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MFS Modern Fiction Studies, Volume 61, Number 2, Summer 2015, pp. 226-250 (Article)

Published by Johns Hopkins University Press
DOI: https://doi.org/10.1353/mfs.2015.0020

THE COGNITIVE LITERARY THEORY OF RICHARD POWERS'S *GALATEA 2.2*

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"Every postmodern postsolipsist," says the narrator of Richard Powers's *Galatea 2.2*, "should do a postfrontal neurology stint. The most agile of them would . . . take to weighing the violence in their every predicate. Once they saw the bewilderingly complex fiber in its impossible live weave, theorists would forever opt for the humblest, least-obtrusive sentence allowed them" (40). This passage is typical of references narrator Rick Powers[1] and other characters make throughout the book to an ill-defined group of literary theorists and theoretical discourses labeled variously as literary theorists, criticism, lit crit, lit critters, poststructuralism, postmodernism, pomo, and the like. These characters' engagements with theory are often indirect or evasive; the passage above, for example, suggests that there is some implicit contradiction between neuroscience and postmodernist uses of language without specifying what the contradiction is. Most of the references are so brief and general that even sorting out precisely what specific theorists or arguments the characters are countering is difficult. A defender of poststructuralism might with some justice object that the book engages with a caricature rather than with any actual body of work, a kind of straw man argument that Richard Powers—whether author or character I shall leave open for the moment—can use as a foil for his representation of cognitive science.

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The very premise of using postmodernist or poststucturalist literary theory as a foil for the novel's profound and wide-ranging engagement with cognitive science suggests that cognitive science entails a theory of texts—a literary theory. By now, of course, it is unsurprising to think so, as there is an extensive body of cognitive literary theory. In the early 1990s, however, when *Galatea 2.2* was written, cognitive literary theory was still rare. If he knew to look for it, Powers could have read work by Reuven Tsur, Mark Turner, Norman Holland, Ellen Spolsky and others,[2] but such work was not mainstream within literary circles, and in my view the novel owes far more to scientific sources than the literary-theoretical ones. Powers was breaking new ground, then, by sketching out in fictional form a theory of literature rooted in cognitive science.

Galatea 2.2 's central premise is sufficient on its face to suggest that the novel is engaged in the development of a theory of literature: taking one side of a bet about whether or not a machine intelligence can be trained to answer questions about the books on a master's-level comprehensive exam in literature, a cognitive scientist, Philip Lentz, and a writer, Rick Powers, collaborate to construct from the ground up an artificial brain, Helen, capable of interpreting literature, articulating foundational premises as they go. I will show later that the theory developed through this premise is extraordinarily sophisticated and detailed. Yet the novel's engagement with poststructuralist or postmodernist theory, as I have suggested above, is often evasive. In this essay, I will answer three questions that the passage above and others like it in the novel implicitly pose: On what grounds does the novel critique poststructuralist and postmodernist theory? What kind of cognitive literary theory can be inferred from *Galatea 2.2*'s representation of teaching a machine to read? And why is that cognitive theory apparently contrasted with postmodernist theory without engaging with it substantively? I argue that while the novel's cognitive theory undercuts the poststructuralist model of language, it affirms or parallels some poststructuralist views of truth, meaning, and human nature.[3]

What's the Matter with Postmodernism?

There are no neutral or precise terms for the body of theory that I have referred to as poststructuralism and postmodernism. The terms most often used in the novel itself, criticism and lit crit, are too broad; poststructuralism is too narrow. Postmodernism—denoting as it does a body of theory, several different movements in the arts, and at least two overlapping but distinguishable historical eras—is too

broad if not simply confused. My imperfect solution to this problem is to use the terms that the novel itself uses, poststructuralism and postmodernism, but with two qualifications. The first is to specify as precisely as possible what I think the novel means by these terms: that body of poststructuralism-influenced, politically inflected theory that rose to preeminence in the late 1960s and through the early 1990s and that shares certain characteristic assumptions such as the idea that knowledge and subjectivity are constructed by cultural discourses; that truth, meaning, and human nature are therefore contingent and unstable; and that because power functions in part through representations, all discourses are ideological. The second is to acknowledge that even this characterization, though finer-grained than any single description of postmodernism or poststructuralism in the novel, is necessarily reductive. The novel's representation of these movements is a caricature not only because it is satiric, but also because it treats contemporary literary theory as monolithic, an evident misrepresentation.

The first relatively substantive representation of poststructuralist theory in the novel is presented in a conversation between Rick and Lentz, in which Rick summarizes the current state of critical theory. Lentz asks, "What do the literary theorists say about reading books these days?" (91). After prompting Lentz to refer to "texts" rather than "books," Rick replies, "The sign is public property, the signifier is in small-claims court, and the signification is a total land grab. Meaning doesn't circulate. Nobody's going to jailbreak the prison house of language." In highly compressed and metaphoric form, this conversation represents a poststructuralist view of meaning and language. Poststructuralism abandons the traditional communications model in which meaning is intended by an author, conveyed in a work, and understood by a reader, to a model in which meaning is a function of the language of a text in relation to the field of language as a whole. In this model, the "sign is public property": a text can only be interpreted in light of the linguistic structures and codes available to the reader. Rick's insistence on using the word "text" makes this point: in "From Work to Text," Roland Barthes distinguishes between work and Text by saying that whereas "the work is a fragment of substance, occupying a part of the space of books . . . the Text is a methodological field. . . . the text is held in language, only exists in the movement of a discourse . . . or again, *the Text is experienced only in an activity of production*" (156–57).

One implication of this shift of model is that textual meaning becomes unstable. Whereas the work "closes on a signified" (158), the Text "accomplishes the very plural of meaning: an *irreducible* . . . plural. . . . it answers not to an interpretation, even a liberal one,

but to an explosion, a dissemination" (159). To return to the passage in *Galatea 2.2*, then, "meaning doesn't circulate," because there is no singular meaning to persist from writing to reading or from one reading to another; meaning is always produced anew in the activity of reading. Nor can meaning be grounded in referentiality in the poststructuralist model of signification: "Nobody's going to jailbreak the prison house of language."[4] In Rick's view, poststructuralism is "solipsistic" in that it denies a connection between language and world. He says to Diana Hartrick, "The literary theorists think a human's real-world interface is problematic at best. And greatly overrated. They say even sense data must be put into symbols" (126). One primary implication for Rick of this solipsism is that meaning is determined and motivated by political considerations rather than by the quest for understanding or truth: "signification is a total land grab," connoting relations of power and ownership.

Rick's conversation with Lentz focuses primarily on the poststructuralist current of contemporary literary theory. His conversation with a master's student in literature, A., is the second substantive discussion of literary theory in the book and focuses primarily on its political aspect. A. is appalled to find that Rick is teaching Helen Gerard Manley Hopkins's "The Windhover," the study of which she considers "Euro-retro" (284). The discussion that follows represents in compressed form the canon debates that raged in literary studies from the 1960s onward and that came into public prominence in the early 1990s in the so-called Culture Wars.[5] Rick and Lentz have chosen for their test domain the list of works on Rick's Master's Comprehensive Exam from a dozen years before, a list one might call an updated traditional canon. "They gave us a list of titles" (43), says Rick in describing it. "Up at the top of page 1 was 'Caedmon's Hymn.' Six pages later, it wound up with Richard Wright." Wright is a telling author to conclude with; while the presence of an African American author on the list suggests that a canon based presumably on traditional principles of excellence or influence (in Rick's words, a "comprehensive" list that assures that people have to "read the great works") can grow to include more than "dead white males," the fact that the list ends with an author who died some twenty years before the exam indicates that the accretion process of the traditional canon is relatively slow and conservative. The master's exam that A. has just passed, on the other hand, abandons traditional conceptions of the canon almost completely: "Nobody *has* to read anyone anymore. There's more to the canon than is dreamt of in your philosophy, bub. These days, you find the people you want to study from each period. You work up some questions in advance. Get them approved. Then you write answers on your preparation" (284). Presuming that liter-

ary periods exist, as A. does here, invokes some residual principles of canonicity. But A.'s approving nod to an exam in which "no one *has* to read anyone" undercuts the conventional notion of a canon as a list of authors considered by a broad consensus to be major. And her list of what she thinks Helen should read is paradigmatically anticanonical, emphasizing the contemporary over the historical, pop culture over high culture, and oppositional and marginalized groups over elites: "Has she read the language poets? Acker? Anything remotely working-class? Can she rap? Does she know the Violent Femmes?" (284).

Rick and A. articulate the political stakes in this dispute over the canon explicitly. Rick's view, centered on a "historical take" (285) on the "great works" (284), is based on the essentially Arnoldian principles operant in the New Criticism era, in which literary study is conceived of as (in Arnold's words) "a disinterested endeavour to learn and propagate the best that is known and thought in the world" (32).[6] For A., no endeavor is disinterested: Rick's old master's exam list is a "culturally constructed, belated view of belles lettres" (Powers 285), and if Rick believes that it is a reflection of "great works" and "cornerstone[s]" (284), he is "buying into the exact aestheticism that prestige and power want to sell [him]" (285). Rick has no countering argument; his only defense of the works he considers great is to say, "I don't know much about books. But I know what I like" (285). Rick can hardly be said not to "know much about books," but the irony of invoking a pop culture reference in defense of high culture seems more self-protective than satiric. In any event, he quickly abandons his defense of the canon. When A. says, "Difference is not going to kill you. Maybe it's time your little girl had her consciousness raised," Rick replies, "I'm all for that" (286).

For Rick, the ultimate stakes are deeper; what he wants to preserve is not so much a vision of literary studies as it is a vision of humanity. He considers breadth and inclusiveness a secondary consideration in literary study because "you can get to the common core of humanity from anywhere" (286). A. dismisses the belief in a "common core of humanity" as "essentializing," and claims that "Foundationalism is bankrupt. . . . The fact is, what we make of things depends on the means of their formulation. In other words, language. And the language we speak varies without limit across cultures" (286). Rick disagrees, if only to himself: "I knew the social science model, knew linguistic determinism. I could recite the axioms in my sleep. I also knew them to be insufficient, a false split" (286).[7] For Rick, the foundation of the common core of humanity is "biology" (286); for all that he espouses a New Criticism-era view of literature (identified as such by A.), his deepest objections to postmodernist theory arise from his scientific training rather than his literary education.

According to Rick, postmodern theory—having argued away the intentions of authors, the ability to refer to the world, a subject matter of enduring importance, and a vision of humanity reconcilable with modern science—has left literary studies with nothing substantive to do. What remains are essentially power struggles and empty displays of verbal ingenuity: "The author was dead, the text-function a plot to preserve illicit privilege, and meaning an ambiguous social construction of no more than sardonic interest. . . . The idea seemed to be that if mind were no more than shrill solipsism, then best make a good performance of it" (191). The novel's sharpest jibes at postmodernism aim at its use of theoretical language as "performance." When Rick asks Lentz whether Rick's description of contemporary theory doesn't depress him, Lentz replies, "No, it doesn't. It just means we have as good a shot at this as any waffling poseur. . . . I've seen the stuff you're talking about. Gnomic is in. We just have to push 'privilege' and 'reify' up to the middle of the verb frequency lists and retrain" (91). Even A. despises the jargon and power struggles: "Who's in, who's out, who's up, who's down. All that hot new stuff, the pomo and the cultural studies and the linguistic-based solipsism. I'm fed up with it. It's all such verbal wanking off" (255).

In a few scattered scenes and a dozen side comments, *Galatea 2.2* offers a pointed critique of postmodern theory, its assumptions, and its use of language. Yet surprisingly, insofar as the various characters' critiques of postmodernism are presented as a running argument against it, postmodernism seems not to lose the argument. The discussion quoted above, in which Rick says to Diana that "literary theorists think a human's real-world interface is problematic at best" and that "sense data must be put into symbols," is a case in point. Diana's rejoinder is not an argument about the truth of the claim, but a surprisingly Foucauldian argument about the theorists' motivations for making it: "The literary theorists have to get tenure," she says (126). "And they have no hard facts to get tenure with. They have to fight for a slice of a pie that's getting smaller every day." Whether there are facts of the matter about how to interpret a text is debatable. But statements such as "sense data must be put into symbols" and "a human's real-world interface is problematic" are surely claims that a scientist working on "associative representation formation in the hippocampus" (38) would assume to be susceptible to factual analysis. To say that there are no hard facts in literary theory (in essence, no facts about language), and that therefore writing is something one does not to speak the truth but to gain advantage within an economic system, amounts to saying that postmodernist theory, as defined by its antagonists, is right. Elsewhere the novel suggests that Rick in particular cannot make the argument. To ask

whether postmodern views are "depressing," as he asks Lentz, is an example: unpleasant ideas that are demonstrably preposterous provoke laughter, scorn, or even anger, but they can only be depressing to those who on some level believe them. Rick says as much outright in an early conversation with A.: "I told her that theory and criticism had shaken my belief in what writing might do" (254).

If Rick Powers, the narrator of *Galatea 2.2*, is highly critical of postmodernism yet unable to mount a defense against it, the position of Richard Powers the author is similarly ambivalent but considerably more open. In a 1998 interview, Powers describes himself as being "very interested" in contemporary theory, albeit as "just an amateur" ("Last Generalist" 101). He acknowledges that part of the point of *Galatea 2.2* was to "poke fun at the high sanctimoniousness of literary theory" (102), but he also avows that "the book also tries to be very aware of deconstruction and poststructuralism and to incorporate those notions into the story it tells" (102). In the terms I have been using in this essay, the book's cognitive theory is in stark disagreement with postmodern theory on some points, but on other points the two bodies of theory are in some degree of accordance. To show this, I must first sketch out the opposing view—*Galatea 2.2*'s cognitive theory.

Galatea 2.2's Cognitive Theory

In *Bright Air, Brilliant Fire*, a book that Powers has indicated he read while he was writing *Galatea 2.2* ("Interview" 177), Gerald Edelman argues that learning and evolution are parallel: "In evolution, differences among various organisms' adaptations to the environment lead to differences among reproductive processes. . . . In neuronal group selection [a process that underlies learning], differences in connectivity, synaptic structure, and the morphology of neurons in the primary repertoire, after confrontation with different correlated patterns of signals from the environment, lead to differences in the probabilities of their responses as groups" (97). Edelman calls his Theory of Neuronal Group Selection (TNGS) a kind of "neural Darwinism."

The neural networks that Lentz and Rick construct and train in order to create an interpreting machine area are in some ways modeled on human brains and operate in accordance with "neural Darwinist" principles. A connectionist machine is trained, rather than programmed, through a process of self-organization in response to external pressure that is analogous both to associative learning and to evolution. Describing a neural network trained to turn written

language into speech, Rick says, "cell connections . . . taught themselves, with the aid of iterated reinforcement. Sounds that coincided with mother speech were praised. . . . All other combinations died away in loneliness and neglect" (30). In other words, the program (if such it can be called) evolves, with the trainer playing the role of an environment selecting the equivalent of fitter organisms.

There are, however, fundamental differences between the evolution of a neural network and evolution in nature. Evolution in nature is a slow, blind, accretive process. The only quality selected for is the ability to reproduce, and there is no consciousness doing the selecting. Any adaptation that works is as good as any other that works as well, and organisms combine a great many adaptive structures (eyes, teeth, hair, claws, an immune system, and so on), layered onto previous structures over eons of evolution. Most pertinently here, the ability to produce language, a relatively recent phenomenon, evolved in humans who were already capable of perceiving, manipulating, and moving around in the environment, and linguistic ability piggybacked onto what was already there.

This interconnectedness of modalities at the evolutionary scale is recapitulated in human development: a child does not learn language in the abstract, but as an interconnected part of a rich range of experiences sensing and acting in the world.[8] That is not the case for Helen and the Imps that lead up to her, for Helen's primary input and only output is language:

> Helen had to use language to create concepts. Words came first: the main barrier to her education. The brain did things the other way around. The brain juggled thought's lexicons through multiple subsystems, and the latecomers, the most dispensable lobes, were the ones where names per se hung out.
>
> In evolution's beginning was not the word but the place we learned to pin the word to. Little babies registered and informed long before they invented more mama by calling her such. (248)

Helen, in other words, is not simply a model of literary interpretation: she is a poststructuralist model of literary interpretation, trapped in the prison house of language to a degree unimaginable for any human.[9] She can in a sense hear, but she is designed that way primarily so that she may absorb language more quickly. After Lentz pastes a "passive retinal matrix" into Imp E (129), E and later Imps can see to some extent, but even Helen, who is significantly more responsive than E and who acts as if hungering for visual input, has

such limited visual abilities that Rick and Lentz show her pictures of U. when she asks to see Paris because "actual Paris would have been no more than a fuzzy, Fauvist kaleidoscope. Home could match that. All sensation was as strange, as foreign, as the idea of its existing at all" (295). Moreover, she has no sense of taste, smell, or touch, no kinesthetic sense, and no ability to move or awareness of motion or location. Without such basic bodily experiences, Helen has difficulty with concepts that for humans are expressed in language but understood on a more fundamental level: "She had trouble with values, because she had no fear of self-preservation, no hierarchy of hard-wired pain. She had trouble with causality, because she had no low-level systems of motion perception from which the forms of causality are thought to percolate. She was a gigantic, lexical genius stuck at Piaget's stage two" (250).[10]

The central premise of *Galatea 2.2*'s cognitive theory, then, is that cognition is embodied,[11] and therefore so is reading, on multiple levels. Reading is in the first place a physical act: "Knowledge is physical. . . . Reading knowledge is the smell of the bookbinding paste," says Rick. "The crinkle of thick stock as the pages turn. Paper the color of aged ivory" (147–48). More profoundly, semantic understanding requires the application of image schemas that are rooted in the body. Helen's questions to Rick are "detached, because she could neither feel nor gauge herself. Hungry—full; warm—cold; up—down: she worked these as abstract axes, not as absolutes of need. Helen accounted to nothing but weak semantics, the brittle-bone disease of word" (243). When Helen asks Rick about the expression "turn a head" in a discussion of love, Lentz replies, "It's a body thing. . . . You wouldn't understand" (265).[12]

Reading is embodied in another sense as well: as an evolved adaptation, the ability to use language is grounded in cognitive processes that assume and make use of a physical world. Without such a grounding, the book suggests, construing meaning is problematic or impossible. Diana tells Rick that his and Lentz's attempt to create an interpreting machine is "infinitely ditzy," because they "want to put everything into *words*. Think about this. You want to make a data structure that will say everything there is to say about 'ball.' You have to have facts for roundness, cohesion, size, weight. You have to have all sorts of probabilistic rules. . . . The list of predicates is—forever. And the exception list is even longer" (125–26). We might compare this view with what Barthes says about the "writerly text": "the networks are many and interact . . . the codes it mobilizes extend *as far as the eye can reach*" (*S/Z* 5–6). The kinds of codes that Barthes is discussing are different from those underlying a "data structure that will say everything there is to say about 'ball,'" but in the most

crucial respect they are the same: they are infinite because they are attempts to specify meaning from within language and with reference only to language.

Because Helen and her predecessors are connectionist machines, not classical AIs, Rick can rightly object that they are not trying to specify rules or properties: "that's where associative learning comes in. . . . We don't have to enumerate those qualities. If the machine keeps coming across them, and sometimes people are gazing into crystals, and sometimes they're pitching a curve, and sometimes they are having—" (126). Diana's interruption, however, shows that the connectionist model, insofar as it emulates the human brain, ought to be relying on a view of cognition as embodied, yet Rick and Lentz's machine does not: "That's just the problem. Any baby can hold a ball in its hands. Your machine can't. How many words is it going to take to say what that globe *feels* like?" (126). What is needed, Diana and Rick come to agree, is "symbolic grounding": "if you're going to make such a thing, you have to give it eyes, hands, ears. A real interface onto the outside" (126). Partly as a result of this conversation, Lentz and Rick add to Imp G the "passive retinal matrix" discussed earlier, but as we have seen, Helen never has anything like a fully developed "interface onto the outside."

Galatea 2.2's emphasis on symbolic grounding does not imply that discourses are somehow not social. On the contrary: "It's all made up," Rick tells Imp H. "All those morals. 'Necessity is the mother of invention.' 'Look before you leap.' 'Don't count your chickens.' They are all things that we've decided. Built up socially" (177). The novel, however, does not oppose socially constructed knowledge to knowledge that is cognitively embodied and anchored in the physical world. In response to Lentz's argument that their project can succeed because any kind of knowledge, human or not, is "stimulus and response," part of an "associative matrix" (148) like the weightings of a neural net, Rick insists that there must be something more: "Knowledge is physical. . . . Knowledge is temporal. . . . knowledge is social" (147–48), he says in a series of parallel arguments, as if physical and social knowledge were the same thing. What connects them is that both are a way of interacting with the world: "Knowing entails testing knowledge against others. Bumping up against them" (148).

Seeing why Rick equates physical knowledge with social knowledge is easier if we consider what it means to "know" something in general. In Lentz's reductionist view (which is to say a partial view, not an inaccurate one), the mind is a "curve-fitter," where "the curve we are trying to fit is as long as existence. As many dimensions" (112). While we tend to think of ourselves as "syllogistic creatures,"

much of intelligence amounts to "massively parallel pattern matching . . . we identify a few constraints, then spin the block endlessly until it drops in the hole" (86). This ability to recognize patterns, to "get the infinite data stream to cohere into lumps" (112), allows humans to react to their environment, if not always well. Lentz says, "We humans are winging it, improvising. Input pattern x sets off associative matrix y, which bears only the slightest relevance to the stimulus and is often worthless. Conscious intelligence is smoke and mirrors. Almost free-associative. Nobody really responds to anyone else, per se. We all spout our canned and thumbnailed scripts, with the barest minimum of polite segues" (86). When Rick responds, "You're not elevating the machine. You're debasing us," Lentz replies, "Much of intelligence isn't really that bright" (86). In fact, however, the "not very bright" cognitive mechanisms that Lentz describes offer solutions to cognitive problems that are so difficult as to be insoluble by "bright"—that is to say syllogistic, algorithmic, rules-based, reason-utilizing—methods. When Rick suggests that Lentz "hard-code a properties list" into Imp A to allow the machine to "dip into" "the semantic data structures as a reservoir of associations," Lentz retorts, "The point is to get this boutique of ICs to comment intelligently on William Bloody Wordsworth. Are you going to give me rules for doing that? . . . We *could* try to feed it algorithms for everything. There are only slightly more of them than there are particles in the universe" (77–78). As a scientist, Lentz believes that the world can be described in terms of physical laws, and his language suggests that algorithms for interpretation could in principle be formulated. But a rules-based description would be so complex as to be unspecifiable. A brain that had to learn "algorithms for everything" could never survive. What's needed, then, are "not very bright" ways to do very smart things.

According to Lentz, the solution is to let the rules arise from—and to an extent be replaced by—the interaction between mind and world. "You still think we have to lay out the rules and specify all the computations ourselves. That *would* be incomprehensibly complex. But we're not going to write out those calculations. We're going to feed the already languaged world to Imp B and let it take the bits apart and reassemble them" (85). In this model, a significant portion of cognitive processing is unloaded onto the environment: "The universe will be its own index. The isomorphic contour map, the way the data get packed together" (85). Context, therefore, is crucial, more important than rules and to some extent a substitute for them. Rick comforts himself by noting that he "didn't have to tell Helen what things meant. Context spun out its own filament. The study questions themselves laddered the world's labelless data into a recognizable index. The accumulated weight of sorted sentences had to self-gloss, or Helen would die before she could come to life" (196).

This emphasis on context over rules puts the novel's cognitive literary theory at odds with poststructuralism at a fundamental level, indeed at the very origins of structuralism, Saussure's *Course of General Linguistics.* According to Saussure, the proper study of linguistics is *langue*, the underlying structure or system of language as a whole, rather than *parole*, or individual speech acts. Structuralism in its various forms generalizes this principle, attempting to abstract such structures from a range of human endeavors such as mythology and literature. The turn from structuralism to poststructuralism often took the form of recognizing that such systems are unspecifiable, for example by revealing that the "codes" mobilized by the writerly text "extend *as far as the eye can reach*" (Barthes, *S/Z* 5–6) or that the "freeplay" of a structure cannot be closed off by a "center" that is both "*within* the structure and *outside* it" (Derrida 248). Without referring to the distinction between *langue* and *parole*, *Galatea 2.2* demonstrates that whatever the merit of identifying structure as the proper study of linguistics, individual humans make meaning and for the most part learn languages through massive exposure to individual acts of *parole*—to context, in the fullest sense of the term. As Rick says, "readiness [is] context, and context [is] all" (174).

Emphasizing context rather than rules might not appear to confer much advantage, as context too is infinite. Rick makes this point when he tries to enumerate what he and Lentz would have to teach the machine in order for it to understand the line "He clasps the crag with crooked hands," from Tennyson's "The Eagle":

> "we have to tell it about mountains, silhouettes, eagles, aeries. The difference between clasping and gripping and grasping and gasping. The difference between crags and cliffs and chasms. Wings, flight. The fact that eagles don't *have* hands. The fact that the poem is not really *about* an eagle. We'll have to teach it isolation, loneliness. . . . how a metaphor works. How nineteenth-century England worked. How Romanticism didn't work. All about imperialism, pathetic projection, trochees. . . . " (85–86)

The infinite nature of context might seem to lead to an interpretive abyss. Lentz quotes Harold Plover as saying, "Meanings extractable from a given linguistic configuration may be neither convergent, bounded, nor recursively enumerable" (112). Plover is a kind of interpretive mysterian (Lentz's word is "mystic"), believing, in Lentz's paraphrase, "that because 'context' is infinitely extensible, there can be no neurological calculus of interpretation" (112). Lentz's phrasing suggests that he accepts that context is infinite, disagreeing only with the implication that interpretation cannot be replicated by material

means. He takes the same position in response to Rick's description of the context of "The Eagle," acknowledging the problem but not considering it insurmountable: "Yes, there's a certain density out there it will have to become comfortable with. Give it time. How did you acquire that density? Half a meg, half a meg, half a meg onward" (86).

Often in *Galatea 2.2*, the acquisition of such "density" in both human and artificial brains is represented by the metaphor of maps. Although "neural representations are maps" is a common conceptual metaphor in cognitive science, the close parallel between Powers's use of the metaphor in *Galatea 2.2* and Edelman's TNGS theory suggest that Edelman was a major if not primary source for Powers.[13] In Edelman's *Bright Air, Brilliant Fire*, maps—groups of neurons that fire together, such as the retinal map in the visual cortex—are self-organizing, and they interconnect with other maps to form larger wholes.[14] Concepts, in Edelman's view, are maps of the mind's own processes, or essentially maps of maps (108–10). *Galatea 2.2* borrows freely from Edelman in its representation both of human and of artificial brains. Rick's description of Helen's gradual development of something like consciousness is an example of the TNGS concept as applied to artificial minds: "Helen's neurodal groups organized themselves into representational and . . . conceptual maps. Relations between these maps grew according to the same selectional feedback that shaped connections between individual neurodes. . . . when she learned to map whole types of maps onto each other, something undeniable, if not consciousness, arose in her" (218). Rick's description of human beings is similar: "Our life was a chest of maps, self-assembling, fused into point-for-point feedback, each slice continuously rewriting itself to match the other layers' rewrites" (320).

The crucial concept here is "feedback."[15] Not only do maps self-organize in response to input from the senses and from other parts of the brain, they also reorganize continuously in response to further input, in a feedback loop. If the brain's first attempts at "curve-fitting" a particular pattern are poor, feedback from the environment and the brain's own conceptualizations cause the maps involved to reorganize. It therefore does not matter, in the long run, that context is infinite. A mapping that takes account of too little context will be a poor map, but each additional remapping, taking into account more or better context, will cause the map to improve, the curve to fit better. As Lentz says when Rick asks him what he is if not a mystic or a cyborg, "I'm a lot of little delta rules running recurrently, evaluating and updating themselves" (113); as a rule for upgrading the weights of artificial neurons, a delta rule is in effect a means of re-self-organizing in response to feedback.

This view of cognition in terms of constantly self-updating maps both affirms and contradicts postmodern theory. Maps gather input

from various sources, both internal and external. An interpretation certainly can reorganize in response to linguistic codes, whether they are conceived along Barthesian lines or not. In this sense, Barthes is right to conceive of meaning as something experienced in the "movement of a discourse" or in "an activity of production" ("Work" 157). But the novel's cognitive theory also undermines postmodern theory on a fundamental level. Given that humans are creatures in an environment, continuously interacting with the physical world; given that language is an adaptation to the environment; given that linguistic abilities piggyback on and make use of perceptual and conceptual abilities; and given that representations are constantly updated in response to feedback from a world that " we take in . . . continuously" and that "presses against us" (148); to say that humans are caught in a "prison house of language" is simply meaningless. Any linguistic construction can be wrong, and all are shaped by preexisting linguistic codes, but language is not apart from the world or opposed to it. On the contrary, it is at root an adaptation to the world, in creatures with physical bodies that are in the world and part of it.

Cold Comfort

A shorthand way of representing the novel's critique of poststructuralist theory is to say that the social science model of language is deeply flawed. Powers himself makes this point explicitly in his 1998 interview: "The standard social science model of everything being culturally constructed in some ways has it backwards. Something must in fact, construct culture, and something other than 'culture' does give language its shape, even before language shapes our sense of self. Part of me wants to say that that something is a couple of billion years of evolution" ("Last Generalist" 102). Although he is quick to acknowledge that biological views of culture have been "so simplified and so abused in the past that the humanists are rightfully on their guard about it" (102), Powers insists that the "next big challenge for humanistic disciplines" is to "come to terms with a fuller and richer understanding of life science and all that it implies" (103).

Why, then, does the novel so often fail to engage with poststructuralism and postmodernism substantively? The primary reason, I argue, is that the novel's cognitive theory to some extent affirms or more accurately parallels poststructuralist views of truth, meaning, and human nature.[16] However much the cognitive theory of *Galatea 2.2* escapes the charge of solipsism it ascribes to postmodernism, it does not escape epistemological skepticism. Given what we have said so far, no representation is perfect; there is always more context

that could be factored into an interpretation. Indeed, finding a way to stop the process of reorganizing is crucial: "life required you to stop after the first reasonably adequate interpretation" (174). Interpretations can be wrong, perception can be wrong, and behavior can be inappropriate. As if to emphasize this point, the novel is full of representations of conditions in which understanding is impaired: Peter's trisomy, Audrey's dementia, the prosopagnosia that Rick's perception researcher friend Ram studies, and even the second-language interference Rick suffers while learning to speak Dutch.

Moreover, the novel insists that all cognition is figural on more than one level. When Imp F infers that falling yellow and brown leaves have fallen from "old trees" because "the trees bald," Lentz explains the erroneous but astonishing leap by saying, "The connections it makes in one associative pairing partially overlap the ones used in another" (154). For Rick, the moment is epiphanic in revealing the centrality of figural reasoning. Such "associations of associations" form "continuous, elaborate, brain-wide pun[s]"—metaphors, in the broad sense of the word: "These weird parallaxes of framing must be why the mind opened out on meaning at all. Meaning was not a pitch but an interval. It sprang from the depth of disjunction, the distance between one circuit's center and the edge of another. Representation caught the sign napping, with its semantic pants down. Sense lay in metaphor's embarrassment at having two takes on the same thing" (154–55). F's performance reveals that, as George Lakoff and Mark Johnson put it in a book I think it likely Powers knew, "Our ordinary conceptual system . . . is fundamentally metaphoric in nature" (*Metaphors* 3). Part of Rick's discussion of metaphor follows Lakoff and Johnson closely in calling attention to the concealed conceptual metaphors in ordinary language: "Of the formula I fed Imp F, every sentence was an abashed metaphor, tramped down so long and so hard it lost its public shame. 'I ran into X on the street the other day,' I told F. 'He cut me dead.' F revived the parallel's anxious source, its roots in ancient, all-out street violence" (155). But Rick goes further by anchoring conceptual metaphors in the structures of F's electronic brain. As he says later when he considers the ways in which "Helen's own existence hinged on metaphor-making," "associative memory itself was like a kind of simile. Three-quarters of the group of neurodes that fired when faced with, say, a whale might remain intact when depicting a thing that seemed, whatever the phrase meant, very like one. Such a constellation of common firings became, in a way, shadowpaint shorthand for some shared quality" (196).

The epistemological implications of Rick's recognition that cognition is metaphoric go in two directions. On the one hand, insofar as a metaphor is by definition not the thing it represents, recognizing

the pervasiveness of metaphor underlines the distance between the world and our representations of it. Rick continues, "After all, the world's items had no real names. All labels were figures of speech" (196). Here too, Powers follows Edelman closely: "Objects in the world," he says in his discussion of metaphor and metonymy, "are *not* labeled with dimensions or codes, and the way they are portioned differs from person to person and from time to time. . . . the mind is not a mirror of nature" (237). And on the other hand, like the not-very-bright "curve-fitting" and "canned scripts" discussed above, metaphor is highly adaptive in an environment in which events and objects need to be understood rapidly even when they are novel: "All labels were figures of speech. One recognized a novel item as a box by comparing it to a handful of examples so small it fit into a single dimple of an egg carton. In time, one learned without being taught. Rode without the training wheels. Somehow, the brain learned to recognize whole categories, to place even those things seen for the first time" (Powers, *Galatea 2.2* 196).[17]

Powers's cognitive theory parallels postmodernism not only in its epistemological skepticism, but also in its calling into question traditional views of human nature. It does not do so, however, in the same ways in which postmodernist antihumanism does. Post-modernist challenges to humanism typically deny the existence of an autonomous self or a universal human nature on the grounds that individuals are constructed by larger cultural forces and structures, however conceived (whether relations of production for Marxists, discourse for Foucault, the Symbolic for Lacan, or patriarchy for feminists). A.'s dismissal of Rick's "essentializing," discussed earlier, follows precisely along these lines. As I have argued, the novel rejects the Standard Social Science Model that underlies this claim. More generally, the novel's neural Darwinist view of cognition implies a very different view of the relationship between individuals and culture. Culture is still crucial in Edelman's TNGS theory, despite the theory's necessarily being centered on the functioning of individual brains. The brain is a selective system in a Darwinian sense. Brains don't develop by creating specified structures from a genetic master plan; every neuronal group structure is formed epigenetically in response to neighboring structures, and neuronal groups are selected in response to input from other neuronal groups and the environment. Thus culture—or more generally, interaction with the world, including interaction with other people and human creations—is absolutely crucial to the development of brain function at every level, and every aspect of cognition, from perception to memory to consciousness, depends, as Edelman says of conceptual memory in particular, "on constant interaction between self and world systems" (121); or, as

Rick says, on "bumping up against [others]" (148). But there is a profound difference between saying that individuals are constructed by culture and saying that brain structures—maps or more general neuronal groups and the reentrant circuits that connect them—self-organize in response to a culture-laden environment. Among other differences, the maps thus created are never identical with the cultural discourses in response to which they self-organize (or with any other individual brain's self-organization in response to those discourses), nor are those discourses, however conceived, separate from all other interactions between the brain and the physical world.

Much that traditional humanism tries to protect, however, is no longer viable within the cognitive framework the novel puts forward. Most humanisms assume and celebrate a vision of humans as conscious, rational, autonomous beings. But we have already seen Lentz debunk human rationality: humans are not "syllogistic creatures" but beings who "spin the block endlessly until it drops in the hole," spouting "canned and thumbnailed scripts" in response to a stimulus to which they may bear "only the slightest relevance" (86).[18] Consciousness fares no better: "conscious intelligence is mostly smoke and mirrors," Lentz says (86). Minds are modular, the book makes clear, and consciousness is but one rather limited module. A good example of this principle appears in a late scene in which Ram describes to Rick his work on facial recognition. People's eyes scan photographs of friends, abstract acquaintances such as movie stars, and total strangers differently; strikingly, the eyes of people who suffer from prosopagnasia, the inability to recognize faces, follow the same patterns that others' do. Consciously, prosopagnosics do not recognize any of the faces, but their eyes act as if they did. As Ram puts it, "perception is carried out in several subsystems," and these subsystems "go on talking . . . even when the others stop listening" (299).[19] Modularity of mind is an essential survival characteristic. An organism that had to process everything consciously could not respond to the environment quickly enough to survive, but the nature of consciousness is such as to exaggerate its own importance. "The function of consciousness," says Rick, "must be in part to dummy up and shape a coherence from all the competing, conflicting subsystems that processed experience. By nature, it lied" (217–18). Consciousness is, in fact, only a "small and fogged" window, and "mediating the phenomenal world via consciousness was like listening to reports of a hurricane over the radio while hiding in the cellar" (218). The challenges that cognitive theory poses to humanistic conceptions of human beings are different from the challenges posed by poststructuralism, but they are every bit as profound.

Writing at roughly the same time as Powers, both Turner and Spolsky explicitly connect cognitive theory with the contemporary literary-theoretical scene. In *Reading Minds*, Turner emphasizes their differences, making an impassioned plea to see cognitive theory as a foundation for renewing literary study in an age of "ungrounded and fragmented" contemporary theory (3). Spolsky's view in *Gaps in Nature* emphasizes the congruences: although she acknowledges that there are fundamental disagreements between cognitive and poststructuralist theory, she also demonstrates that a cognitive approach often confirms some of the more counterintuitive ideas of contemporary critical theorists. She has further advanced this view in "Darwin and Derrida: Cognitive Literary Theory as a Species of Poststructuralism," arguing that "literary interpretation and theory with an evolutionary cognitive perspective," far from "denying the insights of poststructuralist theory . . . actually nestles nicely within a central niche of deconstructionist thinking, that is the critique of representation" (43).

Spolsky's essay has been reprinted as the closing essay in the 2010 book *Introduction to Cognitive Cultural Studies*, edited by Lisa Zunshine. The essay's presence and prominent positioning in that volume suggest that Spolsky's attempt to reconcile poststructuralist and cognitive theory is a continuing project—which is to say both that progress has been made toward that end and that there is enough tension remaining between the two schools to make the argument still necessary. Zunshine herself frames the book as an attempt to overturn the "misconception" that "by making a 'cognitive turn,' a literary critic abandons the traditional paradigms of her own field, be it gender studies, feminist criticism, postcolonial theory, poststructuralism, performance theory, psychoanalysis, or cultural studies" (5). Zunshine argues instead that "there is neither reason nor obligation for her to abandon them; no more than there is reason or obligation for a scholar who develops interest in media studies to give up her commitment to feminist or postcolonial theory" (5). The majority of the essays in the book can be seen as attempts to reconcile cognitive theory with concepts from other theoretical schools: historicism, Gramscian Marxism, narrative theory, postcolonial studies, ecocriticism, and so on.

Galatea 2.2's cognitive theory has commonalities with both Turner's and Spolsky's. Its critique of poststructuralism, and the tone of that critique, shares much with Turner's assessment of contemporary theory as "chess about chess, a game about the concept of games" (3). But its assessment of the implications of cognitive theory is much more like Spolsky's. What Powers says in an interview about his 2006 novel *The Echo Maker* is true of his earlier novel as well: it

is woven around the "new views of the brain that have emerged from laboratories over the last couple of decades—the distributed, modular, massively preconscious, multiply recursive, narrative-dependent model of the bundled 'I'" ("Interview" 175). With such a grounding, the novel cannot dismiss in any simple way the apparent implications of the postmodernism its narrator decries.

Galatea 2.2 finesses the question of just how parallel cognitive and poststucturalist theories are by playing a double game, critiquing poststructuralist assumptions while eschewing substantive engagement with its conclusions. In my view, however, the novel's implicit cognitive theory is not as reconcilable with poststructuralism as Spolsky's and Zunshine's arguments would suggest and certainly cannot be said to "[nestle] nicely within a central niche of deconstructionist thinking." I believe that Powers would probably find persuasive Spolsky's argument in *Gaps in Nature* and "Darwin and Derrida" that modularity of perception, the gap between what we see and what we hear for example, entails a considerable degree of epistemological skepticism and cognitive instability. *Galatea 2.2* does not seem to support the view, however, that the types of epistemological skepticism and cognitive instability that modularity theory entails are the same as those entailed by the poststructuralist critique of language. There are profound differences between a postmodern model in which subjects are constructed by culture and an evolutionary-cognitive model in which individual organisms self-organize in response to an environment that includes but is not limited to culture, between a model that assumes a Standard Social Science Model of language and one that assumes that language is an evolved and embodied adaptation, and between a model in which culture is conceptualized in structural terms and a model in which culture is instantiated in brains through an accretion of massively redundant but not identical engagements between mind and world. It is beyond the scope of this essay to say what follows from these differences. But such differences are surely profound enough to suggest that even if Zunshine is correct to say that a cognitive turn does not entail abandoning other professional paradigms, nevertheless, accepting some cognitive assumptions is likely to require changes, in some cases quite radical changes, in how those paradigms are conceived.

Notes

1. Since the novel's narrator and author share a name but are manifestly not the same person, in this article I will refer to the narrator as Rick and the author as Powers.

2. Among the major cognitive theoretical texts Powers could have read are Holland's *The Brain of Robert Frost: A Cognitive Approach to Literature*, Turner's *Reading Minds: The Study of English in the Age of Cognitive Science*, Tsur's *Toward a Theory of Cognitive Poetics*, and Spolsky's *Gaps in Nature: Literary Interpretation and the Modular Mind*.

3. Jan Kucharzewski has also discussed *Galatea 2.2*'s engagement with poststructuralism, arguing that while the novel's representation of the narrator as "Mr. Author Function" appears to affirm poststructuralist ideas about "the discrepancy between life and language" (174), it in fact ends by "re-emphasizing the relevance of referentiality as a meaning-giving element" (171). I consider Kucharzewski's argument to be largely compatible with my own, although his focus is on the novel's autobiographical elements rather than its implicit cognitive theory, and although I consider the concept of referentiality in particular to be less central and much less securely established in the novel than does Kucharzewski.

4. Although the phrase "prison house of language" was in common parlance in academia in the early 1990s, Powers may be referring explicitly to Fredric Jameson's *The Prison-House of Language*, which argues that the "ontological dispersal" created by structuralism's reliance on metalanguages undermines the status of the referent. See 209–12.

5. Anca Rosu argues that "the rise of theory and the attacks against the canon" are represented in *Galatea 2.2* as "part of a larger crisis of knowledge in the age of information" (139). In that context, she also sees Powers as occupying an ambivalent position in the Culture Wars: the novel's use of parody "seems to take down the whole literary enterprise," but does so in such a way as to "preserve and revitalize that which it criticizes" (139).

6. James Berger notes that Helen, who until close to the end of the novel is constructed primarily of literary texts from the traditional canon, constitutes in herself a test of the value of literature conceived of on Arnoldian principles and thus "becomes the field for another battle in the 'culture wars' that have been waged in universities, legislatures, and the popular press since the early 1980s" (118).

7. I take Rick's formulation of A.'s view as "the social science model" to be a direct reference to John Tooby and Leda Cosmides's description of the Standard Social Science Model (SSSM) in "The Psychological Foundations of Culture." According to Tooby and Cosmides, "the SSSM denies that 'human nature'—the evolved architecture of the human mind—can play any notable role as a generator of significant organization in human life. . . . In so doing, it removes from the concept of human nature all substantive content" (28). Against this model, Tooby and Cosmides advocate the Integrated Causal Model (ICM), which sees the "human mind [as consisting] of a set of evolved information-processing mechanisms" that are "functionally specialized to produce behavior that solves particular adaptive problems" (24).

I argue that *Galatea 2.2* makes an implicit argument that is parallel to Tooby and Cosmides's.

8. Edelman makes a similar argument. See 242–52.

9. Marjorie Worthington and Kucharzewski also note that Helen exemplifies poststructuralist conceptions of language, subjectivity, and literature. See Worthington 122 and 124, and Kucharzewski 179.

10. N. Katherine Hayles also discusses Helen's acquisition of language as a reversal of the human pattern. Hayles sees Helen as an exemplar of posthumanism, however, rather than poststructuralism, where posthumanism is defined as a "point of view" that "privileges informational pattern over material instantiation, so that embodiment in a biological substrate is seen as an accident of history rather than an inevitability of life" (*How We Became Posthuman* 2). I consider my argument compatible with Hayles's, although a discussion of the connections between poststructuralism and posthumanism is beyond the purview of this article. For further discussion of the novel's treatment of posthumanism, see also Miranda Campbell's "Probing the Posthuman: Richard Powers' *Galatea 2.2* and the Mind-Body Problem," Kathleen Fitzpatrick's "The Exhaustion of Literature: Novels, Computers and the Threat of Obsolescence," Nicholas Laudadio's "Just Like So But Isn't: Musical Consciousness in Richard Powers's *Galatea 2.2*," and D. Quentin Miller's "Deeper Blues, or the Posthuman Prometheus."

11. The term "embodied cognition" has a wide range of usages, some very specific (to refer to the use of physical actions such as gestures in cognitive processing, for instance). For a good overview of the more specific uses of the term, see Margaret Wilson's "Six Views of Embodied Cognition." In this article, I use the term in the general sense that I believe fits Powers's views best (and that, not coincidentally, closely parallels Edelman's use of the term in *Bright Air, Brilliant Fire*): cognition is embodied in that cognitive abilities are adaptations to the physical environment, and higher abilities such as formal reasoning and language use are thus grounded in and make use of our abilities to perceive, negotiate, and act on the physical world. The literature on embodied cognition is immense; good places to start are Lakoff and Johnson's *Philosophy in the Flesh*, Mark Johnson's *The Body in the Mind*, and Antonio Damasio's *The Feeling of What Happens*.

12. A number of critics have discussed the novel's representation of the necessity of embodiment. Hayles points to the importance of Helen's nonhuman embodiment for her acquisition of language: "The problem that Helen confronts in learning human language is . . . [that] nothing in her embodiment . . . corresponds to the bodily sensations encoded in human language. For her there is no 'body in the mind,' as Mark Johnson has called it, no schemas that reflect and correspond to her embodied experience in the world" (*How We Became Posthuman* 265). John Frow makes a similar point in the context of a discussion of "everyday knowledge" (634–35). Jon Adams argues that Powers's examination of the necessity of embodiment underscores the

distinction between being human and being a person. Helen, Adams argues, is the inverse of Audrey, Lenz's wife, whose brain has been damaged by anoxia. Audrey is clearly human by virtue of her human embodiment, but not fully a person. If pitted against Helen in a Turing test, Audrey would fail, and thus, by "the agreed standards of AI, Helen is more a person than Lentz's own wife" (145). Helen, on the other hand, is "misembodied," and as such can never be fully human. For a similar argument, see Francisco Ortega and Fernando Vidal 347.

13. For a discussion of the connections between Edelman's neural Darwinism and *Galatea 2.2*'s representation of consciousness and memory, see Mark Bould and Sherryl Vint's "Of Neural Nets and Brains in Vats: Model Subjects in *Galatea 2.2* and *Plus*."

14. See Edelman 22–24 and 81–92.

15. For a remarkable discussion of literary interpretation as a process of linking feedback loops, see Holland's *The Brain of Robert Frost*. It is possible that Powers knew this source, but it is more likely that he is following Edelman here as well; Edelman does not use the word feedback, but the idea is implicit in his somewhat more complicated concepts of recognition, re-entry, and loops. See 73, 85, and 147.

16. Robert Chodat makes a similar argument in the context of *Galatea 2.2*'s representation of AI. According to Chodat, the novel affirms some of the arguments of critics of AI about what AI cannot do, such as constructing narratives about why some things matter. At the same time, the book demonstrates that Rick and other human characters have considerable difficulty with the same things. Such "radical lack of confidence in the ontological weight of our life narratives," Chodat notes, "motivates most of the 'post-modernism' that . . . recent discussion has allegedly moved beyond" (700).

17. The novel's epistemological stance is consistent with what F. Elizabeth Hart, following the separate arguments of Hayles and Nancy Easterlin, calls "constrained or weak constructivism" (326). See Hart's "The Epistemology of Cognitive Literary Studies," Hayles's "Constrained Constructivism: Locating Scientific Inquiry in the Theater of Representation," and Easterlin's "Making Knowledge: Bioepistemology and the Foundations of Literary Theory." Edelman's "biological based epistemology" is similar, although by naming it "qualified realism" he emphasizes the opposite pole of the spectrum in which all of these theorists are carving out the middle ground. See 160–61.

18. A.'s "more or less brilliant New Historicist reading" emphasizes this point (Powers, *Galatea 2.2* 326). Her reading of *The Tempest* is in fact not especially original: A. reads the play "as a take on colonial wars, constructed Otherness, the violent reduction society works on itself," an argument similar to other readings of *The Tempest* that were in vogue at the time. For example, in his 1985 essay, "'This Thing of Darkness I Acknowledge Mine': *The Tempest* and the Discourse of Colonialism," Paul Brown reads the play as a site in which

colonial discourses produce "an encounter with the other involving the colonizer's attempt to dominate, restrict and exploit the other" (51). That A.'s answer is not original is not, perhaps, much of an indictment of her, given the time pressure at work in an exam. But it is confirmation of the larger indictment of human intelligence in general that, as Lentz says, "Nobody really *responds* to anyone else, per se. We all spout our canned and thumbnailed scripts, with the barest minimum of polite segues" (86). Sharon Snyder and Kathleen Fitzpatrick have pointed out that the novel's concern with unoriginality extends to the figure of Rick, who in effect cribbed his first novel from the text of his girlfriend C.'s life.

19. Edelman discusses prosopagnosia as a disorder in which reentrant circuits between neuronal groups are disrupted. See 139.

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