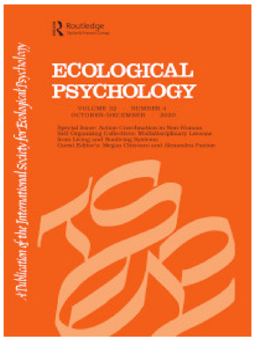

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EDITORIAL

Action Coordination in Non-Human Self-Organizing Collectives: Multidisciplinary Lessons From Living and Nonliving Systems

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ABSTRACT
While interpersonal coordination, collective intelligence, and self-organization have been fundamental in the study of human social interaction over the past several decades, these phenomena have a rich history in non-human systems as well. This special issue aims to unite disciplines studying inter-entity coordination of action in shared conversation. Here, we bring together ecological psychologists, ecologists, biologists, neuroethologists, and chemists, all working toward understanding the fundamentals of group coordination. We believe that contact among these different perspectives is essential for continuing to expand the impact of the ecological perspective to other fields. While this multidisciplinary special issue takes an explicitly non-human view of collective behavior, we hope it will not only improve our basic understanding of inter-entity dynamics but also spark curiosity and inspire new approaches in the study of human collectives.

Introduction

While interpersonal coordination, collective intelligence, and self-organization have been fundamental in the study of human social interaction over the past several decades, these phenomena have a rich history in studies of non-human systems as well. Schools of fish and flocks of birds (Hemelrijk & Hildenbrandt, 2012) are some of the most visually obvious examples of self-organization in the animal kingdom, but we also see examples in insect colonies. Termites build mound structures up to three meters in height (Turner, 2011), and honey bees partition tasks among five worker castes (Seeley, 1982). Even nonliving systems demonstrate collective dynamics, with examples from chemical (Chen et al., 2019; Satterwhite-Warden et al., 2019) and electrical systems (Davis et al., 2016) exhibiting striking lifelike behavior under the right constraints. Until now, researchers from each of these fields have explored these phenomena within the bounds of their own disciplines, despite their deep relevance to one another.

This special issue aims to bridge those disciplines and spark a new, multidisciplinary conversation about inter-entity coordination of action. Here, we aim to bring these areas together to tell a cohesive story about action coordination across disciplines,

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across species, and even across living and nonliving systems. It is important that we open up the discussion and begin to draw parallels between what have formerly been treated as distinct subjects. We bring together ecological psychologists, ecologists, biologists, neuroethologists, and chemists, all working toward understanding the fundamentals of coordination within collectives.

We believe the ecological approach is uniquely suited to facilitate cross-disciplinary pollination. Not only will this contact expand the impact of the ecological perspective to other fields, but it will—we hope—help the ecological perspective advance its own goals of creating a unified framework across the sciences (e.g., Turvey, 2008; Turvey & Shaw, 1995). While this multidisciplinary special issue takes an explicitly non-human view of collective behavior, we hope it will not only improve our basic understanding of inter-entity dynamics but also spark curiosity and inspire new approaches in the study of human collectives.

Overview of the special issue

Moiseff and Copeland present an account of species-specific male firefly synchronization during mating. Previous work supports that, by synchronizing flashes, species-specific flash patterns facilitate recognition by a female (Moiseff & Copeland, 2010). Here, they argue that male fireflies' action coordination may be due to a "sensitive period" in female fireflies, which—when exposed to extraneous flashing—disrupts her ability to respond to a male.

De Bari, Kondepudi, Kay, and Dixon provide insights from studies of nonliving collective dissipative structures. They review previous work by Davis et al. (2016), which explored dynamics of the Electrical Self-Organized Foraging Implementation (E-SOFI), and present novel related simulation results. The Chemical Self-Organized Foraging Implementation (C-SOFI; Satterwhite-Warden et al., 2019) is also discussed. The authors use both the E-SOFI and C-SOFI to argue for field reciprocity and their analogous nature with that of biological inter-organism dynamics.

Clifton draws parallels between human warfare and that of non-human animals, through applications of Lanchester's models of combat (Adams & Mesterton-Gibbons, 2003). Clifton reviews the use of these models in different kinds of battles observed in various species and the dimensions of variability that impact their success, such as colony population size and the size of individual fighters.

Chiovaro and Paxton present a discussion of the western honey bee, *Apis mellifera*, and its perception-action capabilities, both as individuals and as a collective. The authors outline the honeybees' impressive repertoire of context-sensitive communicative methods (including the famous waggle dance; von Frisch, 1967) as well as the phenomena of nest-site selection and task-allocation. Inspired by work on human collectives (Goldstone & Gureckis, 2009), the authors close by proposing a framework for using insect phenomena to improve human groups.

Embracing a multidisciplinary approach to collective coordination

Though this special issue is presented in *Ecological Psychology*, we specifically sought out contributors from a variety of backgrounds. We expect that some of the ideas expressed within these articles may run counter to the deep-rooted beliefs of Gibsonians, and we thus acknowledge that some readers may, perhaps, be unsettled.

Acknowledging these differences in theoretical perspectives is important, but more important still is that we open ourselves to conversations with those from other perspectives who are earnestly working in areas of shared interest. If those of us who identify as ecological psychologists want to continue to make an impact across all fields, then this is just the place to start. We hope this special issue inspires readers to start their own conversations, expose themselves to other methods and theories, and ultimately work toward a unified understanding of collective coordination.

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