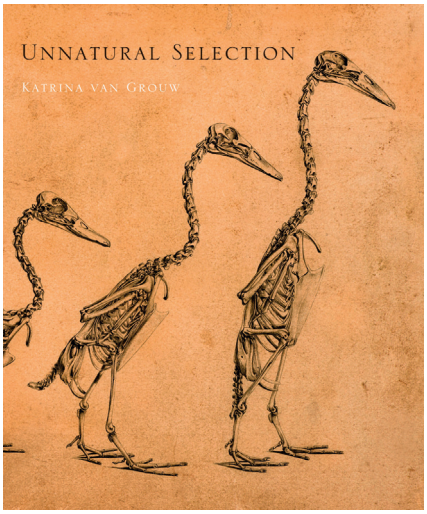
1. Bonduriansky, R. and Day, T. (2018) *Extended Heredity – A New Understanding of Inheritance and Evolution,* Princeton University Press
2. Johannes, F. *et al.* (2009) Assessing the impact of transgenerational epigenetic variation on complex traits. *PLoS Genet.* 5, e1000530
3. Jennings, H.S. (1937) Formation, inheritance and variation of the teeth in *Difflugia corona*. A study of the morphogenic activities of rhizopod protoplasm. *J. Exp. Zool.* 77, 287–336
4. Price, G.R. (1970) Selection and covariance. *Nature* 227, 520–521
5. Dickins, T.E. and Rahman, Q. (2012) The extended evolutionary synthesis and the role of soft inheritance in evolution. *Proc. Biol. Sci.* 279, 2913–2921
6. Godfrey-Smith, P. (2009) *Darwinian Populations and Natural Selection,* Oxford University Press

7. Lynch, M. (2007) *The Origins of Genome Architecture,* Sinauer Associates
8. Segerstråle, U. (2000) *Defenders of the Truth,* Oxford University Press

Book Review

A Modern-Day Darwin

Caitlin R. Kight[1,*]



Katrina van Grouw is immensely proud of her latest book, *Unnatural Selection*. She mentioned this during a book tour appearance at TetZooCon, where she gave one of the event's most popular and well-attended presentations, and on social media, where she bemoaned the fact that her publication has not had much press. While these are probably common sentiments among artists, not all creators are as justified as van Grouw in lodging these complaints; *Unnatural Selection* truly is a masterpiece and deserves to be both read and praised widely.

What sets *Unnatural Selection* apart – not just from van Grouw's previous works, which also feature animals and art [1,2], but also from other books in general – is its subject matter. It is a book about evolution, but not about evolution as it is typically thought of, discussed, or studied: it is about the evolution that humans have knowingly facilitated (although likely without using this term for it) in domesticated animals.

Intended as a celebration of, and homage to, Charles Darwin's *The Variation of Animals and Plants under Domestication* [3] – published 150 years ago this year – *Unnatural Selection* looks deeper into a truth that Darwin himself had only begun to appreciate: selective breeding is evolution, and there is much to be gained from joining up the more-or-less distinct bodies of knowledge associated with these two concepts.

Enter *Unnatural Selection*, which recognises boundaries only long enough to smash through them. For example, van Grouw references not only classic academic work (e.g., Belyaev's canonical fox experiments) but also a slew of more obscure and niche studies from, for example, the poultry and pet industries. She also incorporates unpublished – but profoundly insightful – wisdom shared by contemporary fanciers. van Grouw and her husband even undertook their own experiments for the book, and many of *Unnatural Selection*'s 400-some (stunning) illustrations were produced using skeletons that van Grouw sourced and prepared in her own home.

This is one of the reasons why it is difficult to discuss the book without discussing the author: van Grouw literally got her hands dirty to research and write *Unnatural Selection* and her earthy voice is strong throughout. She references her own and her husband's experiences rearing and observing domestics and shares remarkable viewpoints that stem from understanding both art and science – two disciplines with which the author is strongly affiliated without being entirely an insider. This is intended as a compliment: van Grouw has all the skills and comprehension of a dedicated expert in each area, yet also brings the outsider's propensity to ask 'but why?' and 'well, why not?' in insightful, fruitful ways.

The most obvious demonstration of her unique perspective is how well she utilises skeletons – a largely unfamiliar sight to the vast majority of readers, including even a good portion of biologists – to strip away unnecessary complexities and get down to the bare bones (yes, literally) of interesting features and processes. van Grouw's beautiful anatomical illustrations are as informative and scientifically rigorous as a statistical plot but also as aesthetically pleasing as the pieces hanging in an art gallery; it's no surprise that the author sells both books and prints when she makes her book tour appearances or that her presentation slides contain eye-catching bespoke imagery and animations to convincingly emphasise her oral message.

Given her interdisciplinary career trajectory, van Grouw is perfectly placed to communicate in a way that is conversational but also precise, confidently knowledgeable, and often poetic. It seems too easy to make a comparison with Darwin, yet it would be remiss not to; he, too, fashioned an illuminating and mind-changing narrative founded on a wealth of experimental evidence.

Between the lines of her excellent explanation of evolution, van Grouw uses this Darwinian rhetorical technique to argue a range of points that both scientists and nonscientists could benefit from examining – for example: rigid scientific views often cannot stand up to the messiness of the real world; a 'scientist' is not just someone who does science