The Handbook of Evolutionary Psychology

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Edited by

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To Charles Darwin

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Foreword

For many years after I decided to become a psychologist I was frustrated by my chosen field, and fantasized about a day when it would satisfy the curiosity that first led me to devote my professional life to studying the mind. As with many psychology students, the frustration began with my very first class, in which the instructor performed the ritual that begins every introduction to psychology course: disabusing students of the expectation that they would learn about any of the topics that attracted them to the subject. Forget about love and hate, family dynamics, and jokes and their relation to the unconscious, they said. Psychology was a rigorous science which investigated quantifiable laboratory phenomena; it had nothing to do with self-absorption on an analyst's couch or the prurient topics of daytime talk shows. And in fact the course confined itself to "perception," which meant psychophysics, and "learning," which meant rats, and "the brain," which meant neurons, and "memory," which meant nonsense syllables, and "intelligence," which meant IQ tests, and "personality," which meant personality tests.

When I proceeded to more advanced courses, they only deepened the disappointment by revealing that the psychology canon was a laundry list of unrelated phenomena. The course on perception began with Weber's Law and Fechner's Law and proceeded to an assortment of illusions and aftereffects familiar to readers of cereal boxes. There was no there—no conception of what perception *is* or of what it is for. Cognitive psychology, too, consisted of laboratory curiosities analyzed in terms of dichotomies such as serial/parallel, discrete/analog, and top-down/bottom-up (inspiring Alan Newell's famous jeremiad, "You can't play twenty questions with nature and win"). To this day, social psychology is driven not by systematic questions about the nature of sociality in the human animal but by a collection of situations in which people behave in strange ways.

But the biggest frustration was that psychology seemed to lack any sense of *explanation.* Like the talk show guest on *Monty Python's Flying Circus* whose theory of the brontosaurus was that "the brontosaurus is skinny at one end; much, much thicker in the middle; and skinny at the other end," psychologists were content to "explain" a phenomenon by redescribing it. A student rarely enjoyed the flash of

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insight which tapped deeper principles to show why something *had* to be the way it is, as opposed to some other way it could have been.

My gold standard for a scientific explanation was set when I was a graduate student—not by anything I learned in graduate *school,* mind you, but by a plumber who came to fix the pipes in my dilapidated apartment and elucidated why they had sprung a leak. Water, he explained, obeys Newton's second law. Water is dense. Water is incompressible. When you shut off a tap, a large incompressible mass moving at high speed has to decelerate quickly. This imparts a big force to the pipes, like a car slamming into a wall, which eventually damages the threads and causes a leak. To deal with this problem, plumbers used to install a closed vertical section of pipe, a pipe riser, near each faucet. When the faucet is shut, the decelerating water compresses the column of air in the riser, which acts like a shock absorber, protecting the pipe joints. Unfortunately, this is a perfect opportunity for Henry's Law to apply, namely, that gas under pressure is absorbed by a liquid. Over time, the air in the column dissolves into the water, filling the pipe riser and rendering it useless. So every once in a while, a plumber should bleed the system and let air back into the risers, a bit of preventive maintenance the landlord had neglected. I only wished that psychology could meet that standard of explanatory elegance and show how a seemingly capricious occurrence falls out of laws of greater generality.

It's not that psychologists never tried to rationalize their findings. But when they did, they tended to recycle a handful of factors like similarity, frequency, difficulty, salience, and regularity. Each of these so-called explanations is, in the words of the philosopher Nelson Goodman, "a pretender, an impostor, a quack." Similarity (and frequency and difficulty and the rest) are in the eye of the beholder, and it is the eye of the beholder that psychologists should be trying to explain.

This dissatisfaction pushed me to the broader interdisciplinary field called cognitive science, where I found that other disciplines were stepping into the breach. From linguistics I came across Noam Chomsky's criteria for an adequate theory of language. At the lowest level was observational adequacy, the mere ability to account for linguistic behavior; this was the level at which most of psychology was stuck. Then there was descriptive adequacy, the ability to account for behavior in terms of the underlying mental representations that organize it. At the highest level was explanatory adequacy, the ability of a theory to show why *those* mental representations, and not some other ones, took root in the mind. In the case of linguistics, Chomsky continued, explanatory adequacy was rooted in the ability of a theory to solve the problem of language acquisition, explaining how children can learn an infinite language from a finite sample of sentences uttered by their parents. An explanatory theory must characterize Universal Grammar, a part of the innate structure of the mind. This faculty forces the child to analyze speech in particular ways, those consistent with the way human languages work, rather than in any of the countless logically possible ways that are consistent with the input but dead ends in terms of becoming an expressive language user (e.g., memorizing every sentence or combining nouns and verbs promiscuously). As a result, a person's knowledge of language is not just any old set of rules, but ones that conform to an algorithm powerful enough to have acquired an infinite language from a finite slice of the environment. For example, locality conditions on movement rules in syntax—the fact that you can say,

"What do you believe he saw?" but not, "What do you believe the claim that he saw?"—allow children to acquire a language from the kinds of simple sentences that are available in parental speech. In this way, a psychological phenomenon (the distribution of well-formed and malformed questions) could be explained in terms of what was necessary to solve the key problem faced by a human child in this domain.

Artificial intelligence, too, set a high standard of explanation via the work of the vision scientist David Marr. A theory of vision, he suggested, ought to characterize visual processing at three levels: the neurophysiological mechanism, the algorithm implemented by this mechanism, and, crucially, a "theory of the computation" for that domain. A theory of the computation is a formal demonstration that an algorithm can, in principle, compute the desired result, given certain assumptions about the way the world works. And the desired result, in turn, should be characterized in terms of the overall "goal" of the visual system, namely to compute a useful description of the world from the two-dimensional array of intensity and wavelength values falling on the retina. For example, the subsystem that computes the perception of shape from shading (as when we perceive the contours of a cheek or the roundness of a ping-pong ball) relies on a fact of physics that governs how the intensity of light reflecting off a surface depends on the relative angles of the illuminant, the surface, and the observer, and on the physical properties of the surface. A perceptual algorithm can exploit this bit of physics to "work backwards" from the array of light intensities, together with certain assumptions about typical illuminants and surfaces in a terrestrial environment, and compute the tangent angle of each point on a surface, yielding a representation of its shape. Many perceptual phenomena, from the way makeup changes the appearance of a face to the fact that turning a picture of craters upside down makes it look like a picture of bumps, can be explained as byproducts of this shape-from-shading mechanism. Most perception scientists quickly realized that conceiving the faculty of vision as a system of well-designed neural computers that supply the rest of the brain with an accurate description of the visible environment was a big advance over the traditional treatment of perception as a ragbag of illusions, aftereffects, and psychophysical laws.

Language and perception, alas, are just two of our many talents and faculties, and it was unsatisfying to think of the eyes and ears as pouring information into some void that constituted the rest of the brain. Might there be some comparable framework for the rest of psychology, I wondered, that addressed the engaging phenomena of mental and social life, covered its subject matter systematically rather than collecting oddities like butterflies, and explained its phenomena in terms of deeper principles? The explanations in language and vision appealed to the *function* of those faculties: in linguistics, acquiring the language of one's community; in vision, constructing an accurate description of the visible world. Both are extraordinarily difficult computational problems (as yet unsolvable by any artificial intelligence system) but ones that any child can perform with ease. And both are not esoteric hobbies but essential talents for members of our species, affording obvious advantages to their well-being. Couldn't other areas of psychology, I wondered, benefit from an understanding of the problems our mental faculties solve—in a word, what they are *for*?

When I discovered evolutionary psychology in the 1980s through the work of Donald Symons, Leda Cosmides, and John Tooby, I realized my wait was over.

Evolutionary psychology was the organizing framework—the source of "explanatory adequacy" or a "theory of the computation"—that the science of psychology had been missing. Like vision and language, our emotions and cognitive faculties are complex, useful, and nonrandomly organized, which means that they must be a product of the only physical process capable of generating complex, useful, nonrandom organization, namely, natural selection. An appeal to evolution was already implicit in the metatheoretical directives of Marr and Chomsky, with their appeal to the function of a mental faculty, and evolutionary psychology simply shows how to apply that logic to the rest of the mind.

Just as important, the appeal to function in evolutionary psychology is itself constrained by an external body of principles—those of the modern, replicator-centered theory of selection from evolutionary biology—rather than being made up on the spot. Not just any old goal can count as the function of a system shaped by natural selection, that is, an adaptation. Evolutionary biology rules out, for example, adaptations that work toward the good of the species, the harmony of the ecosystem, beauty for its own sake, benefits to entities other than the replicators that create the adaptations (e.g., horses that evolve saddles), functional complexity without reproductive benefit (e.g., an adaptation to compute the digits of pi), and anachronistic adaptations that benefit the organism in a kind of environment other than the one in which it evolved (e.g., an innate ability to read or an innate concept of *carburetor* or *trombone*). Natural selection also has a positive function in psychological discovery, impelling psychologists to test new hypotheses about the possible functionality of aspects of the mind that previously seemed functionless. For example, the social and moral emotions (sympathy, trust, guilt, anger, gratitude) appear to be adaptations for policing reciprocity in nonzero sum games; an eye for beauty appears to be an adaptation for detecting health and fertility in potential mates. None of this research would be possible if psychologists had satisfied themselves with a naïve notion of function instead of the one licensed by modern biology.

Evolutionary psychology also provides a motivated research agenda for psychology, freeing it from its chase of laboratory curiosities. An explanatory hypothesis for some emotion or cognitive faculty must begin with a theory of how that faculty would, on average, have enhanced the reproductive chances of the bearer of that faculty in an ancestral environment. Crucially, the advantage must be demonstrable by some independently motivated causal consequence of the putative adaptation. That is, laws of physics or chemistry or engineering or physiology, or some other set of laws independent of the part of our psychology being explained must suffice to establish that the trait is useful in attaining some reproduction-related goal. For example, using projective geometry one can show that an algorithm can compare images from two adjacent cameras and calculate the depth of a distant object using the disparity of the two images. If you write out the specs for computing depth in this way—what engineers would specify if they were building a robot that had to see in depth—you can then examine human stereoscopic depth perception and ascertain whether humans (and other primates) obey those specs. The closer the empirical facts about our psychology are to the engineering specs for a well-designed system, the greater our confidence that we have explained the psychological faculty in functional terms. A similar example comes from the wariness of snakes found in humans and many other primates. We know from herpetology that snakes were prevalent in Africa

during the time of our evolution and that getting bitten by a snake is harmful because of the chemistry of snake venom. Crucially, these are not facts of psychology. But they help to establish that something that *is* a fact of psychology, namely the fear of snakes, is a plausible adaptation. In a similar manner, robotics can help explain motor control, game theory can explain aggression and appeasement, economics can explain punishment of free riders, and mammalian physiology (in combination of the evolutionary biology of parental investment) makes predictions about sex differences in sexuality. In each case, a "theory of the computation" is provided by an optimality analysis using a set of laws outside the part of the mind we are trying to explain. This is what entitles us to feel that we have explained the operation of that part of the mind in a noncircular way.

In contrast, it's not clear what the adaptive function of music is, or of religion. The popular hypothesis that the function of music is to keep the community together may be true, but it is not an *explanation* of why we like music, because it just begs the question of why sequences of tones in rhythmic and harmonic relations should keep the group together. Generating and sensing sequences of sounds is not an independently motivated solution to the problem of maintaining group solidarity, in the way that, say, the emotion of empathy, or a motive to punish free riders, is part of such a solution. A similar problem infects the "explanation" that people are prone to believe in incredible religious doctrines because those doctrines are comforting—in other words, that the doctrines of a benevolent shepherd, a universal plan, an afterlife, and divine retribution ease the pain of being a human. There's an element of truth to each of these suggestions, but they are not legitimate adaptationist explanations, because they beg the question of *why* the mind should find comfort in beliefs that it is capable of perceiving as false. In these and other cases, a failure to find an adaptationist explanation does not mean that no explanation is forthcoming at all. Recent books by Pascal Boyer and Scott Atran have insightfully explained the phenomenon of religious belief as a byproduct of adaptations (such as a theory of mind module and free-rider detection mechanisms) that are demonstrably useful for solving *other* adaptive problems.

Evolutionary psychology is the cure for one last problem ailing traditional psychology: its student-disillusioning avoidance of the most fascinating aspects of human mental and social life. Even if evolutionary psychology had not provided psychology with standards of explanatory adequacy, it has proved its worth by opening up research in areas of human experience that have always been fascinating to reflective people but that had been absent from the psychology curriculum for decades. It is no exaggeration to say that contemporary research on topics like sex, attraction, jealousy, love, food, disgust, status, dominance, friendship, religion, art, fiction, morality, motherhood, fatherhood, sibling rivalry, and cooperation has been opened up and guided by ideas from evolutionary psychology. Even in more traditional topics in psychology, evolutionary psychology is changing the face of theories, making them into better depictions of the real people we encounter in our lives, and making the science more consonant with common sense and the wisdom of the ages. Before the advent of evolutionary thinking in psychology, theories of memory and reasoning typically didn't distinguish thoughts about people from thoughts about rocks or houses. Theories of emotion didn't distinguish fear from anger, jealousy, or love. And theories of social relations didn't distinguish among the way people treat family, friends, lovers, enemies, and strangers.

For many reasons, then, this *Handbook* represents a remarkable milestone in the science of psychology. The theoretical rigor and empirical richness showcased in these chapters have more than fulfilled evolutionary psychology's initial promise, and they demolish lazy accusations that the field is mired in speculative story-telling or rationalizations of reactionary politics. The chapters don't, of course, summarize a firm consensus or present the final word in any of the areas they cover. (In particular, see my chapter in Christansen and Kirby's *Language Evolution* for a rather different take on the evolutionary psychology of language.) But in topics from parenting to fiction, from predation to religion, they deliver subtle and deep analyses, genuinely new ideas, and eye-opening discoveries. *The Handbook of Evolutionary Psychology* is far more than a summary of the state of the art of evolutionary psychology. It is the realization of the hope that psychology can be a systematic and explanatory science of the human condition.

STEVEN PINKER

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Introduction: The Emergence of Evolutionary Psychology

DAVID M. BUSS

EVOLUTIONARY PSYCHOLOGY, BROADLY conceived, dates back to Darwin. He offered this scientific vision at the end of his monumental book, *On the Origins of Species:* "In the distant future I see open fields for more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation" (Darwin, 1859). This *Handbook of Evolutionary Psychology,* published 146 years after Darwin's prophetic words, symbolizes the emergence of evolutionary psychology based on his vision.

Evolutionary psychology is still a young scientific field, and there's a long and exciting road ahead. Aspects of the field's conceptual foundations remain legitimate topics of debate, such as the nature and specificity of psychological adaptations and the importance of individual differences. Many phenomena remain unexamined, awaiting new explorers of the human mind using the conceptual tools that evolutionary psychology provides. Many of the conceptual foundations are now in place, offering a solid metatheoretical framework from which to build. Hundreds of psychological and behavioral phenomena have been documented empirically, findings that would never have been discovered without the guiding framework of evolutionary psychology. Evolutionary psychology has proved its worth many times over in its theoretical and empirical harvest. If a viable *alternative* framework to evolutionary psychology exists for understanding the origins and nature of the human mind, it has not been revealed to the scientific community. This *Handbook* takes stock of where the field is today and where it needs to go.

A decade ago, a handbook of this scope would have been impossible. The empirical corpus of research testing evolutionary psychological hypotheses was too slim. Now the body of work has mushroomed at such a rapid rate that I had to make difficult decisions about what to include for this volume to keep it a reasonable length. Some important areas regrettably could not be covered. Most chapters had to be shortened, sometimes dramatically. The extensity of coverage, however, reveals that evolutionary psychology has penetrated every existing branch of psychology.

Psychologists working in some subdisciplines in times past could safely disregard evolutionary psychology. Now the robustness of evolutionary hypotheses and the rapid accumulation of empirical findings make it impossible to ignore for all but those who remain conceptually insular. Scientists working in cognitive, social, developmental, personality, neuroscience, or clinical psychology cannot afford to close their eyes to the insights offered by evolutionary psychology.

Some view evolutionary psychology as an optional perspective, an explanation of last resort, to be brought in only when all other alternatives have been exhausted. In my view, this position is naïve. Evolutionary psychology represents a true scientific revolution, a profound paradigm shift in the field of psychology. The human mind can no longer be conceived as it has been in mainstream psychology, implicitly or explicitly, as a blank slate onto which parents, teachers, and culture impose their scripts; a domain-general learning device; a set of content-free information processing mechanisms; or a content-free neural or connectionist network. Instead, the human mind comes factory-equipped with an astonishing array of dedicated psychological mechanisms, designed over deep time by natural and sexual selection, to solve the hundreds of statistically recurring adaptive problems that our ancestors confronted. Understanding these mechanisms of mind requires understanding their evolved functions—what they were designed by selection to accomplish. Just as a medical researcher's insights into the heart, liver, or kidney would be viewed as woefully incomplete without knowledge of their functions, explanations of psychological mechanisms will almost invariably be incomplete without specifying their functions. Evolutionary psychology is no longer a discretionary or elective theoretical option for psychology. It is essential and necessary.

At the current point in the history of psychology, the mainstream field is partitioned into subdisciplines—cognitive, social, personality, developmental, clinical, and hybrid areas such as cognitive neuroscience. Evolutionary psychology provides the metatheoretical foundation that unites the disparate branches of the sprawling field of psychology and suggests that the human mind cannot be logically parsed in the manner the subdisciplines imply. Consider "stranger anxiety" as a candidate psychological adaptation. Its function is to motivate the infant to recoil from potentially dangerous humans and to maintain close proximity to caregivers, thereby avoiding hazards that strangers might pose. Stranger anxiety possesses a number of well-articulated design features. It shows universality, emerging in infants in all cultures in which it has been studied. It emerges predictably during ontogeny at roughly 6 months of age, coinciding with the time when infants begin crawling away from their mothers and potentially encountering strangers. And its focus centers on strange males rather than strange females because strange males historically have been more hazardous to infants' health. Stranger anxiety shows all the characteristics of "improbable design" for achieving a specific function.

In which subdiscipline of psychology does stranger anxiety belong? It obviously involves information processing and thus could be claimed by cognitive psychology. It shows a predictable ontogenetic unfolding, so it could be claimed by developmental psychology. It is activated by interactions with others, so it belongs to social psychology. Individual infants differ in the intensity of stranger anxiety, so it falls within the province of personality psychology. The mechanism can malfunction in a minority of infants, so it's relevant to clinical psychology.

And its biological substrate must include the brain, so neuroscience can also lay claim. Obviously, stranger anxiety belongs simultaneously to all or to none.

Evolutionary psychology breaks down these traditional disciplinary boundaries and reveals them to lack logical or scientific warrant. Viewed through the theoretical lens of adaptive problems and their evolved psychological solutions, evolutionary psychology offers the only nonarbitrary means for carving the mind at its natural joints. It provides the conceptual unification of the disparate branches of psychology that currently operate in virtual isolation. And it integrates psychology theoretically with the rest of the natural sciences in a unified causal framework.

It is a great honor and privilege to serve as editor for the first reasonably comprehensive *Handbook of Evolutionary Psychology,* which contains such a high-powered assembly of scientists. The *Handbook* begins with a Foreword from Steven Pinker, who provides a powerful narrative of his intellectual journey to evolutionary psychology and describes his views about why evolutionary psychology is necessary for psychological science. The *Handbook* ends with an eloquent afterword by evolutionary biologist Richard Dawkins, whose theoretical contributions have informed much work in the discipline. Between are 34 chapters parsed into seven parts.

Part I, *Foundations of Evolutionary Psychology,* contains five chapters that outline the logic of the enterprise, the methods used, and controversial issues surrounding the field. Part II, *Survival,* contains three chapters that deal, respectively, with struggles with the physical environment, with other species (predators and prey), and with other humans. Part III, *Mating,* begins with an insightful essay by Donald Symons, in which he articulates the logic of adaptationism and offers a novel hypothesis about mate rejection anxiety. It is followed by six chapters that range in content from sexual coercion to love in long-term mating, highlighting the breadth and depth of theory and research in the domain of human mating. Part IV, *Parenting and Kinship,* contains a cogent introduction by Martin Daly and Margo Wilson and is followed by five chapters on cooperation and conflict among kin, parental investment, parent-offspring conflict, and the evolution of the human family. Part V, *Group Living,* deals with social exchange, aggression, social exclusion, status hierarchies, language, cognitive biases in mind reading, and the evolution of morality. Part VI, *Evolutionizing Traditional Disciplines of Psychology,* contains six chapters on how the conceptual foundations of the current disciplines within psychology can be informed by an evolutionary framework. Part VII, *Applications of Evolutionary Psychology to Other Disciplines,* offers two chapters, one on evolutionary psychology and literature and one on the evolutionary analysis of the law, revealing how evolutionary psychology provides insights into far-ranging and disparate disciplines. The *Handbook* ends with an Afterword by Richard Dawkins, who offers insightful reflections about the history of field.

After a long succession of conceptual advances and empirical discoveries, a robust field of evolutionary psychology has finally emerged. Darwin's prophetic vision is being realized—a psychology based on a new foundation.