

## Book Review

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Paz-y-Mino-C, G. & Espinosa, A.

2018. Kin Recognition in Protists and Other Microbes — Genetics, Evolution, Behavior, and Health.

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KIN recognition (i.e. the ability to identify or distinguish kin from non-kin) is known to be an important trait underlying many social and sexual behaviors. Accordingly, it has received considerable attention in studies on humans and other animals. For example, kin recognition is one of the underlying mechanisms of Hamilton's *inclusive fitness* theory, allowing individuals to benefit their relatives and thus to increase the chances of shared genes being transferred to the next generation. Kin recognition has been repeatedly documented in many animal species, ranging from insects to humans, and has been identified also in non-animal systems. Indeed, kin recognition in plants, protists, and prokaryotes has recently gained increased attention. Studies on such systems have the potential to provide us with insights that go far beyond what we can reach by studying animals alone on the one hand and can challenge our thinking about our definition of the concept of *behavior* itself on the other. For example, work on protists allows us to understand very specific questions like the molecular mechanisms of kin recognition, as well as very fundamental concepts like the *Major Transitions in Evolution*. However, a comprehensive overview summarizing the state of knowledge in protists and other microbes has been lacking thus far.

In their recently published book "Kin Recognition in Protists and Other Microbes – Genetics, Evolution, Behavior and Health" Guillermo Paz-y-Mino-C and Avelina Espinosa set out to fill this gap in the literature. To this end, they summarize the current state of knowledge on the behavior, evolution, and genetics of single cells that are able to discriminate between other cells of varying relatedness. The book is organized in nine complementary chapters that are supplemented with two extensive appendices. The different chapters increase in complexity, but the authors provide ample recapitulations and links to specific parts of previous chapters to allow reading single chapters independently. Furthermore, most chapters are accompanied by a summarizing box of essential terminology right at the beginning, which nicely increases readability.

Chapter one (*Kin recognition: Synopsis and the advent of protists models*) sets the stage for the following chapters by explaining the most important terms and concepts of the kin recognition literature. It further highlights the importance of kin recognition in animals and introduces protists as

promising model organisms. Chapter two (*The genetics of kin recognition: from many cells to single cells*) explains the genetic mechanisms of kin recognition (e.g. green beard effects) using red fire ants (*Solenopsis invicta*) and social amoeba (*Dictyostelium discoideum*) as examples. Chapter three (*Can protists learn phenotypic cues to discriminate kin?*) introduces learning as possible nongenetic kin recognition mechanisms. While this chapter is intentionally rather speculative, it is highly inspiring at the same time when thinking about definitions of terms like *learning* or *memory*. Chapter four (*Entamoeba clone-recognition experiments: morphometrics, aggregative behavior, and cell-signaling characterization*) introduces one of the authors' own study systems, and how it might help us understand clone recognition in protists, the authors devote almost 100 pages of chapter five (*The prokaryote's tale*) to show the impact of relatedness on the evolution, ecology, and pathogenicity of prokaryotes. By doing so, they largely increase the breadth and information content of the book and open it to wider audience. Chapter six (*Protists' clonality, kinship and pathogenicity*) illuminates the gregarious and social behaviors of pathogenic protists like *Plasmodium* or *Trypanosoma*. In chapter seven (*Micro-biogeography: kinship and social/spatial structure*), the authors focus on the local and global distributions of various protist species, with a special focus on Becking's *Everything is Everywhere* hypothesis. Chapter eight (*Multicellular aggregations: from single cells to many cells*) highlights the importance of understanding the multifarious levels of protists' social organization and cooperation, when aiming to understand the evolution of multicellularity in more general terms, which is considered as one of the *Major Transitions in Evolution*. The short ninth chapter (*Conclusions and future directions*) eventually provides a brief summary of the book and suggests promising future research avenues for the study of kin recognition in protists.

Overall, I think this is a highly timely and interesting book. People not being too familiar with microbiology, like me, will find it as a fascinating and inspiring introduction into kin recognition in nonanimal systems, which thereby challenges our thinking of underlying cognitive processes such as learning. Students of Evolutionary Biology will find it highly useful to read, for example, about the advent of multicellularity and sociality, leading to major transitions in evolution. Researchers in microbiology will appreciate a comprehensive summary of the field, with some additional dives into methodological details. Teachers finally, will take advantage of the more than 120 detailed figures showing experimental setups, results, and schematic diagrams as well as of the great appendix linking to recent media resources that can be

downloaded and included in lectures. As a grain of salt, I would have loved to see some more terminological strictness at some occasions. The field of kin recognition is full of semantic debates, often leading to confusion whenever researchers from different backgrounds come together. The same is also true for the concept of learning. Defining clear terms before opening the discussion would have been helpful to the reader, even if not everybody will agree on the definition itself. The authors acknowledge this mess of concepts and try to avoid the debate by using very broad definitions, which I agree are inclusive, but will be too broad

to be useful at the same time. However, these are very minor shortcomings that reflect current debates in the field and do not diminish the scientific and scholarly value of this great book, which I can highly recommend.

Joachim G. Frommen 

*Division of Behavioural Ecology, Institute of Ecology and Evolution, University of Bern, Wohlenstrasse 50a, 3032 Hinterkappelen, Switzerland*