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INTERDISCIPLINARY MIND MODELING

Exploratory Cycles in Cognitive Science, Narrative Theory, and Fictional Creativity

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Introduction: Closer than We Think?

Talks of models, if we pay attention to them, are widespread across disparate areas. And yet, the word "model" can be an equivocal one. The term can, for instance, indicate the source of a representing activity as it can be pointing at its target object. In painting, a mountain can be the source "model for" a creative representation of that landscape. Equally, though, the painting itself can be regarded as a "model of" the mountain (or, better, of its perception by a human creative modeler). Examples of this ambiguity can continue in the quite unruled currency of the term. In fashion, we have human models wearing clothes designed by a stylist for an audience to imagine themselves in the everyday actual use of this design. Here, the model, although physically modeling in the flesh, is not to be considered as the real thing, only as an impersonating prop for imagination. In photography, a subject can similarly act as a model for what will become the real, marketable photography, regardless of the latter's status as a representation. Alternatively, we can consider the representation itself as modeling a particular way of looking at the world. Playing with depth of field, aperture, framing, contrast, exposure, and composition can make us discover something new about the represented target (i.e., the photograph becomes a "model of" the world).

Regardless of their different scopes and construction, the models and modeling practices mentioned, however, at least exemplify how "models for" and "models of" are functions that sometimes can be performed by the same device, object, subject, or representation – often taking turns according to use and context. This double nature of models and modeling will be relevant for what follows, as it is operationally central to the scientific modeling practice, too. Models of objects or processes in the world ("model-of" function) are purposeful operations ("model-for" function) with epistemic drives geared toward learning or exploring. Models of an object or process usually operate for a better understanding or heuristic exploration of the workings, affordances, components, dynamics, and behavior of that object, system, or process.

A quick charting of the term's usage in quite distant activities (and more could be added, from sawing to architecture) already helped us think of modeling as an operation not restricted to the scientific domain. However, the terms models and modeling in the science have a more technical and specific meaning, pointing at fine-tuned operational procedures for specific

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epistemic purposes that we shall review in the next section. This might lead us to think we should restrict these procedures to scientific modeling and consider modeling beyond science as a loose or tacit metaphor. This chapter will argue that instead, it is precisely because of those specific operations that we should look at some fictional narratives as a modeling of cognition. The scope of the chapter is thus to argue for the benefit of a meeting of models and modeling practices between cognitive sciences and fictional narratives via another modeling discipline, narrative theory. This is what will be championed as interdisciplinary mind modeling.

Twenty years have passed since the influential interdisciplinary call for joining forces made by the edited volume *Narrative Theory and Cognitive Sciences* (Herman). Just the year before, a pioneering special issue in *Poetics Today* announced the "cognitive revolution" in literary studies (Richardson and Steen, "Literature"). That special issue was followed by a splashing critical commentary in the same journal (Adler and Gross) and a solid reply to that skeptical adjustment (Richardson and Steen, "Reframing"). Since then, the trajectory of cognitive literary studies and cognitive narratology has progressed steadily from hype to maturity, generating a wealth of books, methods, approaches, theories, seminar series, projects, doctoral works, and even centers. However, there seems still to be a lingering feeling of an emergent field or mission. Possibly, because this interdisciplinary field, whose multifaceted investigations are mirrored by a variety of field-flagging names such as "cognitive narratology" (Se), "cognitive literary studies" (Zunshine, *Oxford Handbook*), "cognitive humanities" (Garratt), "neuroaesthetics" (Zeki, Bao, and Pöppel), and even "cognitive literary science" (Burke and Troscianko), is still struggling to make scientists and humanists cooperate on equal footing, fueled by beliefs in shared stakes and the possibility of a common practice (or at least, an intersecting area of joint research).

The lack of a common parlance might hold some responsibility. However, the problem of communicating across the border goes beyond terminology and includes more pragmatic issues on how we can do mind research together. Why we should do it feels like a separate question, but an answer to that might be naturally emerging if we solve the how first. In their unnecessarily caustic commentary, Adler and Gross were right, nonetheless, when pointing out how the problem is not reaching a flattened interdisciplinary Esperanto but rather asking whether "beyond the level of terminology, do the fundamental assumptions and values of the fields permit the exchange of knowledge and opinions between equals, as opposed to an enterprising 'kidnapping' of knowledge from one field to another?" (212).

The chapter will argue that when considering the investigation of the human mind, sciences and fictional narratives not only have a shared focus and concern (i.e., human cognition, self, and consciousness) but might also find some fundamental shared assumptions and values in the shared practice of modeling. Views of scientific models as some sort of fictional devices have been advanced by a few critical contributions to the philosophy of science (Frigg and Hunter). Scientific models have been compared to fables or thought experiments (Cartwright), working on a generative principle of imaginative make-believe (Frigg). This is the "fiction view of modeling" (Frigg and Nguyen, "Fiction View"). In comparison, a view of fiction as some modeling that partakes in elements and procedures with scientific modeling is unexplored if we exclude a recent notable exception countering this view (Currie). This is the "modeling view of fiction" that this chapter will promote. I have elaborated at length on such a view in a recent book on the narrative work of Samuel Beckett (Bernini, *Beckett*) and already extended it to the specific modeling of processes such as mind-wandering and inner speech in other writers (Bernini and Fernyhough). This chapter will be a chance to recap, rehearse, and expand further on this view, particularly how models in the cognitive sciences can be challenged and updated when coupled with fictional cognitive models. This interdisciplinary coupling of models can thus generate what I call "exploratory cycles" that should become the looping core of interdisciplinary mind

modeling. The hope is that by providing a rationale and operational motivations for coupling models between science and fictional narratives – helped by models in narrative theory – we might realize we are already closer than we think.

Adding Intellect to Experience: Models and Modeling in Cognitive Science and Narrative Theory

What is a model in the sciences? A model is a purposeful, selective, and simplified representation of reality with epistemic, explanatory, or exploratory potential (more on this distinction later). Why does science need them? A general answer that applies to all scientific models is that scientists use them to capture something in the world that is hard to investigate just by direct observation. This is the purposefulness of scientific models (their "model for" function). To allow access and understanding to obscure, complex, phenomenologically hidden, or scientifically intractable processes. How do they do that? By selection and simplification. The two operations are combined since it is by selecting only relevant elements in the target system that a model system generates a simplified representation of the target ("model of" function). As Railsback and Grimm argue, in the sciences, "we usually want to understand how things work, explain patterns that we have observed, and predict a system's behavior in response to some change" (4). The problem is that for direct observation, "real systems often are too complex or develop too slowly to be analyzed using experiments . . . Therefore, we try to formulate a simplified representation of the system" (Railsback and Grimm 4). Because of this simplifying potential of models, in the sciences, "there is hardly a domain of inquiry without models. Models are essential for the acquisition and organization of scientific knowledge. We often study a model to discover features of the thing it stands for" (Frigg and Nguyen, "Models" 49).

Cognitive science is no exception, and unsurprisingly so. Human cognition, mind, self, and consciousness are, in fact, very complex targets for investigation. Thus, cognitive models can become indispensable tools for investigating their dynamic workings since they can purposefully select hypothesized key elements in a cognitive process to selectively create a model of that process. Thanks to the model, structures can be perceived (or hypothesized), patterns explored, and processes characterized in terms of key components. It is worth repeating, though, that, as Lewandosky and Farrell constantly highlight:

> models are intended to be simpler and more abstract versions of the system—in our case human cognition—they are trying to explain […] Models seek to retain the essential features of the system while discarding unnecessary details. By definition, the complexity of models will thus never match the complexity of human cognition—nor should it, because there is no point in replacing one thing we do not understand with another. (Lewandowsky and Farrell 11)

It is time to give a couple of examples. Let us say you want to understand the workings of our feeling of having or being a self. A human self is a complex entity or process, and to understand how that entity or feeling of self emerges, it is better to simplify things a little instead of just trying to record everything a human self does or is or feels to be by direct observation. This is why some cognitive scientists have created models of the self by selecting elements in its predictive and embodied nature, thus leading to a model of a "predictive self" (Seth "Interoceptive"). Others have selected its narrative activity, prizing the recruiting of autobiographical memories and a feeling of temporal continuity, leading to a model of a "narrative self" (Schechtman). For some, the self should be considered for its minimal experiential components (e.g.,

non-narrative or pre-narrative), and the resulting is a model of a "minimal self" (Zahavi). More comprehensive modeling has attempted to capture several elements combined (narrative, social, minimal, embodied, and linguistic) in ever-changing patterns, leading to a "pattern theory of self" (Gallagher).

All these models, even the more comprehensive, are still purposefully selective and simplified. Many aspects of the actual target are ignored or eliminated in each of them (e.g., dietary requirements, nationality, class, Instagram followers, circadian habits, proper names, IT skills, preferred sport, holiday, or movie genre, for instance, are not factored in as fundamental elements). This reduction makes these models useful epistemic tools for investigation. They can show how the hypothesized core elements play together once the model is implemented and running. Admittedly, most of the models of self-listed here will not be run into a computer simulation, as mathematical and computational models do (e.g., models of neuronal networks). Instead, the models of self here are classed as "conceptual models" (Seth, "Models of Consciousness"). Their simulative unfolding is mainly assigned to igniting, following, and investigating, verbally and logically, the consequences of rigorous arguments following their selective premises. These are the models of the philosophy of cognitive science and cognitive phenomenology. They use empirical neuroscientific research (the outcome often of computer-based cognitive modeling) to build conceptual and verbal models. These models, however, can, in principle, be implemented in computer simulations. Often, they remain models for further empirical research in psychology, neuroscience, and phenomenology – whose outcome can then loop back into a new updating of conceptual models.

Even without the computational power of running millions of iterative simulations to test predictions and behaviors of processes or agents, however, these models are tools empowered by purposeful selectivity and simplicity. These kinds of purely non-computational models are particularly beneficial for phenomenological research aimed at bridging what we know about brain processes (e.g., hippocampus activation in episodic memory) with what we know about how that process feels to the mind and consciousness (e.g., its relation to narrative self-shaping, emotional or embodied predictions). They are especially relevant also to the kind of "modeling view of fiction" proposed here. Literature and other narrative media can hardly have something to offer to computational models of brain processes (i.e., models not interested in any correlation with phenomenological felt qualities). In contrast, their leading trade is on the side of experience.

Targeting cognitive experiences and processes, scientific models operate, thus a paradoxical subtraction and addition. By taking away from experience irrelevant or noisy factors, via selection and simplification, they can add something to the experience. That something is nothing less than accessibility and, if lucky, a better understanding. To narrative theorists and cognitive narratologists, this operation might remind them of the premises and promises of a structural analysis of arts and narrative. A quick detour into the structuralist roots of narratology might be the right step aside to see better from a historical distance how what I am suggesting can be linked to the – for some inspirational, for others nightmarish – debate about the possibility of a science of literature.

The comparison with sciences was a key selling point in all disciplines where structuralism was promoted. For instance, Roman Jakobson claimed that structural linguistics is "like quantum mechanics" (Dosse 53). While studying mythologies across different cultures in structural anthropology, Levi-Strauss suggested that "the kind of logic which is used by mythical thought is as rigorous as that of modern science" (Levi-Strauss 231). In structural narratology, Tzevtan Todorov hoped to set the ground for a "science of narrative" (Todorov and Weinstein 10). Saussure's dream was for linguistics to become a key player within a larger "science that studies

the life of signs at the heart of social life" (Dosse 45). Following Saussure, Roland Barthes saw in linguistics "the true science of structure" (Barthes 213).

Two passages from Barthes' foundational essay on "The Structuralist Activity" from 1963 (*Critical*) are particularly relevant to the interdisciplinary view of modeling between science, narrative theory, and fictional creators I am proposing here. In the essay, Barthes importantly links "analyst and creators" in the common practice that he calls "an exercise of structure" when he says that:

> We can, in fact, presume that there exist certain writers, painters, musicians in whose eyes a certain exercise of structure (and no longer merely its thought) represents a distinctive experience and that both analysts and creators must be placed under the common sign of what we might call *structural man*, defined not by his ideas or his languages, but by his imagination – in other words, by the way in which he mentally experiences structure (214).

What Barthes calls "exercise of structure" can be aligned with what modeling is and with what models do to their target object. The linkage between structuralist analysis and modeling via Barthes can help us add a few essential qualifiers. First, as Barthes says, a modeling activity is not only purposeful, selective, and simplifying. It is also creative, inventive, and imaginative. Here, we can already see a convergence of practice between analysts (from scientists to narratologists) and creators (writers, painters, musicians, and the list could go on). Secondly, structuralist analysis, as modeling, is a generative *activity*, not an expression of pre-existing thoughts or intuitions about a process, problem, or object of reflection. This means it is exploratory and allows forms of understanding and access that were impossible before the modeling began. Elsewhere, I have linked this "material agency" of the modeling process to contemporary theories of the extended mind (Bernini, "Supersizing"; Bernini, *Beckett*), according to which technologies (including models and creative writing) allow thinking to be extended beyond what was possible before the scaffolding coupling with technologies and practices was in place.

Thinking imaginatively in your head is a powerful activity. However, when the target is as complex as the human mind, self, and consciousness, models are powerful scaffolding tools, and modeling a unique practice or exercise of structure beyond thinkable possibilities. This is what McClelland points out about cognitive modeling when he claims, "the essential purpose of cognitive modeling is to allow investigation of the implications of ideas beyond the limits of human thinking. Models allow the exploration of the implications of ideas that cannot be fully explored by thought alone" (McClelland 16). Between pure or spontaneous thinking about a target phenomenon or experience and its extended modeling, then, something happens that opens up factors, dynamics, relations, consequences, and predictions inaccessible before. These are what Barthes calls, in another passage, the "two tenses" of the structural activity, which fitly also describes the relation between a cognitive experience and its formal modeling. This is the passage where Barthes sets up the goal of structuralist activity, very closely allied to the idea of a shared goal in modeling between arts and cognitive sciences. The passage is rich and, to the benefit of readers who have never encountered it, worth citing in full:

> The goal of all structuralist activity, whether reflexive or poetic, is to reconstruct an "object" in such a way as to manifest thereby the rules of functioning (the "functions") of this object. Structure is therefore actually a simulacrum of the object, but a directed, interested simulacrum, since the imitated object makes something appear which remained invisible or, if one prefers, unintelligible in the natural object. Structural man takes the

> real, decomposes it, then recomposes it; this appears to be little enough (which makes some say that the structuralist enterprise is "meaningless," "uninteresting," "useless," etc.). Yet from another point of view, this "little enough" is decisive: for between the two objects, or the two tenses, of structuralist activity, there occurs something new, and what is new is nothing less than the generally intelligible: the simulacrum is intellect added to object. (214–15)

The definition of models as an "interested simulacrum" is not only elegant but also striking a neat balance between an intentional, purposeful, selective, creative human modeler and the material agency of the model itself in offering constraints and possibilities as a simplified selection of core *simulata*. The detailed description of stages in modeling and of the relation between models and their target is also fitting when Barthes talks about decomposition (equivalent to modeling dissection and selection) and recomposing (i.e., simplification) for novelty to emerge. Only a misunderstanding of structuralism and modeling as a simple mimetic translation or an impoverishing simplification can misjudge the distance between an experience and its skillful modeling as uninteresting. Revitalizing such structuralist tenets – ecumenically granting modeling protocols to scientists, analysts, and creators – can do justice to what Barthes seems to claim here. Nothing more and nothing less than an interdisciplinary call to recognize how arts and science, creators and analysts, have a shared ethos, method, values, and epistemic horizon. What they all do in crafting models of the world (including of human minds, selves, and consciousness) is, as Barthes wonderfully puts it, adding intellect to an object.

Moving south from Barthes' Paris, take, for example, Cezanne's famous series of paintings of Mont Sainte-Victoire in southern France from the 1870s to 1895. Far from being a naturalistic rendition of the landscape, these paintings can be considered models of visual perception. Cezanne has detached his gaze from the mountain's natural experience and produced a structuralist analysis of this perceptual view. In doing so, Cezanne brings us beyond an immersive, natural perception to show us how perception works, structurally, even if we are unaware of this. He shows us the relations, the functions of each block and shape, and what Saussure would have called the "differential value" of each block of colors, clustering into small or larger patterns, which then become recognizable elements playing with and against each other. In doing so, Cezanne is not just giving us access to the functioning of that specific experience but also to the broader working of perception, in general, as a structured target system. Cezanne dissects perception and then creates a selective representation of its key elements that were not visible or intelligible before. Cezanne first decomposes the perception of the mountain (his target model system) and then re-creates it into a different object (the model simulacrum).

This is precisely the double movement Barthes sees as the scope and method of the structuralist activity, which we can detect in many structuralist thinkers or creators extending their investigation through conceptual scaffolding tools. They all applied their intelligence to a different object and then created a simulacrum of the object that shows its underlying laws and relations, namely, its structure as a system. Cezanne took perception as an object, then added his intelligence (his painting technology and imagination) to create a simulacrum of the natural experience, which shows the working laws of perception as a system. In linguistics, Saussure added his intelligence to natural spoken language and then created a simulacrum of it (in his case, a series of conceptual tools such as langue, parole, differential value, and functional relations). This way, spoken language reveals its non-natural, structured nature. Roman Jakobson took poetic language as a target object and imaginatively reworked Saussure's toolbox, adding intellect to the natural experience of reading poetry. The outcome is a simulacrum of the original, natural experience leading to a theory of poetry as a system with the discovery of "the

poetic function." The same did Levi Strauss, taking myths and ritualistic behaviors as an object, which, after his imaginative application of Saussure's theory of signs, can reveal universal laws and structural functioning. All these structuralist analysts and creators were conducting the same journey in and out of experience: they were taking experiences in which we are naturally immersed (perception, spoken language, poetry, myths, rituals, literary narratives, social norms, fashion, and many more) and then trying to excavate out of the apparent randomness or spontaneity a series of recurring patterns or dynamics. That is, they were modeling.

This historical reappraisal of structuralist tenets should help see how contemporary narrative theory and cognitive narratology have roots in modeling drives and procedures akin to scientific modeling. Even literary scholars beyond narratology, however, have become familiar with and benefitted from concepts like "focalization" or "duration," which were the outcome of Gérard Genette's intellect added to his experience of Proust's masterpiece (see Genette). The selectively modeled elements in Proust's novel have, as good models should do, been nourishing investigations far beyond that specific reading experience of a particular text. In classical narratology, concepts like "narrativity," "tellability," "plot," "mediacy," "figural narrative situation," "mind-style," "narrative communication," "progression," "principle of minimal departure," "experientiality," and many more (for a comprehensive encyclopedia of terms, see Herman, Jahn, and Ryan; on the overarching "model of communication levels" in narrative theory, see Schmid 34–36) can also be considered as results of modeling activity of imaginative analysts making selective and simplifying models out of a variety of narrative works.

Cognitive narratology and cognitive literary studies should be seen in continuity with this primary modeling ethos, only brought to interdisciplinary advanced possibilities. Consciously or not, most of these new approaches to mind and narrative and to the representation of mind in narrative have operated under (and paved the way for) the possibility of interdisciplinary mind modeling. To mention but a few, some narrative theorists have taken models of cognition from enactivist cognitive science and applied them to embodied dimensions in a story and its reception (see Polvinen; Carraciolo; Popova). Other scholars have taken predictive models of cognition (Kukkonen) or extended models of the mind (Anderson; Bernini "Supersizing") and applied them to the representation or recruitment of probability or extensions in literary practice and readerly experiences. Others have taken models from cognitive research on dreams to be integrated or challenged by models from narrative theory (Walsh). Pioneers like Herman use cognitive models of personality to understand characters as "model persons" (Herman, *Storytelling*). Scientific models of processes like mind wandering (Cuddy-Keane), empathy (Keen), imagination (Kuzmičová), emotions (Bernini, "The Opacity"), perception (Troscianko), consciousness (Palmer; Armstrong; Bernini, "A Panting"), and theory of mind (Zunshine, *The Secret Life*) have been carefully demonstrated to have a lot to offer to literary analysis. The modeling nature of its historical roots has a fruitful legacy in cognitive approaches to literature today, and this is why cognitive narrative theory is particularly suited as a triangulating discipline bridging scientific modeling with the fictional modeling of cognition.

Despite this wealth of careful transfer of models from science into narrative analysis (thorough to a point that can hardly be described as an interested "kidnapping"), the case for how models in narrative theory can help the science of mind still has to be forcefully made. If Herman already advocated how "both narrative theory and language theory should … be viewed as resources for—elements of—the broader endeavor of cognitive science" (*Story Logic* 2), that call awaits more contributions geared toward understanding how. I have suggested (Bernini, *Beckett*) one avenue to be for narrative theory to become the modeling discipline acting as a bridge between scientific and fictional ways of modeling cognition. Let us see how.

Mind Modeling and Exploratory Cycles

In my book, I have developed a theory of a modeling view of fiction to account for a specific author, Samuel Beckett, who – or so I have argued – innovated a usage of fictional and narratological devices as modeling tools to explore a variety of cognitive processes: from the illusory and narrative feeling of self to memory and residual inner presences; from emotions, mental imagery, and inner speech to consciousness and the mind's complexity. Beckett's work and aesthetic reflections bear explicit traces of modeling drives and procedures (chiefly the possibility of "lesioning" models of human cognition to explore what is revealed about its functioning). The theory I have developed for his work, however, had the ambition to account for different – from more radical to less evident – cases of fictional modeling of the mind. Accordingly, I have recently expanded that view to the problem of consciousness as a stream and to interlaced processes like mind wandering and inner speech (Bernini and Fernyhough), as modeled by authors like James Joyce and Virginia Woolf. I will briefly present an abridged version of the latter study on mind wandering to clarify what we should consider as a fictional modeling of the mind and how it can inform interdisciplinary mind modeling. For the economy of words, I refer the reader back to the published article for a detailed analysis of passages from Joyce and Woolf.

The science of mind wandering is undergoing a new renaissance (Callard et al.), moving away from the stigmatizing view of this process as a form of distraction toward an understanding of its ubiquity and, often, productivity in everyday human cognition. This new wave of studies is bringing forward new models of how mind wandering might work. Among these, an influential model sees it as a case of "decoupling" between perception and attention when the mind spontaneously strays away from a task toward "self-generated thought" (Smallwood and Schooler). There is more to the model, but for our purposes here, let us focus on its key, selected, and simplifying elements: its being task-unrelated, spontaneous, self-generated (i.e., not related to external stimuli), and with a neat decoupling of perception and attention. This is a capable model that seems to capture a lot: not only of what goes on in the experiential reality of the phenomenon but also of the kind of modeling of the process produced by writers like Joyce or Woolf. And yet, if we bring this model, like a cookie cutter, to a passage of *Ulysses* (1922) or *Mrs Dalloway* (1925), much is left off or over.

For instance, both Leopold Bloom and Clarissa Dalloway seem to constantly switch off and then go back to task-related thinking in their wandering trajectories (being the task of buying flowers or eating meat). In addition, both novels model mind wandering as constantly prompted and recursively going back to external stimuli (being a noisy city or the advertising of a tea company). Once a mind-wandering trail is generated, there is indeed an internal, autonomous, associative force driving the thinking of characters. However, once more, this seems tightly entangled with external factors (such as the hot day in Dublin leading to thoughts of the Far East for Bloom) or remote concerns (Bloom having to attend a funeral generating thoughts of the Dead Sea). The idea that perception is decoupled from attention in mind wandering is a powerful simplification. These literary models of mind wandering, however, are putting much pressure on the explanatory potential of such simplicity. The kind of dynamism, temporal unfolding, and recursive swing between inner and outer influences make Joyce's and Woolf's modeling a potent challenge to scientific models. Nonetheless, and importantly, it is thanks to scientific models that we can see and compare how these literary authors have decided to model the process.

The fact that these fictional renditions are more nuanced and richer than the scientific model does not mean they are not selective and simplifying. Both Joyce and Woolf make formal decisions when modeling mind wandering, although they make different ones. Joyce, for instance,

opts for exploring and formally selecting condensation of words and images in modeling mind-wandering episodes. This is in line with scientific models of inner speech, too, which stress the abbreviated nature of inner language. As a result of *Ulysses*' truncated inner experiences and verbalizing, Joyce's model can capture a dynamism in cognition that borders on a feeling of competing associative images (Hogan). This way, Joyce's modeling scores high in phenomenological accuracy but loses in narrativity (hence many readers' complaints about the novel being unreadable). By contrast, in Woolf's novel, mind-wandering episodes are modeled in a language whose grammar and syntax are closer to spoken language, thus with a higher degree of narrativity but slightly lower phenomenological accuracy. However, condensation is still something that Woolf's modeling does capture if compared to other literary models of the same process by other writers.

If we take John Fante's *Ask the Dust* (1939) – a novel where the protagonist, Arturo Bandini, is a compulsory mind wanderer and delusional fantasizer – the language of Arturo's fantasies is fully expanded in temporality and pace to exaggerated length and sentences in his wandering inner experiences. As a result, the degree of narrativity of Fante's novel is even higher than Woolf's. However, when scored against scientific models of inner speech and mind wandering, condensed decoupling, and fleeting contents, it seems to lose even more ground in accuracy. This is not due, however, to Fante ignoring his contemporary master innovators since Joyce is even explicitly mentioned in the novel as an aspirational model and modeler. Instead, the three writers create models of mind wandering and inner speech with different exploratory results. Joyce's is a model capturing condensation. Woolf strongly aims at narrative relations within thoughts and between inner and outer perceptions. Fante's lengthy and overblown wandering episodes explore instead how the contents of mind wandering impact and relate to the development or devolution of a narrative sense of self. They all, however, model mind wandering and inner speech as tightly interwoven phenomena and processes – another aspect on which cognitive science is still behind literary modelers.

We need cognitive scientific models to understand the processes these literary models target. We need narrative theory, even better if cognitively informed, to understand these modeling practices' composition, selections, and formal simplicity (which can then be compared across different writers and periods). In short, to understand concretely how literature practices modeling as an exploratory activity. The outcome of this triangulation of cognitive science, narrative theory, and fictional modeling can lead us to two crucial outcomes. First, we can understand how literature is not just a representation of cognition but an autonomous field of modeling investigation. As such, it should not be treated as an ancillary, simplified, and naively simplifying repository, archive, or record of cognitive processes (although we owe a debt to sophisticated proposals calling attention to literature as a unique "archive" or "record," for instance, by Cave's *Thinking with Literature* and Lodge's *Consciousness and the Novel,* respectively). Literature's autonomy as a field of investigative research into the mind, however, must be recognized on its own terms and activities, specific potential and limitations, before being capable of offering findings and experiential data back to scientific research. This is why narrative theory's models and concepts are crucial to making the case for literature's operational selections and *simulata*.

In addition, narrative theory can also offer a technical cross-media comparison between, say, literary and cinematic models of a process. It can bring models of narrativity or characterization and see how they can comparatively illuminate different ways of modeling mind wandering in a literary text like "The Secret Life of Walter Mitty" by James Thurber (1942) and its movie adaptation with Ben Stiller (2013) playing the hyper-fantasizer protagonist. Literature and movies have different scaffolding potential and inherent constraints when modeling. If, as Lubomír Dolêzel (*Hetercosmica*, 169–84) reminds us, all fictional worlds are incomplete

by necessity, with gaps and different degrees of "saturation," the way literature can play with incompleteness and gaps differs from movies, which applies to the modeling of mind wandering. Joyce, Woolf, Fante, and Thurber can all differently modulate – at times imperceptible, often unstable, always dynamic – swings between the coupling and decoupling of attention and perception and inner and outer perceptions. This is also due to the possibility of decreasing saturation of what we "see" through the character so that we do not know whether the represented perception is outer or inner, thus achieving a sense of layering and interaction between the wandering mind and the external world. On the other hand, movies are forced to treat mind wandering as either on or off (thus closer to some limitations in scientific models), showing us *either* wandering imagery or the context in which it happens. As a result, mind wandering feels more hallucinatory in movies or TV series, from Walter Mitty to *Scrubs* (2001–10) or *Ally McBeal* (1997–2002), than in real-life cognition. This limits the potential of film modeling to some extent.

On the other hand, film narratology (Verstraten) can chart the modeling possibilities of cinematic exploration of inner speech, where movies or TV series are, for instance, more capable than literature to model overlapping layers of external perception and inner commentary using the scaffolding technology of voice-over. However, no matter what medium they are modeling with, fictional worlds exploring cognition will always have to be selective due to the inherent incompleteness (i.e., saturation) of their ontology and phenomenological granularity. For some authors, like Beckett, this incompleteness is a modeling resource that he actually radicalized further toward the utmost modeling excavation of unprecedented selectivity and strategic simplicity. Overall, however, every fictional creator must make modeling selections, and the kind of resulting model of cognition has to be judged by what it can capture about the inner experience as much as for what it might lose in terms of experiential accuracy.

Without the space here to go into much more detail, it needs to be mentioned how the "modeling view of fiction" in investigating cognition should not be limited to modernism or the exploration of the inner mind. As Alan Palmer has influentially argued, taking mainly Victorian novels as case studies, traces of what he calls "the whole mind in action" are distributed in fictional narratives through the inner perspective of characters as well as in the information we gather about that character from the outside, including through her social interactions. Fictional narratives have been praised extensively for their capacity to be informative simulations of social worlds – a claim also validated by important empirical studies (Oatley). Fictional mind modeling has thus preempted some revolutionary frameworks in the science of mind, such as views of embodied and socially extended cognition (Herman, *Emergence of Mind*). Therefore, the view I am proposing here should be possible to extend to many more authors, processes, and target dimensions – from inner experience to external actions and, even better, to modeling of loops between inner and outer cognition.

Nor should a modeling view of fiction in exploring cognition be restricted to mimetic texts. While cognitive models are mediators between synthetic (i.e., formal) and mimetic (i.e., phenomenological) dimensions, between simplification and reality, to explore natural cognition through models, you can operate manipulations whose outcome might feel unnatural. As Lewandosky and Farrell note, "[u]nlike people, models can quite literally be taken apart. For example, we can "lesion" models to observe the outcome on behavior of certain localized dysfunction … one can do things to models that one cannot do to people, and … those lesioning experiments can yield valuable knowledge" (Lewandowsky and Farrell, 27–28). As mentioned, I have argued that this "lesioning" potential is one of the key elements of Beckett's modeling strategy to see what lesions might reveal about everyday cognition. Manipulations can include narrative works where one or more natural laws are also

violated for experimental purposes. For instance, in the recent movie *Dream Scenario* (2023), Nicholas Cage is a character who suddenly keeps appearing in people's dreams. Reversing this plot device, in John Irving's short story "Other People's Dream" (1982), the protagonist mysteriously starts dreaming past dreams of other people. Both narratives, however, are not targeting only (or mainly) dream cognition but rather selecting dream cognition as an element to manipulate in the model to explore social and identity aspects of human minds and selves. These are minimal manipulations compared to Beckett's. Yet – like Beckett's – defining them as anti-mimetic, non-mimetic, or unnatural might limit an understanding of their epistemic import in mind modeling. This said, the precious conceptual models of "unnatural narratology" (Alber, *Unnatural*) can be of great value in understanding how fictional models of physical, logical, or human impossibilities work in mind research. Does this mean that every fictional narrative should count as a model? The answer, to some extent, should be a cautious yes. I would be more inclined to say that if every fictional narrative must be assigned a modeling dimension due to its inherent selectivity (i.e., incomplete saturation), only some fictional creators make the most of this condition by purposefully pushing the modeling potential of fiction to exploratory practice.

Now that we better understand how fictional mind modeling works, how can we integrate its methods and findings into scientific mind research? My answer would be through interdisciplinary "modeling cycles." A modeling cycle describes how a model is generated, tested, and updated. As Railsback and Grimm describe it:

> Being scientific always means iterating through the tasks of modeling several times because our first models can always be improved in some way: they are too simple or too complex, or they made us realize that we were asking the wrong questions. It is therefore useful to view modeling as iterating through the 'modeling cycle'. (Railsback and Grimm 4)

They continue by naming stages in the cycle, which include (i) *formulating the question*, (ii) *assembling hypotheses for essential processes and structures*, (iii) *choosing scales, entities, and parameters*, (iv) *implementing the model*, and (v) *analyzing and revising the model*. What we have seen so far should help us understand how, individually, cognitive science, narrative theory, and the creators of fictional worlds and minds all go through some version of each stage. What is to formulate a question about cognition for a scientist, however, would be naturally somehow different from what problems in fictional cognition are pressing for narrative theorists and/or for a writer of fiction who has to build fictional minds. However, they might be close enough and getting closer when they all move to selective decisions about essential processes to investigate (e.g., mind wandering or the self) and at what scale, with which entities and parameters (e.g., local or global, human or cosmological, individual or social, how many agents or characters, with natural or unnatural laws and elements).

Even the implementation process, at the surface level the most divergent in practice, can show convergence in its core aspects. For scientific modeling, running models through computer simulations, this "is the most technical part of the modeling cycle, where we use mathematics and computer programs to translate our verbal model description into an "animated" object (Railsback and Grimm 9). In which sense is this kind of implementation described as turning a model alive? This is because "the implemented model has its own, independent dynamics (or 'life'), driven by the internal logic of the model" (Railsback and Grimm 9). The divergence between implementation in science, narrative theory, and fictional creative processes here might be thinner than it appears. Regardless of whether or not a model is run through powerful computer-based iterations (and we have seen that this is not the case for cognitive conceptual

models), it is the way implementation is described as an unleashing of an independent agency that describes something common to modeling practices across the board.

For cognitive conceptual models, animation results from "running" the consequences of the selective choices and witnessing them unfold, fueled by a dynamic mixture of logical arguments and integration of neuroscientific data. These consequences can be unpredictable before the conceptual model is animated and might force the modeler to follow the chain of conceptual animation with dread and marvel. Likewise, every narrative theorist knows well how risky and complicated the implementation of a theoretical model is even before it gets in touch and becomes animated by case studies. While "running" selective assumptions about what narrative, narrators, and characters might work, the narrative theory model might feel like independently manipulating and challenging its own elements and premises. Fictional writers are also not alien to this independent agency of the material they mold and model. If writing is a scaffolding operation that extends the possibility of the writer through the material agency of the medium (Bernini, "Supersizing Narrative Theory"), the price to pay for novelty generation is a well-studied feeling of not being in complete control anymore of the material, contents, and entities. This includes the well-studied "illusion of independent agency" (Taylor, Hodges, and Kohányi), whereby characters feel to authors like they are taking up a life of their own. This is the beauty of fictional implementation, where the model is animated to the point of feeling like it is bringing characters alive as real persons (Foxwell et al.). The agency distribution between the modeler and the model that becomes perceptible in implementation across science, narrative theory, and fictional modeling corroborates the view that modeling is a proper exploratory practice that generates novelty beyond the modeler's initial selection. In writers, the evolution of the model's agency can also be studied in the traces left in manuscript genetics (Hulle) as sediments of a distributed modeling cycle.

What is left is then to analyze and revise the model after witnessing its animation. This will lead cognitive scientists, narrative analysts, and fictional creators to their own individual cycles of revisions. Checking what works, what frustrates the hypotheses, and what elements should be included further or eliminated. This will direct each to single or multiple revisions (and, for the writers, drafts) of one or more cycle stages. The idea of iterative cycles in modeling thus captures extremely well how modeling is a process that is not just purposeful and selective but also openly creative and exposed to unpredictability – itself a marker of creativity in many reports and interviews with writers (Foxwell et al.). The modeling cycle somehow humbles the modeler and shows her the way further via its independent vitality. The coupling of a human modeler with different modeling technologies extends epistemic possibilities toward the landmark aspiration of any research, which is discovery. The closing question that my proposal for interdisciplinary mind modeling then asks is, what if we couple models across disciplinary practices, thus extending the benefits and potential of modeling cycles? By identifying modeling as a common practice in researching mind, self, and consciousness between science, narrative theory, and fiction, this chapter hopefully made its own selective simplification, allowing a possible simulation of what these extensive and interdisciplinary extended modeling cycles might look like. To operationalize this practice, however, we might need not just a new interdisciplinary framework but also actual environments for collaborative research.

Conclusion: Co-Modeling Ecologies and Operational Empathy

The chapter has argued that interdisciplinary mind modeling (conceived of as a series of looping exploratory modeling cycles) can be seen not only as a trade of models but also as a comparative and collaborative outlook on individual stages in modeling cycles. This might also

lead to a recognition of different methodological strengths. If cognitive science is solid in providing ideas on how to choose a model structure or implement models through conceptual or computer-based implementation, narrative theory might be good for analyzing patterns in fictional models. Fictional creators, instead, might be better suited to formulate original questions or unpredictable, imaginative implementations. By coupling not just finished models but also stages in individual modeling cycles, we can reach a cross-disciplinary iteration, leading to many benefits. At least three are worth mentioning briefly in the conclusion.

First, creating the possibility for interdisciplinary modeling cycles can lead us to a deeper understanding of the methodological specificity, potential, and constraints of each discipline involved in modeling cognition. This should help overcome barriers beyond problems of terminology, disclosing what we can call *operational empathy* for how other disciplines work. Second, the idea of modeling cycles retains the importance of individual disciplinary cycles running in isolation so that their relevance is not dissolved into a normative call for mandatory interdisciplinarity. Third, interdisciplinary cycles of mind modeling should unleash a distributed agency in the process without the disciplines involved having to figure out from the onset why they need each other and for what. The purpose of this chapter was to advance a proposal on the how. Building on what might already be a common practice, if unrecognized, I have suggested that an interdisciplinary mind science might proceed as a coupling of models and connectivity of cycles.

Interdisciplinary mind modeling, however, should also be conceived of as a framework calling for a coupling of people. While there are already benefits in connecting, comparing, and revisiting stages in different modeling cycles by studying different data, models, hypotheses, and implementations by multiple disciplines (as the most substantial works in cognitive narrative theory partly have already done), a more dynamic, radical, and vital coupling would take place if different disciplinary minds (Bernini and Woods) could operate in a shared environment and research ecology. This would allow deeper reflection and recursive impact of each stage across the board and, importantly, to devise new models together toward what I have called a proper "co-modeling of cognition" (Bernini, *Beckett*) on equal footing and mutual exposure. This would make interdisciplinary mind modeling a framework for active co-modeling and injection of intellect into the study of cognition. Promising signs are emerging globally; hopefully, more can be done if we have more proposals on how to connect operationally. Contingent workshops, conferences, and research seminars are encouraging starts, but what is needed might be a more stable ecology for interdisciplinary mind modeling that can host temporally extended, iterative coupling of people in long-lasting cycles of exploration. This would also allow scientists to understand that explanatory or descriptive modeling is only one kind of science that can be done and that exploratory modeling (on which see Holland) might take longer but lead to higher explanatory rewards in the long term.

Research ecologies like the "Aachen Center for Cognitive and Empirical Literary Studies" (RWTH Aachen University), the "Centre for Literature, Cognition, and Emotion" (University of Oslo), the "Diegesis in Mind" project (Baylor, St Andrews, and Bonn), the "Fiction and Other Minds" seminar (University of Oxford), the "History of Distributed Cognition" project (University of Edinburgh), the "Interdisciplinary Centre for the Study of Narrative" (University of York), and the "Literature and the Mind Centre" (UCSB) have already demonstrated long-term virtuous and vital cycles. The belief in co-modeling and exploratory cycles through longitudinal collaborative efforts will also guide the ethos and protocols of the newly established "Narrative and Cognition Lab" at Durham University. This chapter can also be considered as a manifesto of what the lab aims to achieve, implicitly working as an open call for connective cycles with centers and institutions around the globe under a shared passion for the interdisciplinary modeling discovery of the human mind.

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