How the mind works. By STEVEN PINKER. New York: W. W. Norton & Company, 1997. Pp. xii, 660.

Reviewed by D. TERENCE LANGENDOEN, *University of Arizona*

Pinker begins by acknowledging that 'we don't understand how the mind works'. However, we've made progress. Certain theories from a variety of disciplines now offer 'a special insight into our thoughts and feelings', which can be integrated using 'the computational theory of mind and the theory of the natural selection of replicators' (ix). The book consists of eight chapters, notes, references, and an index, all substantial. Ch. 1 (3–58) presents the book's central thesis 'that the mind is a system of organs of computation designed by natural selection to solve the problems faced by our evolutionary ancestors in their foraging way of life' (x). Ch. 2 (59–148) discusses the computational theory of mind, including refutations of the views of two of its major critics, John Searle and Roger Penrose, and a very readable account of connectionism. In Ch. 3 (149–210), P discusses the theory of natural selection and argues that four conditions were necessary for the emergence of intelligence in our ancestors: a well-developed (stereoscopic, color) visual system, group living, the hand, and hunting. Anticipating Alfred Russel Wallace's objection that natural selection cannot account for human intelligence, P writes: 'Many theorists have wondered what illiterate foragers do with their capacity for abstract intelligence. The foragers would have better grounds for asking the question about modern couch potatoes' (188).

Chs. 4–7 are devoted to visual perception (211–98), reasoning (299–362), emotion (363–424), and social relations (425–520); Ch. 8 (525–65) discusses art, music, literature, humor, religion, and philosophy. Although no chapter discusses language per se (the reader is referred to Pinker 1994), two linguistic topics are central to P's concerns in this book: metaphor and logical form.

Metaphor is an important part of P's solution to Wallace's puzzle about why our ancestors should have evolved an intelligence equivalent to our own. Following John Tooby and Leda Cosmides's theory of 'ecological rationality' (304), P maintains that the human mind is not adapted to think about arbitrary entities and their relations; instead its intelligence is subject-specific: 'It is equipped with faculties to master the local environment and outwit its denizens. People . . . have several ways of knowing . . . adapted to the major kinds of entities in human experience: objects, animate things, natural kinds, artifacts, minds, and . . . social bonds and forces' (352).

Metaphor extends our mental ability to cope with other kinds of things and relations, and P suggests that it is a process like evolutionary change 'which often works by copying body parts and tinkering with the copy. . . . A similar process may have given us our language of thought. Suppose ancestral circuits for reasoning about space and force were copied, the copy's connections to the eyes and muscles were severed, and references to the physical world were bleached out. The circuits could serve as a scaffolding whose slots are filled with symbols for more abstract concerns like states, possessions, ideas, and desires' (355). But surely this is not a THEORY of metaphor; at best it is a metaphor of metaphor. To be a theory, it would require at minimum a specification of what is being replicated and how, and of how natural selection comes into play.

The nature of the logical form of ordinary sentences of natural languages figures prominently in P's refutation of the associationist theory of meaning, particularly as it is embodied in the version of connectionism he calls 'connectoplasm'. P points out that the difference between the two interpretations of the sentence *Every forty-five seconds someone in the United States sustains a head injury* (both of which figure in the joke whose punch line is *Omigod! That poor guy!*) depends on the relative scope of the existential quantifier binding the subject variable and the phrase *every forty-five seconds,* and observes: 'Our mentalese must have machinery that does something similar. But so far, we have no hint as to how this can be done in an associative network' (123).

However, P later retracts the claim that our mentalese must have such machinery, the reason being the subject-specificity of human intelligence (ecological rationality), with the appearance of generality being the result of metaphoric extension: 'Unlike computers and the rules of mathematical logic, we don't think in *F*'s and *x*'s and *y*'s. We have inherited a pad of forms that capture the key features of encounters among objects and forces, and the features of other consequential themes of the human condition such as fighting, food, and health. By erasing the contents and filling in the blanks with new symbols, we can adapt our inherited forms to more abstruse domains' (358).

The most dramatic evidence for ecological rationality comes from Cosmides's 1989 work with an experimental paradigm developed by Wason (1966), in which subjects are told that a certain deck of cards consists entirely of cards which have a single letter printed on one side and a single number on the other. They are then presented with an array of four of these cards, two with letters and two with numbers face up, and asked which cards they need to turn over to verify a rule such as 1.

(1) If a card has a *D* on one side, then it has a *3* on the other.

Given Rule 1 and the array *D F 3 7,* most subjects report that they need to turn over the *D* alone or the *D* and the *3,* whereas the logically correct answer is the *D* and the *7.* Cosmides found that subjects succeed in the task if it is altered in a certain way. For example, if subjects are told that each card represents a customer in a bar, with one side showing what the customer is drinking and the other, his or her age in years, and their task is to determine which cards they need to turn over to verify compliance with Rule 2, then when presented with the array *beer cola 25 16,* most subjects correctly report that they need to turn over the *beer* and the *16.*

(2) If a customer is drinking beer, then he or she must be at least 18 years old.

Following Cosmides, P suggests that our ability to succeed in this task is not because it (unlike Wason's task) somehow engages our full capacity to reason but rather because it activates special-purpose cheating detectors, which we humans developed in our foraging days in support of reciprocal altruism: extending help now in return for help in the future (337; see also 402–6 and 502–9).

However, giving up the theory of variable binding in semantics is too high a price to pay for obtaining the explanatory benefits of ecological rationality. Nor is it necessary to do so. Detecting cheating doesn't require special-purpose mechanisms; logic suffices.

To successfully carry out the task of verifying 1, we may apply either the single procedure in 3, in which the *make sure* operator has scope over the entire conditional, or the two procedures in 4, in which that operator has scope over the consequent only.

(3) Make sure that if a card has a *D* on one side, then it has a *3* on the other.
(4) a. If a card has a *D* on one side, then make sure that it has a *3* on the other.
b. If a card does not have a *3* on one side, then make sure that it does not have a *D* on the other.

Apparently what most of us do in attempting to verify 1 is to apply procedure 4a only, or 4a together with the irrelevant procedure in 5. (This assumes that people who examine the *3* card report a violation of 1 if the other side does not show a *D*.) Either way, we fail to detect the need to apply the contrapositive procedure 4b.

(5) If a card has a *3* on one side, then it has a *D* on the other.

Similarly, to successfully verify compliance with 2, we may apply either the single procedure in 6 or the two procedures in 7.

(6) Make sure that if a customer is drinking beer, then he or she is at least 18 years old.
(7) a. If a customer is drinking beer, then make sure that he or she is at least 18 years old.
b. If a customer is less than 18 years old, then make sure that he or she is not drinking beer.

I conjecture that what we actually do in this task is apply both procedures in 7, successfully detecting the need to apply the contrapositive procedure 7b. I also conjecture that our success is based not on our being equipped with special-purpose cheating detectors but on our ability to determine that the contrapositive of 2, given in 8, expresses a prohibition.

(8) If a customer is less than 18 years old, then he or she is not allowed to drink beer.

If this is correct, then our success with Cosmides's task is based on a formal property of the rules that are presented (either they or their contrapositives express prohibitions) rather than on their subject matter. Proponents of ecological rationality would then be advised to seek a somewhat different kind of explanation for why we fail at Wason's task but succeed at Cosmides's, one that involves formal semantic analysis of both the experimental sentences and of the procedures we use to verify them. P was correct the first time: we DO think in *F*s, *x*s, and *y*s.

REFERENCES

COSMIDES, LEDA. 1989. The logic of social exchange: Has natural selection shaped how humans reason? Studies with the Wason selection task. Cognition 31.187–276.

PINKER, STEVEN. 1994. The language instinct. New York: Harper Collins.

WASON, PETER C. 1966. Reasoning. New horizons in psychology, ed. by Brian M. Foss 135–51. Baltimore, MD: Penguin.

Department of Linguistics
University of Arizona
P.O. Box 210028
Tucson, AZ 85721
[langendt@arizona.edu]

Phonologies of Asia and Africa. Ed. by ALAN S. KAYE. Winona Lake, IN: Eisenbrauns, 1997. 2 vols. Pp. xxi, 1041.

Reviewed by GONZALO RUBIO, *The Johns Hopkins University*

These two volumes contain 50 chapters describing the phonological systems of 50 different languages, both living and dead, spoken in Africa and Asia. The first volume is dedicated to Afroasiatic languages: Akkadian and Amorite (3–38) by GIORGIO BUCCELLATI; Eblaite (39–48) and Ugaritic (49–54) by CYRUS GORDON; Phoenician and Punic (55–64) and Old Aramaic (115–25) by STANISLAV SEGERT; Ancient Hebrew (65–83) by GARY A. RENDSBURG; Tiberian Hebrew (85–102) and Jewish Palestinian Aramaic (103–13) by GEOFFREY KHAN; Classical Syriac (127–40) by PETER T. DANIELS; Modern and Classical Mandaic (141–59) by JOSEPH L. MALONE; Old South Arabian (161–68) and Geʕez (169–86) by GENE GRAGG; Arabic (187–204) by ALAN S. KAYE; Moroccan Arabic (205–17) by JEFFREY HEATH; Cypriot Arabic (219–44) and Maltese (245–85) by ALEXANDER BORG; Israeli Hebrew (287–311) by SHMUEL BOLOZKY; Modern Aramaic (313–35) by ROBERT D. HOBERMAN; Modern South Arabian (337–72) by ANTOINE LONNET and MARIE-CLAUDE SIMEONE-SENELLE; Chaha—Gurage—(373–98) and Amharic (399–430) by WOLF LESLAU; Egyptian and Coptic (431–60) by ANTONIO LOPRIENO; Berber (461–76) by MAARTEN G. KOSSMANN and HARRY J. STROOMER; Awngi—Cushitic—(477–91) by ROBERT HETZRON; Oromo (493–519) by MARIA-ROSA LLORET; Somali (521–35) by ANNARITA PUGLIELLI; and Hausa (537–52) by PAUL NEWMAN. In this first volume, Kaye should be specially praised for his excellent introduction and for his arrangement of the subjects, especially for devoting separate chapters to Ancient Hebrew and Tiberian Hebrew.

More than half of the second volume deals with Indo-European languages: Hittite (555–67) by H. CRAIG MELCHERT; Old Persian and Avestan (569–600) and Ossetic (707–31) by DAVID TESTEN; Pahlavi (601–36) by DIETER WEBER; Hindi-Urdu (637–52) by ALAN S. KAYE; Gujarati—Indo-Aryan—(653–73) by P. J. MISTRY; Persian (675–89) by GERNOT L. WINDFUHR; Kurdish (691–706) by ERNEST N. MCCARUS; Pashto (733–60) and Balochi (761–76) by JOSEF ELFENBEIN; and Armenian (777–93) by JOHN A. C. GREPPIN. Also studied are Dravidian, Brahui (797–811) by J. ELFENBEIN; Nilo Saharan (815–38) by M. LIONEL BENDER; Niger-Congo, Swahili (841–60) by ELLEN CONTINI-MORAVA and Sango (861–80) by JAMES A. WALKER and WILLIAM J. SAMARIN; some so-called Altaic languages (883–925), Turkish, Tatar, and Uyghur by BERNARD COMRIE; Caucasian, Georgian (929–39) by HOWARD I. ARONSON, Chechen (941–71) by JOHANNA