This chapter examines the question of whether there is an essential connection between language and number, while looking more broadly at some of the potential innate precursors to the acquisition of the positive integers. It focuses on the theoretical question of how language may figure in an account of the ontogeny of the positive integers. Despite the trend in developmental psychology to suppose that it does, there are actually few detailed accounts on offer. Two exceptions are examined — two theories that give natural language a prominent role to play and that represent the state of the art in the study of mathematical cognition. The first is owing to C. R. Gallistel, Rochel Gelman, and their colleagues; the second to Elizabeth Spelke and her colleagues. Although both accounts are rich and innovative, they face a range of serious objections, in particular, their appeal to language isn't helpful.

The gargle call of black-capped chickadees: ontogeny, acoustic structure, population patterns, function, and processes leading to sharing of call characteristics

Myron C. Baker and David E. Gammon

This chapter summarizes investigations of a common vocalization in the repertoire of the black-capped chickadee. This vocalization, known as the gargle call, has an ontogeny that is dependent upon learning occurring from early life through adulthood. As is the case for the territorial songs
of a great many species of songbirds, social interactions most likely play a significant role in gargle call ontogeny. Thus, these calls evidently result from ‘socially biased individual learning,’ simply termed ‘social learning’ in this chapter. In examining the gargle call, this chapter gives a brief description of the call, provides information on the ontogeny of the call as it occurs in natural populations, and describes the fundamental features of the call, the nature and extent of sharing of calls by birds in a local area, and the similarities and changes in calls across time. Furthermore, observational and experimental evidence on the roles of the calls in the social lives of the birds is reported, and inferences are drawn about the ways social behaviour selects based on vocal convergence among birds in a local area, and the possible functional significance of convergence.

Elementary, my dear Watson, the clue is in the genes...or is it?

ANETTE KARMILOFF-SMITH

in Proceedings of the British Academy, Volume 117: 2001 Lectures

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This chapter argues that there is no one-to-one, direct mapping between specific sets of genes and cognitive-level outcomes. Rather, there are very indirect mappings, with the regulation of gene expression more likely to contribute to very broad differences in developmental timing, neuronal type, neuronal density, firing thresholds, neurotransmitter types, etc. It presents the neoconstructivist framework where gene/gene interaction, gene/environment interaction and, crucially, the process of ontogeny itself (pre- and postnatal development) are all considered to play a vital role in how genes are expressed and how the brain progressively sculpts itself, slowly becoming specialised over developmental time. The infant brain is not simply a miniature version of the adult brain.

Sexual size dimorphism and offspring vulnerability in birds

Ellen Kalmbach and Maria M. Benito

in Sex, Size and Gender Roles: Evolutionary Studies of Sexual Size Dimorphism

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Item type: chapter
This chapter uses recent experimental and observational studies of birds to explore patterns of sex-specific offspring vulnerability (increased mortality and reduced fledging mass under poor conditions) in relation to sexual size dimorphism (SSD). The results show size-dependent modulation of male fledgling mass but size-independent mass reduction in females. Overall, growth is more phenotypically plastic in males than in females. Comparisons of fledging mass reached in ‘good’ and ‘poor’ environments suggest that having to grow large is mainly disadvantageous when coupled with the male phenotype. Differences in environmental sensitivity between the two sexes during ontogeny, either in the form of increased mortality or reduced body size, will tend to reduce dimorphism during development, affecting adult SSD. These results suggest that environmental conditions during ontogeny contribute significantly to variation in SSD within bird species, particularly when comparisons are made among environments or between generations.

Evading predators

Anne E. Magurran

in Evolutionary Ecology: The Trinidadian Guppy

Trinidadian guppies provided one of the first experimental demonstrations that predators have a significant impact on behaviour and morphology. This chapter begins with a brief general introduction to predator prey interactions. The consequences of variation in predation risk for Trinidadian guppies, and the trade-offs linked to effective predator defences are then evaluated. It asks if and when adaptive differences can be classed as evolutionary change, and considers the pitfalls associated with such assumptions. Schooling behaviour, evasive tactics, crypsis and colour patterns, mating activity, foraging, and time budgets are examined as well as the relationship between learning skills and geographic variation anti-predator responses. Age-related changes in morphology and behaviour are explored. The chapter ends by examining differences between the sexes in response to predation.
This concluding chapter draws together the main themes of the book before summarizing the legacy of the pioneer guppy researchers. It identifies some areas where research is likely to be directed in future. These include the application of genomic tools and analyses of multi-trait evolution. There are three main conclusions. First, quality empirical work (such as behavioural observation and ecological recording) is of lasting value. The Trinidadian guppy system illustrates well how durable good data are. Second, investigations involving the guppy have led to significant advances in evolutionary ecology. It is a uniquely tractable vertebrate system. Lab studies can be dovetailed with field observations and manipulations. In addition, the guppy illustrates beautifully how changes in one trait, for example predator avoidance, impinge on others such as mating behaviour. Finally, the guppy system will continue to offer unrivalled opportunities to test theories in evolutionary ecology. The book concludes with a plea that the system be safeguarded.

This chapter argues that human cognitive development tells us a great deal about what makes human thinking qualitatively unique, but it does so in the same way that current evolutionary biologists explain how organisms are particularly well adapted to niches; that is, the way in which human concepts are specialized, rather than the product of a linear increase in complexity. The chapter outlines a few key developmental transitions that are commonly assumed in human cognitive development and then demonstrates how these ontogenetic distinctions fail to contribute to our understanding of cross-species differences.
Phylogeny and evolution
Nicola S. Clayton, Randolf Menzel, Stanley B. Klein, and Sara J. Shettleworth

in Science of Memory: Concepts
Published in print: 2007 Published Online: May 2009
Item type: chapter

This part presents four chapters on the concepts of phylogeny and evolution. The first focuses on three key evolutionary concepts which have important implications for memory research: homology and convergence, ontogeny, and adaptive specializations. The second evaluates comparative studies on the evolutionary processes of learning and memory. The third argues that a number of computational processes—the ability to self-reflect, a sense of personal agency/ownership and an awareness of the self as being situated within a temporal framework—are involved in the transformation of declarative knowledge into an autobiographical memorial experience. The fourth chapter presents a synthesis of the chapters in this part.

Functions of Play
Anthony D. Pellegrini

in The Role of Play in Human Development
Published in print: 2009 Published Online: April 2010
Item type: chapter

This chapter focuses on the link between cultural practices and the function of play. It first defines the meaning of function, drawing from both the behavioral biology and the developmental psychology literatures. Before delving into the theoretical discussions of function, it considers different ways that function is established. In further attempting to explicate the function of play, the chapter follows Tinbergen's advice by simultaneously considering function along with the ontogeny and phylogeny of play, as well as proximal causes of play. As part of this discussion, the possible difference in functions of different forms of play for males and females is considered. Guided by sexual selection theory, the hypothesis that males' and females' reproductive roles influence their play and its function is explored.
This chapter deals with the neurobiology of cortical networks, the postulated substrate of all cognitive functions. It examines the ontogeny and phylogeny of the cerebral cortex, although the two are inextricably related. Much has been inferred about the evolution of the cortex from its development in the individual organism. Conversely, certain principles of natural selection at the core of evolution theory have been deftly applied to current reasoning on the development of neocortical structure and function. A persuasive line of reasoning is emerging on the interplay of genetic factors with neural activity and individual experience in the development of the neocortex. Nowhere is that line of reasoning more relevant to cognition than on the issue of conical connectivity and its constituents, the synapses, axons, and dendrites that bind neocortical neurons into cognitive networks. This chapter discusses the evolution and ontogenetic development of the cortex, the principles of network formation, the role of extracortical factors in that process, and the general structural characteristics of cognitive networks.

Social behavior occurs in some of the smallest animals as well as some the largest, and the transition from solitary life to sociality is an unsolved evolutionary mystery. The Evolution of Social Wasps examines social behavior in a single lineage of insects, wasps of the family Vespidae. It presents empirical knowledge of social wasps from two approaches: one that focuses on phylogeny and life history; and one that focuses on individual ontogeny, colony development, and population dynamics. It also provides an extensive summary of the existing literature while demonstrating how it can be clouded by theory. This approach to the conflicting literature on sociality highlights how often repeated models can become fixed in the thinking of the scientific community. Instead, it presents a mechanistic scenario for the evolution of sociality in wasps.
that changes our perspective on kin selection, the paradigm that has dominated thinking about social evolution since the 1970s.

Desert food webs and ecosystem ecology
David Ward

in The Biology of Deserts

This chapter begins with the trophic model of Hairston, Smith, and Slobodkin and the food-web model generated by Cohen. It explains why, even in a desert, such generalities are inappropriate. Desert food-webs are much more complex than the ones described by previous researchers, and indicate that: energetics is not necessarily the most appropriate way to view food-webs; interaction webs (describing population effects) and descriptive webs (quantifying energy and matter flow) are not necessarily congruent; and consumer regulation of populations need involve little energy transfer and few feeding interactions. Most importantly, if the animals at the bottom of the chain are small, then more steps can be incorporated as one moves up the trophic pyramid. The important roles of disturbances and decomposition are considered.

Ontogeny
Gennaro Auletta

in Cognitive Biology: Dealing with Information from Bacteria to Minds

After having considered the flow of information as an irreversible process during the life of an individual, the chapter deals with the three main stages of ontogeny: Development, maturity, and aging. Then, the intrinsic randomness of the organism as one of the main sources of variations among individuals is considered as well as the most important aspect in which the ontogenetic information control of the organism is displayed: The construction of environmental niches.
Development and Culture
Gennaro Auletta

in Cognitive Biology: Dealing with Information from Bacteria to Minds
Published in print: 2011 Published Online: September 2011
Item type: chapter

After having recalled Piaget’s main contribution to epigeny, his historical work on children’s postnatal development is considered. Then, some expansions of these frameworks into both directions, that of ontogeny and that of culture and social interaction, are worked out. The question of up to which point it is possible to speak of innate endowment of the child is raised. Finally, the important issue of culture is examined.

Embryos in Deep Time
Marcelo Sánchez

Published in print: 2012 Published Online: September 2012
Item type: book

How can we bring together the study of genes, embryos, and fossils? This is a critical synthesis of the study of individual development in fossils. It brings together an up-to-date review of concepts from comparative anatomy, ecology, and developmental genetics, and examples of different kinds of animals from diverse geological epochs and geographic areas. Can fossil embryos demonstrate evolutionary changes in reproductive modes? How have changes in ocean chemistry in the past affected the development of marine organisms? What can the microstructure of fossil bone and teeth reveal about maturation time, longevity, and changes in growth phases? This book addresses these and other issues, and documents with numerous examples and illustrations how fossils provide evidence not only of adult anatomy, but also of the life history of individuals at different growth stages. The central topic of biology today—the transformations occurring during the life of an organism and the mechanisms behind them—is addressed in an integrative manner for extinct animals.
Early ontogeny of complex organisms involves simple cells dividing over and over again, eventually developing into a recognizable organism. It is a magnificent scientific achievement to have discovered this process and the mechanisms behind it at different levels of organization. Usually, two aspects of ontogeny, from conception to death, are treated separately: development and growth. Development concerns cell differentiation and the formation of the basic body pattern, with fundamental structural changes and the first appearance of major features. Growth, in fossils and in living forms, involves changes in size and shape. This chapter discusses fossil growth series and taxonomic issues.

Thinking from an evolutionary perspective

Since the inception of the scientific theory of evolution of Charles Darwin in 1859, another question arises — how are humans different from their distant cousins the chimpanzee and bonobo? The difference of course lies in our ability to think and to communicate through systematic sets of codes. This chapter discusses the complexity of human thinking — the components of thinking and how this process has evolved. Thinking is the most central feature of consciousness. Thinking is a complex combination of sensation, attention, emotion, memory (procedural, semantic, and episodic), thought and imagination, planning, self-consciousness, free will, and language. The four sources of empirical support cited in this study are: phylogeny, neurophysiology, ontogeny, and archaeology (and anthropology). It also discusses the four-step model for the development of consciousness. Lastly, this chapter discusses how thinking is related to the behaviourist approach of Frederic Skinner.
This Festschrift for Chris Humphries provides an opportunity to reflect on how much has changed in systematic biology since the 1970s. Humphries, together with his longtime collaborator, Kåre Bremer, pioneered the application of cladistic methods of phylogeny reconstruction in the Compositae and soon influenced the systematics of other groups of living and fossil plants. Today, the classification of the Compositae has been turned literally upside-down thanks to the availability of DNA sequence characters and the almost universally adopted procedures of phylogenetic systematics. There can be little doubt that Humphries's pivotal role in the promotion of cladistics was greatly enhanced by his appointment to the Department of Botany at the (then) British Museum (Natural History). This chapter focuses on Humphries's contribution to the field of evolution and development. It considers how the field of ontogeny and systematics has developed through to the present day, with particular emphasis on pollen ontogeny. It concluded that Humphries played an influential role in the emergence of the discipline now recognized as “evo-devo”: evolutionary developmental biology.

Gonad Development in Hermaphroditic Gobies
Kathleen S. Cole

Among hermaphroditic goby taxa (Perciformes, Gobiidae), considerable variability in the composition and configuration of gametogenic tissue within the gonad proper is coupled with a diversity of accessory structures of the reproductive complex. Such diversity prompts the question of how gonad ontogeny and morphogenesis may have become modified to produce such an impressive array of anatomical complexity. This chapter addresses that possibility. First, it provides a brief overview of hermaphroditic gonad morphology among gobiiid fishes. The chapter
then explores various aspects of early cell differentiation and tissue formation associated with the ontogeny of the reproductive complex in teleosts. It also examines patterns of gonad morphology as possible clade traits in order to investigate whether hermaphroditism has multiple origins within the Gobiidae and to what extent shared patterns of gonad morphology may be predictive of phylogenetic relatedness. The chapter concludes with a discussion of how ontogenetic processes may inform our understanding of the evolution of gonad morphological diversity among hermaphroditic gobiid fishes.

Personality and social network analysis in animals
Alexander D. M. Wilson and Jens Krause
in Animal Social Networks
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Over the last decade, the study of consistent individual-level differences in behaviour, or animal personality, has become a subject of significant research growth. This ongoing interest in personality traits is likely attributable to the diverse range of taxa as well as ecological contexts in which personality has been shown to be mechanistically involved. Despite this research interest, surprisingly little is known about the role of personality in terms of complex social interaction dynamics and group-level interactions such as those characterized by social networks. The aim of this chapter is to highlight recent advances in the integration of personality and network analysis research and provide an overview of areas of current and future research promise. This chapter discusses the potential importance of key individuals, or individuals with particular behavioural characteristics (i.e. behavioural types) in animal social networks as well as the need for considering networks and personality over ontogeny and related processes. Lastly, this chapter offers new directions and perspectives for future research on this exciting topic.