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An Invitation to Cognitive Science. Justin Leiber. Oxford: Blackwell, 1991, 167 pages, \$17.95 paper.

Reviewed by Valerie Gray Hardcastle, University of California, San Diego

This book is fun—full of amusing anecdotes, historical tidbits, and scientific asides. It is also informative and challenging, telling one man's version of cognitive science's intellectual origins. Superficially, it is indeed, as Leiber calls it, "a narrative account of cognitive science in a look through its classical formulations," but it is also much more. Leiber winds together the technological advances of Greece, Wittgenstein's disdain for the autonomous, coherent mind, Turing's formulations of computations and computability, and a bit of Chomskian linguistics in a way that is altogether refreshing and new. The juxtaposition of Wittgenstein and Turing form the center of the text, and Leiber uses the contrast to cast a fresh glance at the old question: How much of our understanding is insight and how much invention? More specifically for cognitive science, that question becomes: Does our experience of formal systems allow us to carve ourselves at the proverbial joints, or are we instead forcing ourselves to fit that description? Is the computer really a mirror, or is it only a mold?

Leiber focuses on a proper appreciation of language as the route to answering his questions. He claims that language is not something we invented, but something we became. Descartes had it exactly right: we take the intelligent command of language to be indicative of cognitive personhood. Though I must challenge this intuition—we quite often, albeit perhaps mistakenly, consider our nonlinguistic pets to be miniature people and do everything possible to hold fast to the belief that, regardless of their communicative sophistication, computers aren't cognitive—Leiber uses language to get at a deeper problem, that of characterizing our generalizing logical capacity. He points out that when we look at the real advances in cognitive science, we must turn to linguistics, among other things. (Since this book is supposed to chart his own ideosyncratic understanding of the mind sciences, I shall not quibble this dubious point.) The lesson we learn there is that the mind must have rules which generate analytic sentences in particular. That is, the rules must roughly generate the truths of sentential and predicate logic. The bottom line is that thinking boils down to a combination of logic and heuristic "guessing."

Ignoring the pressing question in both linguistics and psychology of whether the rules are instantiated or descriptive, Leiber goes on to argue that knowledge about

our cognition and the formal systems we create are mutually dependent. Here is where the Wittgenstein–Turing debate picks up and where the book becomes original. Wittgenstein held that there are no checking procedures for our actions. All meaning is in use. Leiber argues that Wittgenstein's deeper point is that in our everyday world, we have no procedure for determining whether someone or something is a computational machine. We automatically take a particular attitude toward others through a sort of cognitive reflex. Only when we meditate on this reflex, as Turing did, do we run into problems.

Leiber uses language to flesh out his notion of a cognitive reflex. Since purely physical correlations make meaning indeterminate, we must have some innate (computational) mechanism for language-learning. Moreover, we cannot see or hear words without bringing our linguistic history to bear. These experiences are shaped by cognitive reflex, "reflexes" similar to the notion of automaticity, though not replaceable by step-by-step procedures, since it is impossible for us to become conscious of the computations which rule our perspectives.

Since actual symbol use is indeterminate, patchy, and contradictory, its successful operation depends on the non-formal peculiarities of human cognition whose procedures are not open to view. As Leiber sees it, Wittgenstein's real message is that our experienced world requires a computational world beyond. Our computational mind determines our experienced "life-world," a life-world which then lacks coherence and self-sufficiency. Made up of family resemblances, and partially formalized, paradoxical, illusion breeding, procedures and parts of procedures, it is intranslatable and irreducible.

Of course, Turing and Wittgenstein are undertaking different projects. Turing wants to build a reliable brain, while Wittgenstein wants to describe our actual practices. But Turing still must reflect on Wittgenstein's points since (as Turing demonstrated in 1937) a contradiction will cause formal systems to crash. Unlike computers, we are "inoculated" against contradictions; for us, a contradiction is not a symptom of some deeper "illness." Leiber argues that there must be "levels of description and processing not available in ordinary experience" that explain our protection and how we unconsciously filter out the ambiguities and mishearings in ordinary speech. Still, Leiber presents a harmony between Wittgenstein and Turing because he believes that we can assign meaning to sentences within "a full characterization of its user's natural cognitive system in its neurobiologically, developmentally, and socially mature form." Moreover, Turing machines warn us, much as Wittgenstein does, that there is no distinction between knowledge and intelligence, program and data. With Turing, too, to know is to do. Harking back to the primary question of whether we are inventing or discovering ourselves, and picking up on the Wittgenstein–Turing point that knowledge and intelligence are indistinguishable, Leiber draws the obvious, but hitherto unappreciated, conclusion: the reason we think others think is that they pass the Turing test, and if we could make a machine that would actually fool us into believing that its responses were human, we would learn about our own cognition, since we have to be cut from the same cloth, as it were.

Having delivered his central message, Leiber returns to his discussion of language and examines Quine's indeterminacy of translation thesis. Arguing that Quine wasn't really radical enough, he points out that for true radical translation we first have to overcome the problem of dividing a sound structure up such that we can recognize phonological and syntactic properties. Quine assumes that generalizations about natural language are about how utterances are perceived, which are not the generalizations available in the analysis of a physical sound stream. Even to identify

recurrences of a native's utterance, "Gavagai!" we have to know a lot about the native's psychology, most particularly, about his computational mind as it embodies language.

Leiber believes that this computational mind also determines the core of our logical system which then underwrites the form of linguistic meaning and analytic truths. Since analytic truths follow from linguistic form alone, they will show us something about the natural structure of our thoughts that have been "carved out" by our Chomskian Language Acquisition Device and hence set apart from conventions and learning.

In his concluding, and, regrettably, his weakest and least motivated chapter, Leiber reminds us of the mind's inherent modularity and that our sense of cognitive unity is only superficial. Following Gazzaniga, Leiber explains that our verbal module explains, unifies, and narrates what the other modules produce. Language then only outlines what we truly wish to say, but through language we also understand what it is like to be a person, including oneself. Central to cognitive personhood is the ability to carry on a monologue or dialogue about oneself and others in natural language. What makes us pass the Turing test is our ability to go on, to engage in embedded dialogue, responding to questions we, or others, might ask. At our essence, we are but stories which we tell to ourselves.

However, even though I do recommend this book—it is entertaining, engaging, and deftly written—it is not without a few difficulties. First and foremost is an apparent circularity in Leiber's argument. To pass the Turing test is to give responses which are indistinguishable from a human's, so to claim that the reason we think others think is that they pass the Turing test is to claim that the reason we believe other humans think is that they give responses which are indistinguishable from a human's. But we are all human, so *ipso facto* we respond in a manner indistinguishable from a human's.

This argument too seems to run counter to Leiber's earlier claim that we have no procedure for determining whether something is a computational machine. If we can judge whether something passes the Turing test, then since we are computational machines, we can determine at least a sub-set of computational machines. I take it that Leiber's response would be that these "judgments" are nothing more than a procedureless cognitive reflex. But one must be careful to distinguish consciously accessible procedures, e.g., the rules of multiplication, from procedures which our brains use, but which are nonetheless inaccessible to us consciously, e.g., the vestibular-ocular reflex. And if there be some unconscious procedure for determining whether something passes a Turing test, once we make explicit how the brain is issuing that judgment, we could perhaps teach ourselves to follow that procedure consciously.

Second, Leiber entertains a rather old-fashioned view of analyticity. He believes that even though nonsyntactic lexical meaning and synonymy are buffeted by fact, fashion, and science, analytic, purely syntactic (linguistic), forms are not. But as Quine makes clear, nothing is beyond the pale of revision, given appropriate physical evidence and proper psychological motivation; the analytic/synthetic distinction in language seems passé, and Leiber should give us reason to accept it again.

Finally, there are a few themes which are dropped or insufficiently developed in the book. For example, Aristotle's distinction between the theoretical and the practical sciences is mentioned early on as inappropriate for cognitive science, but exactly how and why it is wrong is not fully discussed. To have this point fully fleshed out would have been nice. Nevertheless, this book is worth reading and thinking about.

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