I. READER PROCESSING AND PSYCHOLOGY

Neuroscience, Narrative, and Narratology

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Abstract Cognitive narratology needs a neuroscientifically sound understanding of language. This essay lays out a neurobiological model of narrative that explains how stories arise from and set in motion fundamental neuronal and cortical processes, and it then asks how the aims and methods of narratology should be aligned with what we know about language and the brain. The formalist goal of identifying orderly, universal structures of mind, language, and narrative does not match up well with the probabilistic, reciprocal interactions in the brain through which cognitive patterns emerge from our embodied experiences of the world. Cognitive narratology needs to break with the structuralist legacy still evident in the terminology of frames, scripts, and preference rules and to embrace the paradigm shift proposed by various pragmatically oriented, phenomenological theories of narrative that have contested the formalist program.

Keywords cognitive narratology, embodied cognition, neuroscience, phenomenology, language, reading, temporality, action, empathy

The ability to tell and follow a story requires cognitive capacities that are basic to the neurobiology of mental functioning. Neuroscience cannot of course reveal everything we might want to know about stories, but it is also true that our species would probably not produce narratives so prolifically if they weren't somehow good for our brains and our embodied interactions with the world. What kind of brains do we have that enable us to tell each

Poetics Today 40:3 (September 2019) DOI 10.1215/0333537-7558052

other stories? And how do stories configure our brains? How plots order events in time, how stories imitate actions, and how narratives relate us to other lives, whether in pity or in fear—these central concerns of narratological theorists from Aristotle to Paul Ricoeur are perhaps surprisingly aligned with a variety of hot topics in contemporary neuroscience: temporal synchrony and the binding problem, the action-perception circuit in cognition, and the mirroring processes of embodied intersubjectivity. The processes through which stories coordinate time, represent embodied action, and promote social collaboration are fundamental to the brain-body interactions through which our species has evolved and has constructed the cultures we inhabit.

Triangulating our phenomenological experience as tellers and followers of stories with neuroscientific findings about embodied cognition and with narrative theories about plots, fiction, and reading is an attempt to understand the relation between language, cognition, and narrative—a goal that many thoughtful investigators across a variety of disciplines have pursued. One of the reasons why philosophers, literary theorists, and everyday readers have wondered about why and how we tell stories is that narrative has seemed to hold the key to how language and the mind work. Narratology is now at a turning point in its understanding of the relation between language, cognition, and narrative, poised between formalist models of schemes, scripts, and preference rules inherited from structuralism and pragmatically oriented theories of narrative as embodied, intersubjective interaction. Whether and how these models can be reconciled is an important, unsettled question. Understanding the neurobiological bases of narrative may help solve this problem by showing how the ability to tell and follow stories aligns with how the brain processes language. The first section of this essay lays out a neurobiological model of narrative that explains how stories arise from and set in motion fundamental neuronal and cortical processes, and the second section then asks how the aims and methods of narratology should be aligned with what we know about language and the brain.

1. The Neuroscience of Narrative

Stories help the brain negotiate the never-ending conflict between its need for pattern, synthesis, and constancy on the one hand and for flexibility, adaptability, and openness to change on the other. The brain's remarkable, paradoxical ability to play in a to-and-fro manner between these competing imperatives is a consequence of its decentered organization as a network of reciprocal top-down, bottom-up connections among its interacting parts. Narrative theorist Seymour Chatman (1978: 47, 45) attributes plot formation

to "the disposition of our minds to hook things together"; as he notes, "our minds inveterately seek structure." This is, indeed, a basic axiom of contemporary neuroscience. Against the cognitive need for consistency, however, the psychologist William James ([1890] 1950: 1:139) describes the brain as "an organ whose natural state is one of unstable equilibrium," constantly fluctuating in ways that enable its "possessor to adapt his conduct to the minutest alterations in the environing circumstances." The brain knows the world by forming and dissolving assemblies of neurons, establishing the patterns that through repeated firing become our habitual ways of interacting with the environment, even as ongoing fluctuations in these syntheses combat their tendency to rigidify and promote the possibility of new cortical connections. The brain's ceaseless balancing act between the formation and dissolution of patterns makes possible the exploratory play between past equilibria and the indeterminacies of the future that is essential for successful mental functioning and the survival of our species.

Stories contribute to this balancing act by playing with consonance and dissonance. Borrowing Frank Kermode's (1967) well-known terms, Ricoeur (1984: 65–66) describes emplotment as "concordant discordance"—"a synthesis of the heterogeneous" that configures parts into a whole by transforming the "diversity of events or incidents" into a coherent story. According to Ricoeur, the act of "composing plots" converts "the existential burden of discordance" into narrative syntheses that give meaning to life's imbalances by constructing patterns of action (33, 31). Even in the simplest narratives that approach what Gérard Genette (1980: 35–36) calls the hypothetical "zero degree" of difference between the order of events in the telling and their order in the told, the conjunctions that join together the elements of the plot are invariably disrupted by twists and turns on the way to resolution. What Genette calls temporal "anachronies" (flash-forwards and flashbacks, for example, that disrupt the temporal correspondence between the telling and the told) further play with the competing impulses toward consonance and dissonance that are basic to narrative. The imbalances between pattern-formation and dissolution in the brain make possible this narrative interaction between concord and discord, even as the construction and disruption of patterns in the stories we tell each other help the brain negotiate the conflicting imperatives of order and flexibility. The neuroscience of these interactions is part of the explanation of how stories give shape to our lives even as our lives give rise to stories.

Stories can draw on experience, transform it into plots, and then reshape the lives of listeners and readers because different processes of figuration traverse the circuit of interactions and exchanges that constitute narrative activity. First, the neural underpinnings of narration start with the peculiarly

decentered temporality of cognitive processes across the brain and the body—disjunctions in the timing of intracortical and brain-body interactions that not only make possible but also actually require the kind of retrospective and prospective pattern-formation entailed in the narrative ordering of beginnings, middles, and ends. Next, the strangely pervasive involvement of processes of motor cognition not only in the understanding of action and gesture but also in other modalities of perception suggests why the work of creating plots that simulate structures of action can have such a profound effect on our patterns of configuring the world. Finally, if stories can promote empathy and otherwise facilitate the cointentionality required for the collaborative activity unique to our species, the power and the limits of their capacity to transform social life ultimately depend on embodied processes of doubling self and Other through mirroring, simulation, and identification, processes whose limitations are reflected in the strengths and weaknesses of narratives as ethical and political instruments. In each of these areas, narratives configure lived experience by invoking brain-based processes of pattern-formation that are fundamental to the neurobiology of mental functioning.

1.1. Narrative Time and the Temporality of the Brain

The concordant discordance of emplotment is based on the decentered, asynchronous temporality of the brain. One of the many ways in which the brain differs from a computer is that its temporal processes are not instantaneous and perfectly synchronized (see Armstrong 2013: 91–130). Unlike electrical signals that discharge simultaneously at nearly the speed of light, action potentials at the neuronal level take more than a millisecond to fire, and different regions of the cortex respond at varying rates. For example, as neuroscientist Semir Zeki (2003: 215) observes, in the visual cortex "colour is perceived before motion by [approximately] 80 ms [milliseconds]," and "locations are perceived before colours, which are perceived before orientations." The integration of neuronal processes through which conscious awareness emerges may require up to half a second. As Zeki points out, however, this "binding" (as it is called) is itself not perfectly homogeneous: "The binding of colour to motion occurs after the binding of colour to colour or motion to motion" because "binding between attributes takes longer than binding within attributes" (216, 217). More time is needed to integrate inputs from vision and hearing, for example, than to synthesize visual signals alone. Although we typically don't notice these disjunctions, the nonsimultaneity of the brain's cognitive processes means that consciousness is inherently out of balance and always catching up with itself.

This imbalance is not a bad thing, however, because it allows the brain to play in the ever-changing horizonal space between past patterns and the

indeterminacies of the future, the space that plots organize into beginnings, middles, and ends. Concord with no trace of discord would be disabling. In waking life, as neuroscientists Gerald Edelman and Guilio Tononi (2000: 72) observe, "groups of neurons dynamically assemble and reassemble into continuously changing patterns of firing." The synchronization of brain waves across the cortex makes possible the formation of neuronal assemblies and coordinates the workings of different regions of the brain (see Buzsáki 2006). As cognitive scientists Bernard Baars and Nicole Gage (2010: 246) explain, "normal cognition requires selective, local synchrony among brain regions," "highly patterned and differentiated" oscillatory patterns in which "synchrony, desynchrony, and aperiodic 'one-shot' waveforms constantly appear and disappear." But as Edelman and Tononi (2000: 36) explain, "If a large number of neurons in the brain start firing in the same way, reducing the diversity of the brain's neuronal repertoires, as is the case in deep sleep and epilepsy, consciousness disappears." In those conditions, "the slow, oscillatory firing of . . . distributed populations of neurons is highly synchronized globally" (72), and global hypersynchrony paralyzes normal functioning by disrupting the to-and-fro of synchronization and desynchronization. In contrast to sleep and epilepsy, "consciousness requires not just neural activity," Edelman and Tononi point out, "but neural activity that changes continually and is thus spatially and temporally differentiated"—"distributed, integrated, but continuously changing patterns of neural activity . . . whose rich functioning actually *requires* variability" (73, 74–75). The ability of a plot to join concord and discord through temporal structures that order events while holding them open to surprise, variation, and refiguration is one instance of this necessary tension between pattern and change, synchrony and fluctuation, coordination and differentiation.

Stories set in motion reciprocal processes of pattern-formation that are always already occurring beneath our awareness and that are fundamental to the brain's operation as a to-and-fro ensemble of neuronal assemblies that are constantly coming and going, waxing and waning. The concordant discordances of narrative play off of the brain's necessary, never-ending alternation between synchronization and desynchronization. By manipulating the time lags built into cognition, narratives can reinforce established patterns through the pleasures of recognition, providing support for the structures that build coherence across our temporal experience, or they can disrupt the expectations through which we build consistency and thereby make possible new patterns of synchronization. The conjunctions that smooth over temporal discordances can facilitate configurative activity, but the disjunctions inherent in these time-lags can also be productive by combating habitualization and promoting flexibility.

One narrative correlative of these temporal discrepancies is the relation between discourse and story—the sometimes concordant, sometimes discordant interplay between the order of events in the telling and their sequence in the told. When the telling and the told reinforce each other, the formation of cognitive syntheses is facilitated; when they veer off and diverge, the possibility emerges of interruptions and disjunctions through which the ordinarily invisible temporal operations of cognitive pattern-formation can come into view. As narratologist Christian Metz (1974: 18) observes, "Narrative is a . . . doubly temporal sequence," and "one of the functions of narrative is to invent one time scheme in terms of another time scheme." Even the classic formula "Once upon a time . . . " has the basic temporal structure of doubling one time over against another. The capacity to play with temporal differences is a defining characteristic of narrative, and this is possible only because of the asynchronous temporality of the embodied brain. Were cognitive processes temporally homogeneous and globally hypersynchronized, they would not give rise to the doublings entailed by the interaction of discourse and story.

1.2. Narrative Action and the Action-Perception Circuit

The temporality of the decentered brain makes mimesis possible because imitation is not a static correspondence of sign to thing but a dynamic configuration of an action. Narration is a kind of action (a linguistic making) that produces an organization of events (an emplotment of actions) that the reader or listener follows and reconstructs (the activity of comprehension). According to Ricoeur (1984: 54), "The composition of the plot is grounded in a preunderstanding of the world of action, its meaningful structures, its symbolic resources, and its temporal character." The lived experience of action is characterized by "temporal structures that evoke narration," and so Ricoeur (1987: 434) describes life "as an activity and a desire in search of a narrative." The configuration of existential patterns of action into plots and stories is, however, not an end in itself: "Structuration is an oriented activity that is only completed in the spectator or the reader" (Ricouer 1984: 48) through the potentially transfigurative action of comprehending the narrative. And so the circuit is completed, only to stand ready to begin again, as culturally shared and shaped patterns of action are taken up and refashioned by poets, writers, and storytellers of all kinds who offer refigured narratives to ever-new audiences that in turn may play with and transform the configurations through which they experience the world. It may be, as Ricoeur (1987: 425) observes, that "stories are told and not lived" whereas "life is lived and not told," but there is a circuit between living and telling that is mutually formative and potentially transformative, and that is because the work of figuration crosses and joins these modes of narrative activity.

Contemporary neuroscience suggests that the biological basis of these connections is an action-perception circuit that makes action fundamental to many cognitive processes that might seem unrelated to the control of various body parts by the motor cortex. Plots can play a central role in structuring our understanding of the world because action is thoroughly implicated in perception and cognition. Seeing, hearing, and touching are all active processes, for example, that are especially attuned to difference and change. According to neurophilosopher Alva Noë (2004: 8), "The basis of perception . . . is implicit practical knowledge of the ways movement gives rise to changes in stimulation."[1] As he points out, "the world makes itself available to the perceiver through physical movement and interaction" (1). For all modes of perception, exploratory activity of the environment provides ever-changing information about regularities and irregularities, and it is these differences to which the organism responds. Noë consequently claims that "all perception is touch-like," even vision (1): "As in touch, the content of visual experience is not given all at once. We gain content by looking around just as we gain tactile content by moving our hands" (73). As he notes, for example, "in normal perceivers, the eyes are in nearly constant motion, engaging in saccades (sharp, ballistic movements) and microsaccades several times a second. If the eyes were to cease moving, they'd lose their receptive power" because "optic flow contains information that is not available in single retinal images" (13, 20).

One reason for this is that the workings of "opponency" make the retina more sensitive to changes in light than to a uniform, constant illumination (see Livingstone 2002: 54–55). Similarly, as neuroscientists Mark Bear, Barry Connors, and Michael Paradiso (2007: 420) observe, the responsiveness "of warm and cold receptors" on the skin is "greatest during, and shortly after, temperature changes"; "with thermoreception, as with most other sensory systems, it is the sudden change in the quality of a stimulus that generates the most intense neural and perceptual responses." Perception is an exploratory

1. Noë is affiliated with various intellectual traditions that also inform my analysis of cognition and narrative. His theories about action and perception have much in common with the neurophenomenology of Varela (Varela, Thompson, and Rosch 1991; Varela 1999), Thompson (2007), and Gallagher (2012) that in turn derives from the work of Husserl, Heidegger, and Merleau-Ponty. The phenomenological tradition and its recent neurocognitive offshoots also inform my theoretical framework for neuroaesthetics and reading (Armstrong 2013, 2015). Noë also belongs to the tradition of American pragmatism descending from Charles Sanders Peirce and William James through Dewey and Bruner. The convergences between phenomenology and pragmatism have been much discussed (see Wilshire 1968; Rosenthal and Bourg 1980; Corrington, Hausman, and Seebohm 1987) and were an inspiration for my early book on Henry James, William James, and phenomenology (Armstrong 1983; see also 2018). On the history of these intellectual traditions, also see my entry on phenomenology in *Contemporary Literary and Cultural Theory: The Johns Hopkins Guide* (Armstrong 2012).

activity that can bring all of the modalities of sensation into interaction with each other as the organism's changing relation to its world produces differences to which our sensory equipment responds, even as changes in how we direct that equipment toward the world—moving our eyes or hands or the direction of our ears—can produce differences that are rich in information.

Recent experimental evidence on the responsiveness of the brain to imagined action and even to action words suggests that the brain is primed to respond to linguistically staged configurations of action, and these can have a profound effect on our cognitive processes because perception in many different modalities depends on embodied action (see Pulvermüller 2013). As neuroscientist Marc Jeannerod (2006: 28, 39) points out, many different experiments have shown that "imagining a movement relies on the same mechanisms as actually performing it," and that is because "imagined actions are indeed actions in their own right: they involve a kinematic content, they activate motor areas almost to the same extent as executed actions, they involve the autonomic system as if a real action was under way." If the motor cortex and even muscle tissue can be excited by mental rehearsal of an action, that should also be true of linguistic simulations of actions, and there is experimental evidence that this is so. Cognitive scientist Lawrence Barsalou (2008: 628) reports, for example, that, "when reading about a sport, such as hockey, experts produce motor simulations absent in novices." This is consistent with a 2009 fMRI study by Speer et al. that showed correlations between six different kinds of changes represented in stories and the brain regions activated by "analogous activities in the real world" (changes in the location, cause, goal, character, timing, or the object involved in an action) (Speer et al. 2009: 990). These and many other similar studies point to some of the neurobiological processes set in motion by the feigned figuration of action and sensation in narrative, brain-body interactions in response to imitation that could have the power to reinforce or reshape the recipient's pattern-forming habits across many cognitive domains.

Action seems to perform a fundamental role in coordinating different modalities of cognition, and this organizing role is crucial not only for language but also for narrative and our ability to construct and follow plots. The anatomical region of the brain central to these interactions is Broca's area, a section of the inferior frontal cortex adjacent to the parts of the motor cortex that control the mouth and the lips: "Studies have shown this area to be active in human action observation, action imagery and language understanding" (Pulvermüller and Fadiga 2010: 351). Impairments in Broca's area have long been known to result in difficulties producing and comprehending grammatical sentences. Patients with lesions in this part of the brain can understand and pronounce single words, "but they have great difficulty in

aligning scrambled words into a sentence or in understanding complex sentences," and these deficiencies are "paralleled in non-linguistic modalities" (357). Similarly, a number of brain-imaging studies have shown that musical syntax is processed in Broca's area and that listening to musical rhythms activates the motor cortex (Maess et al. 2001; Chen, Penhune, and Zatorre 2008).

This region of the brain is also apparently crucial for narrative. A recent experiment by Patrik Fazio et al. (2009: 1987, 1980) revealed that "a lesion affecting Broca's area impairs the ability to sequence actions in a task with no explicit linguistic requirements." His group showed patients with Broca's aphasia "short movies of human actions or of physical events," and they were then asked to order, "in a temporal sequence, four pictures taken from each movie and randomly presented on the computer screen." Curiously, although these patients could still recognize before-after relations between physical events, they had a harder time using the pictures to reconstruct the order of human actions. Their ability to remember and compose a sequence of represented actions was impaired. This result suggests that the patients in Fazio's study suffered a deficiency in the capacity for emplotment, the ability to produce and follow configurations of action. Such an inference is consistent with Fazio's claim that "the complex pattern of abilities associated with Broca's area might have evolved from its premotor function of assembling individual motor acts into goal-directed actions" (1987). This capacity for organizing action into meaningful sequences makes the brain ready for language, but it also prepares the brain for narrative. Broca's area is vital for language as well as narrative because both entail the structuration of symbolic action.

1.3. Following a Story, Empathy, and the Social Brain

Our intuitive, bodily based ability to understand the actions of other people is fundamental to social relations of many kinds, including the relation between storyteller, story, and audience. This ability undergirds the circuit between the representation of a configured action emplotted in a narrative and the reader's or listener's activity of following the story as he or she assimilates its patterns into the figures that shape our worlds. In an illuminating analysis of the "kinematics" of narrative, cognitive literary theorist Guillemette Bolens (2012: 1–3) distinguishes between "kinesic intelligence" and "kinesthetic sensations"—"our human capacity to discern and interpret body movements" of other people as opposed to the "motor sensations" we may have of our own actions, whether voluntary or involuntary:

> Kinesthetic sensations cannot be directly shared, whereas kinesic information may be communicated. I cannot feel the kinesthetic sensations in another person's arm.

> Yet I may infer his kinesthetic sensations on the basis of the kinesic signals I perceive in his movements. In an act of kinesthetic empathy, I may internally simulate what these inferred sensations possibly feel like via my own kinesthetic memory and knowledge.

The ability to understand the actions represented in a story (what is told) as well as to follow the movements of the narration (the telling) requires both kinds of cognitive competence—the hermeneutic capacity to configure signals into meaningful patterns (kinesic intelligence) and the intuitive sense of how the structures emplotting the actions and the forms deployed in the narration resonate with my own unreflective, habitual modes of figuring the world (embodied in my kinesthetic sensations).

The kinesic intelligence and kinesthetic empathy that we use to understand stories entail a kind of doubling between self and Other that, according to Maurice Merleau-Ponty, makes the alter ego fundamentally paradoxical. As Merleau-Ponty ([1945] 1962: 362, 358) explains, "the social is already there when we come to know or judge it" because the intersubjectivity of experience is primordially given with our perception of a common world—and yet, he continues, "there is . . . a solipsism rooted in living experience and quite insurmountable" because I am destined never to experience the presence of another person to him- or herself. The kinesthetic empathy Bolens describes is paradoxically both intersubjective and solipsistic, for example, inasmuch as I "internally simulate" what the other must be feeling as if her sensations were mine, which, of course, they are not (otherwise I wouldn't need to infer them on the basis of my own). Following a story is a similarly paradoxical process, with both intersubjective and solipsistic dimensions, whereby my own resources for configuring the world are put to work to make sense of another, fictive, narrated world that may seem both familiar and strange and that may either reinforce or disrupt my sense of the world's patterns, since its figurations both are and are not analogous to mine. Reading is an "as-relation" whereby I think the thoughts of someone else, but think them as if they were my own—a doubling of the "real me" I bring to the text and the "alien me" I produce by lending it my powers of consciousness (see Iser 1978).

The doubling of self and Other in the exchange of stories can have a variety of beneficial or potentially noxious social consequences. Following a story is a fundamentally collaborative transaction that can promote the "shared intentionality" that Michael Tomasello and other neurobiologically oriented cultural anthropologists identify as a unique human ability that other primates seem to lack (Tomasello et al. 2005; Tomasello 2014). What Tomasello et al. (2005: 676) call "'we' intentionality" is the capacity for "participating in collaborative activities involving shared goals and socially coordinated action

plans (joint intentions)" (see Armstrong 2013: 131–74). The fundamental "skills of cultural cognition" made possible by shared intentionality begin with parent-infant "proto-conversations" that involve "turn-taking" and "exchange of emotions"—activities also entailed, of course, in telling and following stories—and such collaborative interactions culminate in what is known as the "ratchet effect" of cumulative cultural evolution (Tomasello et al. 2005: 681, 675; see Easterlin 2012, Boyd 2009). This ability to engage in coordinated activity is analogous to what neuroscientists of music observe in the predisposition of infants "to attend to the melodic contour and rhythmic patterning of sound sequences" and in their attunement "to consonant patterns, melodic as well as harmonic, and to metric rhythms" (Trehub 2003: 13–14). The back-and-forth interaction of telling and following the configured patterns of action in a narrative is similar to how, according to cognitive scientist Ian Cross (2003: 48, 50), music "enables the sharing of patterned time with others and facilitates harmonicity of affective state and interaction"—a "communal experience of affect elicited by moving together rhythmically in music and dance [that] could have enhanced cooperative survival strategies for early humans, for example, in hunting or in inter-group conflict." The coordination of action across subjectivities in the exchange of stories—emplotted patterns of actions reconfigured in the listener's patterns of reception—would similarly enhance the "'we'-intentionality" that makes culturally productive collaboration possible.

The comparison to music is instructive because rhythmically coordinated action beneath conscious awareness can be both enabling and disabling. The sensation of boundaries dissolving in experiences of rhythmic interaction and harmonic unification—what Nietzsche ([1872] 1994) famously attributed to the Dionysian powers of music to overwhelm Apollonian line and form—may miraculously, even sublimely, transport us outside of ourselves, but it can also result in well-documented contagion effects (the shared thrills of an audience response at a concert, for example, or the collective enthusiasm of a crowd at a sports event or a political rally) that disable cognitive capacities for criticism and evaluation (see Garrels 2011; Lawtoo 2013). Although perhaps less sweepingly powerful, the experience of being carried away by a narrative may similarly transport the listener and seem to erase boundaries between worlds. If not as intoxicating as the Dionysian abandon that Nietzsche describes, such an erasure of self-Other differences may facilitate the inculcation of patterns of feeling and perceiving and have a more powerful impact on habitual pattern-formation than cooler, less absorbing, less transportive exchanges of signs and information. For better or worse (and it can be both), the power of stories to reshape or reinforce the listener's unreflective patterns of configuring the world may increase to the extent that the differ-

ence between self and Other in the "as" of empathic identification is reduced or erased. The ideological workings of narrative—its ability to inculcate, perpetuate, and naturalize embodied habits of cognition and emotion—are optimized as the "not" in the doubling of "me" and "alien-me" disappears. If stories ask us to suspend disbelief to immerse ourselves in the illusion they offer, this invitation may be a temptation to the dissolution of boundaries that the demystifying suspicions of ideology-critique rightly resist in order to shake the hold on us of habits of thinking and feeling whose power we may not recognize because they are so deeply ingrained, familiarized, and naturalized.

The capacities of stories to facilitate beneficial social collaboration and to habitualize ideological mystification are two sides of the same coin. This doubleness complicates in important ways the oft-heard claim that a culture's narratives constitute a valuable source of collective knowledge and social cohesion. This argument has recently been reformulated in the terminology of "distributed cognition" based on Andy Clark's (2011) influential notion of the "extended mind." Surveying the various tools and "affordances" (see Gibson 1979) provided by the environment that extend our cognitive capacities, Clark (2011: 226) observes that a "linguistic surround envelops us from birth"—a "sea of words . . . and external symbols [that] are thus paramount among the cognitive vortices which help constitute human thought." These include, of course, the stories we find circulating around us. Stories are equipment for navigating the world and solving problems, but they are not entirely defined by their instrumental dimension. The "as if" of aesthetic experience has a noninstrumental quality that is potentially more playful and open-ended than the use of tools for particular ends. If the to-and-fro play between telling and following stories sets in motion the brain's habitual sense-making patterns, then the "as if" of the aesthetic dimension opens up more room for experimentation, flexibility, and play than may be available in the instrumental use of patterns for problem-solving (although here too, of course, the brain needs to be open to adjustments and realignments when anomalies don't fit the patterns it typically deploys). Paradoxically, perhaps, the pragmatic usefulness of stories for keeping our cognitive processes from congealing into rigid patterns—for holding open their capacity to be reshaped and re-formed—may be enhanced by the noninstrumental play of the aesthetic (see Iser 1978; Jauss 1982; Easterlin 2012: 39–89). An important cognitive, moral, and political value of exchanging stories, then, may be to loosen the habitual, ideological hold of any particular set of narrative patterns on our individual and social minds.

2. Neuroscience and Narratology

The goal of classical narratology was to construct the ideal taxonomy—the classificatory scheme that would identify the fundamental elements of narrative and their rules of combination, based on the model of how grammar and syntax determine meaning by establishing the structural relations between the constituent parts of a logical, ordered system (see Phelan 2006: 286–91; Todorov 1969; Barthes 1975; Lotman 1990). Whether inspired by Ferdinand de Saussure's prioritization of *langue* over *parole* (the presumably stable, orderly structures of language as opposed to the contingencies of speech) or Noam Chomsky's claims about universal grammar (the inborn cognitive structures that constitute what Steven Pinker memorably calls the "language instinct"), the assumption was that the structures of mind, language, and narrative are homologous, innate, and universal. Classical narratologist Ann Banfield (1982: 234) expressed a view shared by many narrative theorists, for example, when she asserted that "the ingredients for represented speech and thought" in a story "are . . . given in universal grammar" and that the ease with which we create and understand stories is explained by fundamental homologies between the structures of narrative and "the speaker's internalized grammar."

Some versions of cognitive narratology still operate within the structuralist paradigm, either tacitly or explicitly. For example, the editors of the recent anthology *Stories and Minds: Cognitive Approaches to Literary Narrative* assert that "rather than turning away from structuralist narratology, cognitive narratologists . . . build on the insights of structuralism and combine them with cognitive studies" (Bernaerts et al. 2013: 13). As James Phelan (2006: 286) explains, "cognitive narratology . . . shares with [structural narratology] the same goal of developing a comprehensive formal account of the nature of narrative" and "conceives of its formal system as the components of the mental models that narratives depend on in their production and consumption." These "mental models" are the frames, scripts, and preference rules that Manfred Jahn (2005: 67–71) defines and explains in his authoritative account of cognitive narratology in the *Routledge Encyclopedia of Narrative Theory*. Spelling out the aims of "postclassical narratology," Jan Alber and Monika Fludernik (2010: 11) endorse this project: "Cognitive narratologists . . . show that the recipient uses his or her world knowledge to project fictional worlds, and this knowledge is stored in cognitive schemata called frames and scripts."

Whether these mental constructs can do justice to the cognitive processes they purport to describe is highly questionable, however. The formalist goal of identifying orderly, universal structures of mind, language, and narrative does not match up well with the unstable equilibrium of the temporally

decentered brain or the probabilistic processes through which cognitive connections develop and dissolve. There is a growing scientific consensus that the formalist model of innate, orderly, rule-governed structures for language should be cast aside because it does not fit with what we know about how the brain works. As the science of cognition and language has shifted, so too must narratology adjust its methods and aims.

New versions of cognitive narratology have arisen to challenge the structuralist paradigm. Advocates of an "embodied, enactive" view of cognition argue that, rather than "conceiv[ing] of the mind" as a structure of "abstract, propositional representations" like "frames" and "scripts," narrative theory should understand "the human mind as shaped by our evolutionary history, bodily make-up, and sensorimotor possibilities, and as arising out of close dialogue with other minds, in intersubjective interactions and cultural practices" (Kukkonen and Caracciolo 2014: 261–62). Whereas first-generation cognitive science was "firmly grounded in a computational view of the mind," with "frames, scripts, and schemata" functioning as "mental representations that enable us to make sense of the world by serving as models of specific situations or activities," second-generation cognitive science shares with phenomenology and the pragmatism of John Dewey and William James an emphasis on the interactions between embodied consciousness and the world in "feedback loops" through which "experience shapes cultural practices" even as "cultural practices help the mind make sense of bodily experience" (Caracciolo 2014: 45; Kukkonen and Caracciolo 2014: 267). Rather than prioritizing the construction of taxonomies, schemata, and systems of rules to explain how the mind works and to account for narrative by disclosing its underlying cognitive structures, second-generation narratology "insist[s] on the situated, embodied quality of readers' engagement with stories and on how meaning emerges from the experiential interaction between texts and readers" (Caracciolo 2014: 4). A quest for structures and rules has been displaced by an emphasis on the interactions between embodied minds, stories, and the world.

Instead of viewing this change as a paradigm shift, some prominent narrative theorists with roots in the first generation have sought ways of reconciling embodied, enactivist narratology with schema theory and formalist, grammatically based models. For example, rejecting the idea that second-generation cognitive science has replaced earlier theories, Monika Fludernik (2014: 406) proposes that they should be regarded as approaches that can coexist and inform one another: "A history of cognitive studies might perhaps better start out from an inherent duality in cognitive work–research that is static and abstract flanking research that looks at the body and human experience." Reminiscent of how structural linguistics juxtaposed synchronic and

diachronic approaches to language, this proposal would view frames and scripts as "static, abstract" structures that are actuated in experience, much as the structuralists thought the rules of *langue* are manifested in the speech-acts of *parole*. David Herman (2002: 1–24) seems to have cast aside his earlier project of constructing a "story logic" that reflects transcendental, universal "mental models" in favor of what he calls "discursive psychology" (Herman 2010: 156), which regards meaning not as a product of "mental processes 'behind' what people say and do" but, rather, holds that "the mind does not preexist discourse, but is ongoingly accomplished in and through its production and interpretation." Still, hoping like Fludernik to rescue formalism and schema theory, he nevertheless asks "how we might work toward a rapprochement between (1) discourse-oriented approaches to the mind as a situated interactional achievement and (2) the work in cognitive grammar and cognitive semantics that likewise promises to throw light on the mind relevance of narrative structures but that focuses on discourse productions by individual speakers?" (175). Again echoing structuralism's opposition between *langue* and *parole*, Herman proposes that we think of language as having social and individual sides that could be separately but compatibly studied—but with the switch that pragmatic, interactive theories rather than formal structures would explain the social side and grammatically based schema theory would provide models for individual mental structures. (As I show below, formalist models and modes of analysis still pervade Herman's 2013 book *Storytelling and the Sciences of Mind*, even though he claims to have embraced enactivism and to have abandoned the structuralist assumptions of his earlier narratological work.)

The problem with both of these proposals, however, is that the epistemological assumptions of first- and second-generation cognitive science are irreconcilably opposed, viewing meaning either as a manifestation of underlying frames, scripts, and rules or as a product of mutually formative, historically evolving interactions between brain, body, and world. The narratological programs based on these opposing epistemologies are also fundamentally at odds—focusing on the figurative, interactive processes through which stories are constructed and experienced as opposed to the schemes, structures, and rules presumably underlying them. This opposition is a reprise of the debates between structuralism and its phenomenological and pragmatic opponents (see Ricoeur 1968; Merleau-Ponty [1945] 1962: 174–99). The problem is not whether to emphasize what happens in interactions between the body and the world or, alternatively, what goes on in the head. What is at issue is how to correlate neuronally based, embodied cognitive processes with our experience of the social world and with our capacities to tell and

follow stories. Two questions are at stake here: How are we to understand the pattern-forming capacities of our cognitive equipment that first-generation cognitive narratologies would formalize into frames, scripts, and preference rules? And how should we understand the regularities of language that formalists would systematize into orderly classificatory schemes and rule-governed structures? Cognitive narratology needs a neuroscientifically sound understanding of language that explains how neuronal and cortical processes interact with our lived experience of the social world.

One obstacle to seeking such correlations is the bogeyman of Cartesian dualism that haunts literary studies. To inquire about the cognitive workings of the brain, it is sometimes feared, is to commit the fallacy of assuming that reality is constituted in the mind of an ego that thinks, thereby overlooking the fact that the cogito is always situated in a body and a social, historical setting and that cognition entails interactions across the boundaries joining brain, body, and social world. Advocates of enactive embodied cognition sometimes similarly worry that asking about processes in the brain may wrongly neglect its situation in a body and a world of natural and socially constructed affordances (for example, see Cook 2018). Enactivism risks becoming a distorting dogma, however, if it refuses to investigate cortical and neuronal processes inside the skull on the grounds that cognition is not only a matter of what happens in the head. By no means mutually exclusive, these perspectives are interdependent and inextricably linked. Usefully reminding us that "the brain is one element in a complex network involving the brain, the body, and the environment," Noë (2004: 214, 222) advises that we need both "to look inward, to the neural plumbing" that gives rise to experience, and "to look outward, too, to the way that plumbing is hooked up to the world."

2.1. "Seeing as" in Language and Cognition

Not everything, to be sure, in first-generation cognitive narratology need be abandoned. Jahn (2005: 67) describes "'seeing X as Y' as a foundational axiom" of cognitive narratology, and this idea is indeed scientifically sound. Configurative processes of categorization and pattern-formation—what existential phenomenologist Martin Heidegger ([1927] 1962) similarly calls the "as-structure " (*Als-Struktur*) of understanding—are crucial to embodied cognition and narrative, but they need to be understood in nonschematized, interactive form. One reason why gestalt theory has been a resource from which neuroscientists like Semir Zeki (2004), cognitive psychologists like James J. Gibson (1979), and phenomenologists like Merleau-Ponty ([1945] 1962) have all repeatedly drawn is its appreciation of the role that figuration or "seeing as" plays in cognition. This is, for example, the epistemological

moral of the famously ambiguous rabbit-duck gestalt (the beak of the duck shifting if we see the shape as a rabbit, a new part-whole configuration that transforms it into a pair of ears). This gestalt is a model of cognition because the circular, recursive work of configurative pattern-building ("seeing as") animates not only vision but cognitive processes of all kinds. Making a case for what he calls "carnal hermeneutics," phenomenologist Richard Kearney (2015: 20) similarly observes that the "'as-structure' is already operative in our most basic sensations." This is because, as Merleau-Ponty ([1945] 1962: 159) points out, "the smallest sense-datum is never presented in any other way than integrated into a configuration and already 'patterned.'" It is consequently a basic principle of contemporary neuroscience that "categorization (or conceptualization) is a fundamental process in the human brain. . . . There are ongoing debates about how categorization works, but the fact that it works is not in question" (Lindquist et al. 2012: 124).

The "as-structure" of categorization—how seeing always entails "seeing as"—is also evident in the circularity of literary interpretation (see Armstrong 2013: 54–90). Literary theorists have long recognized that interpretation is inherently circular because one can understand a text or any state of affairs only by grasping in advance the configurative relation between part and whole. Any act of interpretation sets in motion a reciprocal interaction between part and whole because a detail makes sense only if it can be seen as somehow relating to the entire text, even as the whole can only be understood by working through its parts. This epistemological theory about the need for pattern—the reciprocal construction of part and whole that are together construed as a configurative relation of some kind—is common ground between the humanities and the cognitive sciences.

It is a mistake, however, to reify these configurative processes into mental modules that bear no relation to the anatomy of the embodied brain or to posit linear logical models of cognitive decision-making that do not correspond to the reciprocal, to-and-fro movements of figuration in experience, in the cortex, or in the interactions between brain, body, and world. These are some of the problems with the terminology of frames, scripts, and preference rules employed by cognitive narratology. As Jahn (2005: 69; see also 1997) acknowledges, these notions were developed by "artificial intelligence" theorists "to replace the concept of context by more explicit and detailed constructs" that "aim at reproducing a human cogniser's knowledge and expectations about standard events and situations"—with "frames" referring to "situations such as seeing a room or making a promise," and "scripts" encompassing "standard action sequences such as . . . going to a birthday party, or eating in a restaurant." The brain is not a computer, however. As hermeneutic

phenomenologist Hubert Dreyfus (1992) points out, computers lack context, background, and prior experience that we as embodied conscious beings typically employ in testing hypotheses about how to configure a situation we encounter, whether in a text or in the world, and replacing this deficiency by positing preset mental constructs that do the work only displaces the problem that needs to be solved. Rather than explaining the processes whereby the embodied brain configures experiential contexts, these constructs instead call attention to what computers can't do.

"Seeing as" sets in motion interactions between brain, body, and world that are fluid, reciprocal, and open-ended, and preset schemata like frames and scripts are too rigid and linear to do justice to these sorts of dynamic, recursive processes. This is why psychologist Richard Gerrig (2010: 22), whose work on reading is widely (and rightly) respected among cognitive narratologists, has recently parted company from what Jahn describes as the mainstream view, in the process rejecting the term *schema* as too rigid and formulaic. Gerrig prefers instead to speak of "memory-based processing," a concept that recognizes that "readers' use of general knowledge" is "more fluid and more idiosyncratic" than the terminology of frames and scripts can capture.

The linear, overly tidy notion that cognition is governed by preference rules also needs to be abandoned. According to Jahn (2005: 69), "a preference rule is usually cast in the form *Prefer to see A as B given a set of conditions C.*" In its favor, the notion of *preference* is not absolute and leaves a little wiggle room for probabilistic variation, but the problem with structuring preferences into "rules" is that these posit a linear chain of decision-making, following the form of a logical proposition: if C, then A implies B. This linear, mechanical, logical structure is not an adequate representation of how cognitive decision-making happens either in neurobiology or experience. Neurobiologically, it bears little relation to the interactive, top-down, bottom-up processes of the dynamical systems of synchronization and desynchronization in the brain. Neuronal assemblies form and dissolve according to patterns of habituation that result from the reciprocal reinforcement of connections that can be displaced by other syntheses, and these interactions are not like linear, mechanical algorithms. Experientially, the unidirectional logic of preference rules is unable to capture the to-and-fro circularity of "seeing as" in the phenomenological process of configuring part-whole relations in a text or in life. Reading is not linear logical processing, and embodied cognition cannot be adequately modeled either by ordered hierarchies of modules or mechanical, linear algorithms.

2.2. Brain-Body-World Interactions and the Patterns of Language and Cognition

The work of "seeing as" is not localizable in any particular region of the cortex but extends across the brain, the body, and the world. It is not governed by rules but develops habitual patterns through repeated experiences and is consequently always open to disruption, variation, and change. The formalist goal of identifying orderly, universal structures of mind, language, and narrative doesn't match up well with the messiness of the brain or with how cognitive patterns emerge from our embodied experiences of the world. The consensus among neuroscientists is that the brain is a bushy ensemble of anatomical features whose functions are only partly fixed by genetic inheritance and are to a considerable extent plastic and variable depending on how they connect in networks with other, often far-flung cortical areas. These connections develop and change through experience according to Hebb's law (Hebb [1949] 2002), a fundamental axiom of neuroscience: "Neurons that fire together, wire together." As neuroscientist Stephen E. Nadeau (2012: 1) points out, "Brain order is chaotic rather than deterministic; rules are not defined but instead emerge from network behavior, constrained by network topography" and connectivity (not all parts of the cortex can do everything, and they cannot interact if they are not linked by the axons through which neurons exchange electro-chemical charges). Whatever order can be found in language and cognition results, he explains, from patterns of reciprocal relationship "acquired through experience," and these patterns are attributable less to innate, genetically determined anatomical structures than to "statistical regularities of experience."[2]

The brain, in short, is not an orderly structure consisting of rule-governed relations between fixed elements like a computer with hardwired connections

2. Nadeau's fascinating book provides a thorough and rigorous (although technically difficult) explanation of the neuroscientific case against universal grammar. See Changeaux (2012: 206–8) for a more concise and accessible explanation of why contemporary neuroscience has rejected the Chomksyan model that "mental organs" are "innate," "determined genetically," and "suited to a given species." For comprehensive reviews of the neuroscientific findings that cast doubt on the claim that language is based on inborn, universal cognitive structures, see Evans and Levinson (2009) and Christiansen and Chater (2008). Berwick and Chomsky (2016) have recently attempted to reconcile the assumption of an innate "language faculty" with contemporary neurobiology and evolutionary theory. The scientific community generally remains skeptical, however, for reasons outlined in reviews by cognitive linguist Vyvyan Evans (2016: 46), who politely notes that their "position seems less reasonable today than it once did," and by neuroscientist Elliot Murphy (2016: 8), who more pointedly criticizes their reliance "on outdated assumptions" about "how the brain actually operates (via oscillations and their various coupling operations)" and shows in detail that their assertions about the localization of linguistic operations do not fit the experimental evidence. Also see the highly critical review by the language columnist for the *Economist* (Greene 2016).

between components that operate according to logical algorithms. Much messier, more fluid, and more open to unpredictable (if not unlimited) developments than this linear, mechanical model assumes, the brain is an ever-changing ensemble of reciprocally interacting parts whose functions may vary according to how they combine with other elements. Modular models of the brain (see Fodor 1983), once popular during the heyday of "artificial intelligence" models in cognitive science, have fallen out of favor because cortical regions are not autonomous and orderly. As neurophenomenologist Shaun Gallagher (2012: 36) observes, the brain is "a dynamical system [which] cannot be explained on the basis of the behavior of its separate components or in terms of an analysis that focuses on the synchronic, or static, or purely mechanical interactions of its parts"; "the parts of a dynamical system do not interact in a linear fashion" but, rather, "in a non-linear way, reciprocally determining each other's behavior." Patterns of relationship can become established over time as particular interactions recur and reinforce existing connections or propagate and strengthen new ones, but how repeated experiences lead to the formation of habits through Hebbian "firing and wiring" is a better model for understanding these patterns than the genetically fixed, orderly structures assumed by the epistemological formalists. Preprogrammed modules and linear algorithms are not a good model for understanding the workings of the brain.

The structures of neural anatomy are limiting but not ultimately defining. Different cortical locations have particular functions that can be disabled if they are damaged, but no region works alone, and its role can vary according to how it reciprocally interacts with other areas. Function and connectivity can change with experience. The visual cortex of a blind person, for example, can adapt and become responsive to touch when reading Braille (see Changeux 2012: 208), and some sight-deprived people as well as animals have been shown to have superior sound localization because the unused parts of their visual cortex are recruited for auditory functions (see Rauscheker 2003). These instances of plasticity may seem exceptional, but they are examples of the general rule that, as Kristen A. Lindquist et al. (2012: 123) explain, the "function of individual brain regions is determined, in part, by the network of brain regions it is firing with." According to Lindquist et al., this is why there is "little evidence that discrete emotion categories can be consistently and specifically localized to distinct brain regions" (121). Her review of the experimental evidence shows, for example, that the amygdala is not uniquely and exclusively associated with fear but is also active "in orienting responses to motivationally relevant stimuli" that are "novel," "uncertain," and "unusual" (130). Various studies have similarly shown, she points out, that the anterior cingulate cortex, typically connected with disgust, "is observed in a number of

tasks that involve awareness of body states," including "awareness of body movement," "gastric distention," and even orgasm (133–34).

This research calls into question Patrick Colm Hogan's claim (2010: 255; see also 2011) that "emotion is . . . the response of dedicated neurobiological systems to concrete experiences, not a function of the evaluation of changing situations relative to goals." Lindquist is a member of Lisa Feldman Barrett's group that has led the challenge to the theory of "basic emotions" promulgated by Paul Ekman and Silvan Tomkins. As Barrett (2017: 22, 23, 33) explains, a large and growing body of neuroscientific and psychological research has called into question the view that emotions are universal classes with objective biological markers:

> Overall, we found that no brain region contained the fingerprint for any single emotion. . . . Emotions arise from firing neurons, but no neurons are exclusively dedicated to emotion. . . . An emotion word, like "anger," does not refer to a specific response with a unique physical fingerprint but to a group of highly variable instances that are tied to specific situations. . . . The emotions you experience and perceive are not an inevitable consequence of your genes. . . . Your familiar emotion concepts are built-in only because you grew up in a particular social context where those emotion concepts are meaningful and useful, and your brain applies them outside your awareness to construct your experiences.

Emotions are mixed products of biology and culture that are better thought of as variable, internally heterogenous populations than logical categories or universal classes with fixed neurobiological foundations.

Anatomical location and cortical structure alone cannot explain embodied cognition. Brain-body-world interactions can affect not only internal connectivity but also the functions of particular cortical regions. To understand a complex cognitive phenomenon like vision, emotion, or language, it is not enough to identify structure and modularity (as the formalist models assume); it is necessary, rather, to trace the configurative, nonlinear, to-and-fro processes through which various components of our dynamic cognitive systems interact and reciprocally constitute each other.

A good example of the brain's combination of anatomical specialization and openness to change through experience is the manner in which the visual cortex adapts inherited functionalities in order to support the unnatural, culturally acquired capacity to read written texts (see Armstrong 2013: 26–53). As neuroscientist Stanislas Dehaene (2009: 4) points out, we learn to read Shakespeare by adapting cortical capacities that our species acquired on the African savannah. This is an instance of what cognitive scientist M. L. Anderson (2010) calls "neural re-use"—the capacity of cortical regions to acquire functions for which they did not first evolve. New, unpredictable experiences

with the world may set in motion variable interactions between different areas of the brain and the body as well as with other members of our species that can produce fundamental changes in cortical structure and functionality. As the visual and auditory cortices interact during the often arduous processes through which beginning readers learn to associate word-shapes with phonetic sounds (also activating parts of the motor cortex associated with the mouth and the lips that fire not only in the articulation but also during the recognition of speech), connections get established and reinforced between different regions of the brain that have the effect of converting a specific area of the visual cortex to a culturally specific use (the recognition of visual word forms) for which it was not innately, genetically predetermined. The acquisition of the ability to read may be an extraordinary cultural and neurobiological accomplishment, but as an example of neural reuse, it is simply an illustration of what Anderson (2010: 245) calls "a fundamental organizational principle of the brain."

Our species' development of the capacity to read illustrates the dual historicity of cognitive functions (see Armstrong 2015). Some of our epistemological equipment is based on long-term, evolutionarily stable capacities like the responsiveness of the visual system to edges, orientation, lines, and shapes, but these capacities are open to change depending on learning and experience—they can be recruited, in this case, to identify alphabetic signs—because the function of a cortical region depends on how it interacts with other components of the dynamical system in which it is engaged. The brain can be molded by cultural institutions (like literacy) that adapt particular areas and capacities for their purposes, but as with reading, these capabilities need to be relearned with each generation until or unless the neural reuse through which they are repurposed becomes evolutionarily adapted into the biological makeup of the species. The structures and functions of the brain are historical, not universal, because they are the products of evolution, but some capacities are more enduring than others and are shared by members of our species across time and around the globe, even as they get reshaped and repurposed through particular, historical, culturally situated experiences of learning.

2.3. Language and Narrative as Biocultural Hybrids

Language is what neuroscientists call "a bio-cultural hybrid" (Evans and Levinson 2009: 446) that develops through the interaction of inherited functions and anatomical structures in the brain with culturally variable experiences of communication and education. Although some parts of the brain are known to be linked to language (lesions in Broca's and Wernicke's areas, for example, can disrupt syntactical or semantic processes), Nadeau (2012: 83)

points out that "linguistic function taps the entire cerebrum," and recent fMRI-based research has confirmed that language entails far-flung syntheses of cortical areas and connections between the brain and the body (see Huth et al. 2016). There is no single module that governs language and no discrete, anatomically identifiable set of regions that would constitute the grammar unit predicted by structural linguistics. As Nadeau (2012: 164–65) explains, "The grammar anyone of us uses is not intrinsically universal. . . . Instead it is based on the statistical regularities of our own linguistic experience (instantiated in neural connectivity), which have been determined by the modest community of people we have conversed with or read." Cases of aphasia in different languages reveal not an anatomically based, universal grammar system that gets knocked out with the loss of language function but rather what Nadeau calls "graceful degradation" (17). Everything doesn't simply collapse and disappear, but some functions are more or less strongly preserved, in different patterns of vulnerability that depend on cross-cerebral connections and redundancies and that vary between linguistic communities. This evidence is better accounted for by the stochastic, probabilistic regularities established through Hebbian connections and developed through experience than by a logically ordered, innate grammar.

Such a probabilistic model also helps to explain the duality of language as a set of regularities open to innovation, variation, and change. As neuroscientist Jean-Pierre Changeux argues, the Hebbian explanation of stochastic regularities offers a better account of the creative capacities of language than prefixed formal systems can provide (see Changeux 2012: 206–7, 316–17). On the one hand, language is a set of shared codes, evident in its recurring patterns that support intersubjective communication and well-formed sentences. On the other hand, the irregularities of language are also vitally important because they make possible unpredictable if constrained possibilities for linguistic innovation through rule-governed or rule-breaking creativity. In accord with a probabilistic model, structures do not completely decide in advance all the ways they can be used (innovation within the rules is possible), and sometimes new configurations can emerge as previous connections are replaced by new ones (transgressing existing rules is not always wrong, as with a novel metaphor that at first may seem like a category mistake but then becomes accepted and gets adopted into the lexicon).

If language and narrative are biocultural hybrids, any transcultural, transhistorical regularities in their functions and forms are a product of variable but constrained interactions between brain, body, and world and not universals that are homologous to logical structures of the mind. The sources of these regularities are typically both biology and culture; it's not simply that nature is fixed and culture variable. Similarly, any recurring patterns in the

stories we typically tell each other are the mixed products of interactions between our species' neurobiological equipment and repeated experiences we are likely to undergo. If stories across the world have recurrent forms, this is not a result of narrative structures that reflect universal cognitive schemata. Rather, as biocultural hybrids, the patterns identified by various narrative theories have probably developed because evolved cognitive proclivities shared by members of our species have interacted with recurrent, typical experiences to produce configurative relations between brain, body, and world that demonstrate statistical regularities. These patterns are not logical structures but habitual configurations that are variable but constrained within limits that are attributable to the regularities of both biology and experience.

Consider, for example, cognitive narratologist Patrick Colm Hogan's (2003: 230–38) claim that certain "narrative universals" characterize "the mind and its stories"—"story structures" that he identifies as the romantic, the heroic, and the sacrificial. The question of how to understand cross-cultural "universals" is notoriously difficult. For example, arguing that the claims of relativism overstate the differences between cultures, Donald E. Brown (1991: 9–38) carefully distinguishes between different kinds and degrees of universality—universals of "essence," attributable to the biological characteristics of our species, as opposed to universals of "accident," produced by widely shared experiences, some of which may be "near universals," probably all-encompassing but at least broadly evident, and "statistical universals" that may not be omnipresent but are more common than would be predicted by chance. Hogan (2010: 48–49) admits different kinds and degrees of universality, but he thinks and talks like a structuralist: "Hierarchies of universals are defined not only by the schematization of techniques and by a receding series of explanatory abstractions but by a series of conditional relations. . . . Much as unconditional universals may be subsumed into hierarchies of abstraction, implicational universals may be organized into typologies." This kind of logical formalism is not a good way of thinking about the messy, probabilistic development of regularities that characterize biocultural hybrids like language and narrative.

If narrative patterns like those identified by Hogan recur across cultures, that is not because they reflect universal cognitive structures. They are better understood as biocultural hybrids—recurrent configurations that develop because certain repeated characteristics of our species' shared experiences of birth and death, collaboration and competition, propagation and violence interact with biologically based cognitive proclivities to produce statistically discoverable regularities in cultural institutions, including the stories we circulate in our communities. Given the commonalities in the basic experiences

members of our species typically undergo in their journeys from birth to death, it would be surprising if the cognitive configurations established through Hebbian connectivity between our brains, bodies, and worlds did not demonstrate various regularities that would show up in our narratives. Members of our species fall in love and have sexual relations, engage in conflicts that produce winners and losers, and form communities that join some members and exclude others, and the configurative powers of pattern-formation based on the connective capacities of our embodied brains build narratives about these experiences that may evince various regularities (Hogan's stories of romance, heroism, and sacrifice).

It is misleading to call these "narrative universals" or to attribute them to a structural logic of "the mind and its stories," because these terms are too static, orderly, and ahistorical to do justice to the messy, dynamic processes through which biocultural hybrids get produced in the interactions of brain, body, and world. These interactions may produce patterns that demonstrate regularities because habitual connections are established through Hebbian processing and neural reuse and are then passed on by cultural sharing of the kind through which, for example, literacy is developed and handed down. But formalist terminology and structuralist models are not good tools for describing these processes because such concepts misrepresent the way habitual patterns of connection and configuration get made and transformed in experience and in the brain. Formal taxonomies are not sufficient to explain these interactions.

2.4. Describing (without Reifying) Narrative Worlds

The term *world* is often employed in narrative theory to describe these interactions. For theorists in the traditions of phenomenology and pragmatism, the term refers to the configurations of meaning-making activity that characterize experience—what Merleau-Ponty ([1945] 1962: vii–xxi) calls the unreflective, "operative intentionality" that we find already at work when we reflect on our lives and discover various patterns of relationship that give shape to our typical, habitual interactions with people, places, and things. Narratives bring worlds into relationship as patterns of configurative activity cross back and forth in the circuit joining lived experience, the construction of stories, and their reception by listeners and readers. This circuit entails an interaction between worlds—between what Edmund Husserl ([1954] 1970) calls the *Lebenswelt* or lived world, the fictional worlds constructed by storytellers, and their re-creation in the imaginative worlds built by their recipients. As Ricoeur (1987: 430–31) explains, "The intersection of the world of [the] text and the world of the reader . . . opens up a horizon of possible experience, a world in which it would be possible to dwell." The process of telling

and following stories sets in motion interactions between the patterns of configuration that characterize these different worlds. Pragmatically oriented psychologist Jerome Bruner (1986: 66) similarly invokes this term to characterize stories not as logical, formal structures but as aspects of our lived experience—projections of "possible worlds in which action, thought, and self-definition are possible (or desirable)." What matters for theorists like Ricoeur and Bruner in the phenomenological and pragmatic traditions is how the pattern-making powers of stories contribute to what Nelson Goodman (1978) memorably calls our "ways of worldmaking," a concept also adopted by phenomenological reading-theorist Wolfgang Iser (1993: 152–70) in his "literary anthropology."

It is once again a mistake, however, to reify worldmaking by reducing it to formal, schematic models of the sort sometimes proposed to map the structures of "storyworlds." The interactions between worlds as we tell and follow stories cannot be reduced to grids and schemes. For example, the good thing about David Herman's (2013: x–xi) somewhat awkward, confusing description of "narrative worldmaking" as "worlding the story" and "storying the world" is its recognition that the configurative work of narrative is a dynamic process. It is not necessary to turn nouns into verbs to describe this activity, however. More problematic is the taxonomic drive to construct classificatory schemes to account for these processes. Herman's much-discussed book *Storytelling and the Sciences of the Mind* (2013) offers one classificatory scheme, diagram, and taxonomy after the other and proliferates terms, categories, and distinctions in an almost manic attempt to reduce the dynamism of worldmaking to an orderly system. Rather than clarifying the configurative activity through which worlds are projected and interact in narratives and lived experience, this elaborate edifice of maps, grids, and definitions necessarily fails to capture the processes it attempts to reduce to static schemes.

The fundamental problem with this approach is evident in two of Herman's (2013: 56) central claims about narrative worldmaking—namely, that "interpreters map textual patterns onto WHO, WHAT, WHERE, WHEN, HOW, and WHY dimensions of storyworlds," and that "the patterns in question emanate from reasons for (text-producing) actions" that can be systematically categorized. A static map of positions on a grid charting the answers to these questions cannot do justice to the configurative processes of meaning-making through which worlds are experienced and exchanged. Herman's interrogatory map is reminiscent of the stock questions that newspaper reporters are instructed to ask as they gather material for their stories, but any journalist knows that the answers they jot down in their notebooks are *not* the story but only the bits and pieces out of which it must still be put together when they return to the newsroom. What is missing are the

configurative processes of pattern-formation that connect the dots and fill in the blanks. Resistant to reduction to a classificatory scheme, the patterns of intentionality that animate a world cannot be explained by positions on a map. The spatial, formal logic of Herman's maps of storyworlds cannot account for the dynamic, to-and-fro processes by which fictional worlds arise and through which they interact with the worlds of readers.

A similar problem afflicts Mark Turner's (1996) diagrams of what he calls "conceptual blending," none of which can do justice to the interaction between a word and a context through which metaphorical innovation occurs. This interaction is characterized by what Nietzsche ([1873] 2015) calls "*das Gleichsetzen des Nicht-gleichen*," the "setting equal" of what is "not the same." As Ricoeur explains, a novel metaphor is a category mistake—a term that is surprising because it doesn't fit its context in the expected manner. This incongruity is not simply dismissed as an error, however, but instead produces new meaning because of the interpreter's adjustments through which its initial incoherences are made coherent and, thereby reconfigured, come to seem "right" in unanticipated and new ways. A novel metaphor can then become dead when its incongruities are so assimilated and conventionalized that they are no longer noticed. Turner's schemata necessarily miss this interaction—the category mistake and the readjustments it provokes—and his term *blending* does not do justice to the necessity of incongruity and discordance to the production of new congruence (see Easterlin 2012: 163–79; Armstrong 1990: 67–88; 2013: 87–88). The maps, grids, and schemes that Herman and other structurally oriented narratologists use to characterize the concordant discordance of narrative are similarly destined to miss the processes of figuration, configuration, and refiguration that they reduce to static taxonomies.

This schematic approach is a legacy of the first-generation prioritization of frames and structures. By contrast, various forms of second-generation narratology focus on precisely these interactions. For example, Terence Cave (2016: 4, 5) describes "thinking with literature" as a collaborative process of inquiry, improvisation, and conversation that "conscript[s] our capacity for cognitive inference" and may "alter the cognitive environment of the reader in ways that are powerful, potentially disturbing, and not at all self-evident." Cave's model of reading, based on relevance theory, emphasizes the "bold and highly precise modes of underspecification" of literature that may "act like a prompt or a trampoline, creating unlimited possibilities for imaginative leaps into the blue–or into the minds of others" (27) through improvisatory responses to the world of the text that go beyond mapping dimensions of a story world onto a spatial grid. For Cave, "thinking with literature" is a cocreative response to a literary work "not as [a] neutral text but as an

animated affordance" (9) that encourages and makes possible but does not fully determine our interpretations. According to Cave, "what happens when we redescribe literary conventions as affordances" is that "what was static and merely constraining" turns out to open up "all kinds of unexpected possibilities, ways of breaking out into new territory" (55–56). Mapping a world as points on a grid misses this dynamism and "the human ability to think beyond the immediate demands of their environment" that a text invokes through its "implicatures," "intended meanings that can be derived inferentially from a given utterance" (77, 33).

Other contemporary narratologists have made important attempts to theorize these interactions. Describing narrative as "a purposeful communicative exchange between authors and readers," James Phelan (2015: 121; see 2017) offers a "rhetorical theory" that "defines narrative as somebody telling somebody else on some occasion and for some purposes that something happened." Carrying on the tradition of his teachers at the University of Chicago from before the days of cognitive literary criticism, Phelan's theory of rhetoric as a purposeful communicative exchange deserves "second generation" status because it foregrounds the configurative, mutually formative processes of the text-reader interaction. Drawing on phenomenological and pragmatic theories of text-reader interaction, Marco Caracciolo's (2014: 4) "enactivist approach" similarly insists on "how meaning emerges from the experiential interaction between texts and readers"—"stories offer themselves as imaginative experiences because of the way they draw on and restructure readers' familiarity with experience itself"—a to-and-fro, temporally unfolding, dynamic relationship between the world of the reader and the world of the text in a mutually formative experiential transaction.

Nor can narrative actions be reduced to a logic of "reasons" from which they "emanate." According to Herman (2010: 169–70), "Readers are able to understand the characters' *behaviors* as *actions* in part because of the models of emotions on which they rely to interpret the text"—what he calls an "emotionology," defined as "the collective emotional standards of a culture as opposed to the experience of emotion itself": "An emotionology specifies that when an event X inducing an emotion Y occurs, an agent is likely to engage in Z sorts of actions." Once again adopting a model based on scripts, frames, and preference rules, Herman contends that "the characters' activities can be construed as more than just a series of individual, unrelated doings because of the assumption, licensed by a model of emotions, that those behaviors constitute a coherent *class*" (170). There are several problems with this taxonomic, rule-based approach to character, action, and emotion. To begin with, as explained above, the best contemporary neuroscience of emotions (Barrett 2017) suggests that "anger" or "embarrassment" should be viewed

not as a coherent, homologous "class," but rather as a "population" of related, overlapping, but diverse subjective states. Further, the research on the relation between real and imagined action suggests that our response to the action staged in a text is less like the linear, logical application of a rule from a class than the sort of bodily based resonances that Guillemette Bolens (2012) describes in her kinematic theory of narrative. These intuitive, embodied resonances unfold over our engagement with a text at the level of primary intersubjectivity through unreflective, operative intentionality, and they cannot be adequately described by a logic of models and rules. These interactions are "as-relations" that have the power to reconfigure our sense of the world because they are not simply applications of schemata we already know. They are, rather, dynamic and unpredictable enactments of the paradox of the alter ego, the doubling of the "real me" of my kinematic sensations that I experience while reading and the "alien me" of the world I set in motion as I empathize and identify with the actions of the text.

A scheme outlining an underlying logic of actions cannot do justice to the processes through which these configurations of embodied intentionality emerge, develop, and change across the horizons joining past, present, and future in to-and-fro, reciprocal interactions. What matters is not only where actions come from, but where they are headed to—not just their sources but their goals and directions—and it is the variable, often unpredictable interaction between these that makes actions dynamic. For example, as Elaine Auyoung (2013: 60) observes, narrated actions can seem lifelike because their gaps and indeterminacies draw on "our readiness to contend with partial representational cues in everyday, nonliterary experience." With the actions represented in stories as in those we encounter in everyday life, she notes, we fill out what lies beyond our limited perspective by our expectations about their future course and direction (see Auyoung 2015). Similarly, as Karin Kukkonen (2016) points out, the various kinds of action set in motion by a text—not only the characters' behaviors (the action of the plot) but also our responses to stylistic cues (the action of the narration)—are less like the unilinear application of preference rules than "affordances" that make possible but do not fully prescribe our responses, guiding our actions but leaving open room for improvisation, innovation, and surprise. Drawing on a Bayesian, predictive-processing model of embodied cognition, Kukkonen explains that the narrative environment makes certain actions probable and others less so, thereby motivating not only the development of the plot but also our expectations about the course of the narration in a dynamic, interactive process of "feedback loops" that "cascade" into each other, reinforcing or disrupting the pattern-making work set in motion by different kinds of narrative figuration. The eventfulness of worldmaking and the unpredictability of the interaction

of worlds in the experience of narrative that these second-generation theorists are attempting to describe are essential to how "storyworlds" work, and these are necessarily lost in spatial maps and classificatory schemes.

3. Conclusion

Cognitive narratology needs to break with its structuralist legacy and embrace the paradigm shift proposed by the various pragmatically oriented, phenomenological theories of narrative that have contested the formalist program. If we want to understand stories, logical structures and taxonomies won't do the job. What we need to know, rather, is how elements combine into patterns through their interactions in lived experience and embodied cognition. "How do narratives participate in the formation and dissolution of patterns in the embodied brain's interactions with the world?" is the right question to ask if what we have is not a logically ordered, formally structured mind but a bushy brain that is an ensemble of relationships that get fixed over time but are open to a future of variation. Those interactions are the means by which stories help the brain negotiate the tension between pattern and flexibility thanks to the play of their concordant discordances. Charting the to-and-fro processes of figuration and refiguration through which we tell and follow stories is the dynamic, ever-shifting ground on which neuroscience, narrative, and narratology meet.

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