Abstract: Whereas science fiction has no identity, no necessary conditions, no essence, and no timeless and universal attributes, we should not be able to recognize it. We do. Something must allow it. This article will show how recognition and learning outweigh contingent feature-based academic projects on science fiction as ends, thereby revealing the socio-cognitive frames that buttress such recognition and proposes that we consider semio-cognitive models to refine our understanding of the genre. To that end, this article shows how science fiction is a creative mode recognizable by its prototypes and the theories built thereon. Ultimately, this article promotes a means-based socio-cognitive understanding of science fiction where it is free, in a new way, from retrospective academic projects to define it by ends.

Keywords: categorization; cognition; concepts; genre; mode; recognition; science fiction

1 Introduction

Some concepts are sufficiently perceptual, not necessarily definitional. Children, for example, typically do not learn about trees in the abstract, as something completely new, for they notice and create memories of trees before learning about them. Absent definitions, people learn how to recognize ginkgo, pine, oak, palm, willow, birch, fruit-bearing, and evergreen all the same. Eventually, we develop a theory of trees that permits recognition based on prototypes obtained through perceptual experience (e.g., +plant, +vertical core, +segmented, +structured, ±green {needles, leaves, etc.}, etc.). Could recognition outweigh concepts when their definitions are seemingly impossible, restrictive, or otherwise problematic? Consider science fiction (SF), for example: it is difficult to define and too restrictive when attempted, yet, in texts ranging from the golden age (e.g., *Childhood’s End* [1953] by Clarke) to the new wave (e.g., *The Left Hand of Darkness* [1969] by Le Guin) to Chinese SF (e.g., *Remembrance of Earth’s Past*...
[2008–2010] by Liu Cixin) and Afrofuturism (e.g., *Binti* [2015] by Nnedi Okorafor), such categorical differences collapse under recognition as SF.

When we learn not through definitions but through recognition, the process employs mentally-visualizable but reality-verifiable cognitive models via prototypes and theories informed by perception. In this way, recognition of things that vary in attributes bypasses traditional learning; and, instead, consults both prototypes stored as forms, as clusters of kinds, in memory and a latent theory thereof stored as the inductive attributes that organize exemplar clustering. In short, we essentialize. What if the essence is elusive, though? That is, what if reason, reasons, and reasoning cannot reasonably reveal the essence? It should not be possible to recognize something amorphous. Yet, we do. Some common categories are so nebulous that they are property phobic. Indeed, certain imprecise concepts suffer from such catastrophic categorical failure that they are almost universally understood, to wit: autism, obscenity, and, of course, SF. People inexpertly learn to recognize autism without consulting the DSM, and Cushing (2012) has shown the definition therein harbors too dissimilar variations to be meaningful. Still, people say it is the very thing that it cannot be. People quickly learn to recognize obscenity without consulting *Jacobellis v. Ohio* (Stewart 1964), for they know it when they see it by understanding norms. Finally, people learn to recognize SF through examples, but, like autism, the units are too incongruent and often lead to misidentification. As with obscenity, they know when they see it, even if they have not. Worse, people hate or even love SF when most simply have no idea what it is. Thus, people can form extraordinary, complex, and impressionist theories with limited to no real information, yet this very essentializing process forms, paradoxically, the definition thereof: “a difference which makes a difference” (Bateson 2000: 315).

This impression gives rise to the suspicion that SF is something. Issuing therefrom, attempts have been made to describe if not define it. In a bid to lend credibility to its field of operations twentieth-century SF scholarship tried to produce descriptions and definitions. In the twenty-first century, the goal has been to determine what is not SF (Latham 2014: 1–5). Both efforts stem from an ontology committed to SF as an end. What if SF is not some thing, though? Rather than imagine either by definition or description what SF essentially is, what if, by focusing on production over product and how over what we recognize, a new understanding of process reveals something essential?

Focusing on how we learn to recognize SF could offer us insight into the genre. In this article, therefore, I argue that the cognitive work of recognition outweighs descriptive and definitional and contingent features, while, in so doing,
I show how cultural production qua learning supports such recognition. Since a cognitive model for recognizing SF bypasses feature-based efforts, the question of what we recognize, then, will be answered through how we recognize. To that end, in Section 2, I will show that there is nothing essential about SF as ends, which thereby commits SF to the productive means whereby novological\textsuperscript{1} development necessarily becomes the genre’s essential feature by default. Through this Salthean development,\textsuperscript{2} it is possible to infer that a novologically creative process encodes the estranging features in the now-evolving narratological arena to form the basis for not only the prototypes that emerge therefrom but also the theories that we build thereon. In Section 3, I will show how SF is bi-axially recognized by such prototypes, inspired by exemplars clustered in memory, and the theory that clusters the exemplars. Taken together, Sections 2 and 3 will show SF to be a recognizable mode of creation whose “predictable, irreversible change” is Darko Suvin’s cognitively estranging novum.\textsuperscript{3} SF, therefore, will be shown to be a mode of novological means, recognizably not definitionally. Thus, it is possible to save Suvin’s theory from falsifiable vulnerabilities within science fiction studies by recommitting its focus away from ends to means.

2 Discussion

Rather than verification and falsification of objects as ends, we can focus on means: how they emerge or the process by which they become. In other words, we can focus on change and transformation: how states develop and evolve. To

\textsuperscript{1} Novological: of, about, or related to the novum (nominative second declension neuter singular) that cognitively estranges the narrative. Novalogical: of, about, or related to the nova (nominative second declension neuter plural of singular novum) that cognitively estrange the narrative. Recommendations: (1) novum:nova::novological:novalogical; (2) narratology:narratological::novology:novological.

\textsuperscript{2} Stanley N. Salthe (1930–) is a semiotician who distinguishes between development and evolution. Taking inspiration from his work, development, for my purposes, will be used herein to detail how a narrative becomes generic science fiction, while evolution, in contrast, will be used to describe the narrative becomes science fictional. Development and evolution, as terms, will be explained further in Section 2.

\textsuperscript{3} Darko Suvin (1930–), in his groundbreaking \textit{Metamorphoses of Science Fiction} (1979), introduces new concepts to use when discussing SF, among which include cognitive estrangement and novum. Suvin argues that SF is “the literature of cognitive estrangement” (4) and “that SF is distinguished by the narrative dominance or hegemony of a fictional ‘novum’ (novelty, innovation) validated by cognitive logic” (63). As interpreted by Csicsery-Ronay, “The novum provides a narrative “kernel” from which the sf artist constructs a detailed imaginary alternative reality” (2011: 50). For an extensive analysis of the novum, please see Csicsery-Ronay (2011).
that Salthean end, we can understand development as “predictable irreversible change” and evolution as “the irreversible accumulation of historical information (Salthe 2003: 29–32). By focusing on the moment of irreversible change, the means/process by which something develops, rather than how it evolves as an end, creative predictability, probability, possibility, and tendency become essential to understanding. In Subsection 2.1, I will show that, since SF is often too close to the fantastic to be realistically SF, narratives can be seen to be SF but not truly be SF, which thereby must force us to privilege generic development over evolution for essential quality assignments. Accordingly, in Subsection 2.2, I will show, following others, that SF should be considered a creative mode.

2.1 What is in a name?

Of all the generic narratives, SF is the most difficult to define. Romance, thriller, and zombie narratives, for example, are not only instantly recognizable but also readily defined by their necessary conditions. SF, however, need not be necessarily scientific. The problem is that everyone recognizes SF but no one knows what it is. As remedy, critical projects on SF often begin with an attempt at or rejection of a definition coextensive with an acknowledgment of the difficulty thereof:

The obvious place to begin a Critical History of science fiction is with a definition of its topic, but this is no easy matter. Many critics have offered definitions of SF, and the resulting critical discourse is a divergent and contested field. (Roberts 2016: 1)

What is science fiction? A weird, popular genre full of spaceships, laser guns, robots and bug-eyed monsters? Fiction concerned with the impact of science and technology on human and social life, and thus the literature best suited to understanding the contemporary world? A marketing category to be avoided if a text is to be treated as ‘real’ literature? The answer is in fact far more complex. Indeed, this book is premised on the idea that there is no such thing as SF, but instead multiple and constantly shifting ways of producing, marketing, distributing, consuming and understanding texts as SF. (Bould and Vint 2011: 1)

Attempting to define SF is, in this light, complicated. It would, nevertheless, seem important that projects, like this, build an apparatus of inclusion and exclusion whereby specific texts intrinsically become its core target and others clearly not. To this end, attempts include:

SF is, then, a literary genre whose necessary and sufficient conditions are the presence and interaction of estrangement and cognition, and whose main formal device is an imaginative framework alternative to the author’s empirical environment. (Suvin 1979: 7–8)
SF is that species of storytelling native to a culture undergoing the epistemic changes implicated in the rise and supersession of technical-industrial modes of production, distribution, consumption and disposal. It is marked by (i) metaphoric strategies and metonymic tactics, (ii) the foregrounding of icons and interpretive schemata from a collectively constituted generic 'mega-text' and the concomitant de-emphasis of 'fine writing' and characterization, and (iii) certain priorities more often found in scientific and postmodern texts than in literary models: specifically, attention to the object in preference to the subject. (Broderick 1995: 155; Roberts 2016: 1–2)

A charming romance intermingled with scientific fact and prophetic vision. (Stableford, Clute, and Nicholls 1993: 311–314; quoting Gernsback; Roberts 2016: 2)

Science fiction is anything published as science fiction. (Stableford, Clute, and Nicholls 1993: 311–314; quoting Spinrad; Roberts 2016: 2)

Definitions abound and suffer from falsification. Verification, here too, tends to invite complications. For example, Suvin’s classic definition of SF as “the literature of cognitive estrangement” problematically fails to verify the most widely recognized SF, namely Star Trek and Star Wars, as SF, whereas the former relies on telepathy and godlike beings and the latter on a supernatural “force” and a ghostly afterlife, features which suggest the fantastic (Suvin 1979: 4; Freedman 2000: 19). Other famous examples of quintessential SF equally tend away from the rational. For instance, in Solaris (1961), the entity covering the planet’s surface is an almost godlike consciousness that creates gargantuan babies, physics-breaking manifestations, and memory ghosts. Better still, the popular Dune series (1965–) has genetic memory tracing into the matrilineal past that can be shared by touching foreheads among the women who can survive an overdose of the poisoned water expelled by a drowned desert worm that, when alive, excretes a waste substance that people harvest, process, then ingest for longer lives, even though considerably longer life is attainable by the God Emperor, Leto II, through wearing the larval vector of these sandworms until he can see into the future but not his death because he will eventually breed people to not be seen by oracles, among whom number powerfully-enough his now-dead father who lives in his distributed worm-brain as an ancestral memory ghost. The fantastic, unnatural, and impossible too often creep too closely.¹

¹ Including telepathy, teleportation, omniscience, omnipotence, omnipresence, time travel, black holes, wish machines, and shapeshifters, etc., certain estranging elements invite reconceptualization of related SF texts as fantastic, unnatural, nonhuman, and impossible narratives. Each non-case category (in the tractarian sense [Wittgenstein 1922]), creates an ontology (e.g., mimetic:non-mimetic:anti-mimetic [Alber et al. 2013: 102; Richardson 2016: 398]) onto which certain SF narratives might map, but how they map differs by the theorist. For
Stranger in a Strange Land (1961) or Le Guin’s The Left Hand of Darkness (1969) are not SF but Jurassic Park (1990–) is? Using theory either for verification or falsification against SF products qua ends becomes too problematic when it dispenses indispensable narratives. Nevertheless, if theory can apply to process qua means and attach to intent, then retaining Suvinean theory is as justifiable as it is advantageous. It merely requires a shift in perspective.

2.2 Mode

SF could be considered a species of the fantastic, or even necessarily fantastic (Parrinder 2001: 38), thereby short-circuiting the need to discuss fantastic complications. As analogies (Suvin 1979: 76) or descriptive metaphors (Le Guin 1979: 156–159), creative license could apply. Purists could even reject narratives with any nonzero percentage fantasy, thereby eliminating “nine-tenths of the scientific romance and pulp fantasies that most readers consider prototypes of the genre” (Csicsery-Ronay 2011: 139; after Freedman 2000: 18). SF could be framed more inclusively as the parabolic synthesis of creation and signification through “Cawelti’s work on popular formulas, Samuel R. Delany’s descriptions of science fiction’s reading protocols, Gary K. Wolfe’s study of sf icons, Joanna Russ’s ideas about sf subjunctivity, Hamon’s theory of the megatext, and William Tenn’s description of sf writers as jazz musicians riffing on one another’s work” (Attebery and Hollinger 2013: ix). Or, it could be considered historically, as a function of “production, distribution, and reception” across a “shifting set of conventions and expectations” that “influence...an intersecting but heterogeneous array of practices” (Rieder 2017: 161). Possibilities abound. Issuing therefrom, particularly for critical approaches, either Suvin’s classic example, time travel narratives can be categorized as impossible (Ashline 1995: 218) or unnatural (Alber et al. 2013: 103), while android narratives could be classified as nonhuman narrative (Shang 2022: 62). In the same way that objects can be sorted by colors and shapes differently, it is fair to say that texts can be sorted differently by incompatible generic metaphysics. A (not the) solution here is to consider how they are recognized, even so. Nova create non-case potentiality. We recognize non-case prototypes and cluster them. For some (e.g., the intended audience), certain clusters simply signify SF that would not for others. Freedman’s (2000) “cognition effect,” whereby “the crucial issue for generic discrimination is not any epistemological judgment external to the text itself on the rationality or irrationality latter’s imaginings, but rather...the attitude of the text itself to the kind of estrangements being performed” (18) where “the science-fictional world is not only one different in time or place from our own, but one whose chief interest is precisely the difference that such difference makes” (xvi) could explain how some sorting varies.
definition should remain, be revised, or be dismissed—and each potentiality comes with costs, camps, and chances, all astonishing.

I suggest that it remain, but we should frame it differently: not as a definition of things but as an understanding of the process that produces them, a matter of how not what. We should not treat Suvin’s conceptualization as a falsification device that evaluates narratological ends but as a verification device that detects attempted means: a novologically estranging process during which the narrative becomes science fictional. Just as evaluating justice based on racist judges reveals injustice to be an end fault but not an intrinsic means fault, so too does evaluating SF by narratological products as SF differ from evaluating the intentional process of SF creation. This allows the eventual narratological end of SF to deviate, by authorial hand, without altering the essential means by which it became SF: the cognitively estranging novum.5

If SF is a creative mode, then Suvin’s theoretical framework of cognitive estrangement through a novum can be classed as the process by which a narrative becomes generic SF, for “fictions and fabulations...are both processes of speculative extrapolation,” which maps to means, and, as follows, “testing to see whether they work or not, and what consequences follow from them” map to ends (Shaviro 2016: 10). This understanding connects reasonably well with Le Guin’s stance that one might read “a lot of” SF “as a thought-experiment,” for if “the purpose of a thought experiment...is not to predict the future...but to describe reality, the present world” and if “science fiction is not predictive; it is descriptive” (Le Guin 1979: 156), then creative thought-experiments are modal functions of cognitive estrangement, in that the novalogical situations of thought-experiments are estranged from reality and require the cognitive (re-)consideration of possibilities.6 In this way, “speculation,” “extrapolation,” “fabulation,” and “thought-experiments” attach to novalogical creation and “consequences,” from descriptions that inspire reflection to deviations into the fantastic, unfold afterwards. Just as an automobile factory fashions vehicles into types thereof according to a process, if the author qua driver forces the vehicle into a pond, then it is not a fault of the process engineering or the specifications thereof.

5 For Suvin, the expression of science fiction depends on the content of a novum, such that “SF is distinguished by the narrative dominance or hegemony of a fictional ‘novum’ (novelty, innovation) validated by cognitive logic” (1979: 63). The science fictional novum, then, is a narratological device that signals a break from the fiction of time and place coextensive with reality but not in such a way that the break is irrational.

6 Cognition, here in Suvin’s sense: first, “implies not only a reflecting of but also on reality;” and, second, “implies a creative approach” (Suvin 1979: 10), which again connects with Le Guin’s conceptualization of SF as “descriptive” and metaphoric (1979: 156–159).
The original intent, here, matters more than the result. Customization can void the warranty. Whereas all narratives begin at nothing and become something, the creative process to establish novalogical structures for cognitive estrangement is simply “a way of getting something done,” which is definitionally a mode (Hollinger 2014: 139–140). Mode offers a way out of verifying texts against a monolithic model by replacing it with a method: not science fiction, per se, but a “science fictionality,” after Csicsery-Ronay (2011), who argues it to be “a way of thinking about the world, made concrete in many different media and styles” to the extent that it is “essentially a style of estrangement and dislocation” that produces a “kind of awareness we might call science-fictionality, a mode of response that frames and tests experiences” (ix–2), which, through the dialectic of cognition and estrangement “[allow] us to not only recognize the world of the story but also to see it as strange, prompting creative understanding and critical reflection about the difference between the text’s world and our own” (Vint 2014: 38). Thus, we develop a theory of science-fictionality: modes of creation and interpretation dancing dialectically.

Considered this way, science fictionality and creation thereof qua mode not only frees SF from structural attempts to entirely define it extrinsically (as something) but also commits it to the realm of individual responses intrinsically within social production (as the work of something [i.e., a process]). When experiencing a generic narrative recognized as SF, therefore, we are not noticing the current presence of modus operandi but the earlier science fictional moves thereof (qua Salthean development) previously executed within the generative phase of a narratological enterprise. In other words, we recognize the novalogical elements qua prototypes that commit the narrative to the SF genre faster than the possible fantastically derailing deviances thanks to our culturally-tuned theory of SF. Simply, the estranging elements execute signifying structures faster than the plot. To the extent that SF narratives are not only “different in time and place from our own” but also primarily explore “precisely the difference that such difference makes” (Freedman 2000: xvi; quoted in Vint 2014: 49), this must be the case (i.e., the process of creation foreruns the process of exploration). Thus, when Suvin suggests that “SF is, then, a literary genre whose necessary and sufficient conditions are the presence and interaction of estrangement and cognition, and whose main formal device is an imaginative framework alternative to the author’s empirical environment” (1979: 7–8), nova become the modal arenas in which cognition and estrangement both present and interact. In this way, when how signals differently than what the difference of the difference attaches to what and the “difference which makes a difference,” that is, information (Bateson 2000: 315), attaches to how. As follows, when categorizing texts ranging across time, say, from the golden age to the new wave
to now, comparisons become possible because of differences that attach to “what” (e.g., voyage, militaristic, identity, economies, genders, race, etc.). However, viewing from “how” collapses differences into prototypes (e.g., bifurcations of setting, timing, technology, population, etc.) of alternative frameworks.  

The ontological commitment to arena over operations therein, means over ends thereto, possibility over authorial actualization thereof runs so counterintuitively against how we would traditionally verify generic texts that there must be a reasonably persuasive reason therewith: the recognitional elements (namely, prototypes, exemplars, and theories) emerge only from a creative modality of estrangement through development as functions of predictability and irreversibility. If prototypes and theories allow us to recognize SF as SF, then we are relying on the modalities that give rise thereto and the cognitive frames (Berlatsky 2009; Lakoff 1987, 2014) we build thereon. Since SF is recognized, considering, we have an opportunity to imagine new possibilities for conceptualizing estranging aspects of the genre through neuroscience more than a singular understanding of cognition, “a process that interprets information within contexts that connect it with meaning” (Hayles 2017: 21).

3 (Re)Cognition

If experiences inspire the production of beliefs, knowledge, and recognition then there must be a causal mechanism to produce mental states whose reliability would depend on whether it allows for discrimination or differentiation (Goldman 1988: 43). As follows, one would obtain “perceptual knowledge if and only if not only does [one’s] perceptual mechanism produce true belief, but there are no relevant counterfactual situations in which the same belief would be produced via an equivalent percept and in which the belief would be false” (Goldman 1988: 59). Relatedly, recognition of concepts works to “enable us over time to accumulate

7 What happens when the consequences of this theory are applied to texts? Take Star Trek: Deep Space Nine (1993–1999) and Babylon 5 (1994–1998), for example: both have militaristic tendencies and both transpire on space stations, yet many of their cognitive estrangements derive from colonialism and good versus evil/bad, respectively, while their novalogical settings, timings, technologies, and populations allow for the stories to unfold enough for their cognitive estrangements to present and interact. Interestingly, while both are recognized as SF, their plots pivot on extraordinary beings of supernatural ability, yet their novalogical arenas and pre-deviational estranging elements allow for their recognition. By sidestepping definitions to study understandings, change focus from what to how, we can see SF recognized by people who do not share, create, maintain, or know formal definitions.
practical skills and theoretical knowledge about these substances” (Millikan 2000: 2) to produce beliefs about them. To the extent that one recognizes SF as SF, there are at least two implications: (1) at the moment of such recognition, one must (a) presently commit cognitive resources to the present narratological experience, and (b) have previously committed cognitive resources to store its generic parameters in memory; and, (2) one must reason that his or her current narratological experience (1a) in some way coheres qualitatively, phenomenologically, with experience (1b). Recognition of SF (Section 3.1) is possible, therefore, if and only if a subject reasons that the perception of an experience of a narrative coheres truthfully with a socially indexed8 cognitive prototype of SF that was previously experienced and learned (Sections 3.2 and 3.3) in the same generic episteme (after Foucault).

In other words, recognition of SF must be coextensive with an established cognitive model or theory of SF. Yet, SF has no necessary definition, description, or stable identity. This places SF in an odd position: to be recognized without possessing what it should take to be recognizable. This leaves us at an impasse. To move beyond the complication, the proposition that SF does not have what it takes to be recognized must fall, and to the extent it is recognized, this would have to be the case. It follows that there must be a socio-cognitive mechanism that functions like other recognition mechanisms, thereby allowing for the recognition of SF without depending on definitions, descriptions, and identities. Over the following subsections, I outline such a cognitive architecture of recognition (Section 3.1) and advance a cognitive model of SF (Section 3.3).

### 3.1 Cognitive architecture of recognition

Recalling the previous section, the moment in which recognition occurs must rely on an operation of (1) and (2) in which (2) returns a truth value. Such an operation suggests that there must be a framework controlling the operation. In other words, recognition is a superior cognitive function with two subordinate operations. Accordingly, I proceed from the notion that the operation of recognition is a supervening function of cognition. This commitment requires recognition to establish a cognitive framework to structure, sustain, and carry out its

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8 The social index, particularly suited for recognition, is an appeal to Peirce’s proposition that: “A proper name, when one meets it for the first time, is existentially connected with some percept of other equivalent individual knowledge of the individual it names—only then is it a genuine index. The next time one meets with it, one regards it as an Icon of that Index. The habitual acquaintance with it having been acquired, it becomes a Symbol whose Interpretant represents it as an Icon of an Index of the individual named” (Peirce 1958: 2.329). This can be equally extended to concepts, like SF, where icons represent an index of the concept being named.
operations. Toward that end, recognition can be seen, functionally, through a
cognitive architecture, where such semiotically model mental states as systems
and “theories of cognitive architecture” explore “the nature of the basic structures
and processes involved in cognition” (Aizawa 2007: 172). For my purposes, I
contend that Durst-Andersen’s semiotic model best represents mental states of
recognition, in that: “first you have a perceptual input, then you get a cognitive
intake by involving background knowledge and finally you end up by having a
perceptual-cognitive outcome,” which maps to three states: input (“the stage of
experience”), intake (“the stage of understanding”), and output (“the stage of
storing”) (Durst-Andersen 2011: 66). In this way, recognition is an inferential
mental state—an atomic thought proposition (outcome) that is precipitated by a
sensorial, perceptual experience (input) that is cognitively reasoned to be identical
to, similar to, or typical of a previous perception (intake), as seen in Figure 1.

![Recognition model](image)

**Figure 1:** Recognition model.

This occasions two orders of organization—(1) a superior framework
buttressing and eventually combining (2a) and (2b) into a new mental state,
(2c [recognition]), in this case, reason; (2) a subordinate series of mental
states where (a) the first processes the present perception, (b) the second executes
a recall function exploring the memories of past of perceptions, and (c) if the recall
function is successful, then recognition, else it is unrecognized.

### 3.2 Modeling concepts

Across cognitive science, scholars have developed various theoretical ways to
structurally model concepts, including the following, which attach to SF in the
following ways explored in Table 1.
Table 1: Concept models.

| Theory          | Discussion                  |
|-----------------|-----------------------------|
| **Classical Theory** | SF is X or has the necessary condition Y. |
| Concepts are definitional, decompose, and are held in mental states by their necessary and sufficient conditions (Margolis 1999: 549; Margolis and Laurence 1999: 8–10, 2007: 191, 2021; Komatsu 1992: 500). | **Complications** Definitions are not futureproof. Top-down rejection of a casual, public SF. Widely-recognized SF fails the definition of cognitively rational science fiction, from telepathic abilities and telekinetic powers to omniscience and omnipotence. “There’s nothing scientific about this fiction.” **Analysis** While SF can be recognized through definitions, deviation that should lead to disqualification paradoxically does not. **Evaluation** Reject. The public does not read genre theory. Cultural production works against a definition of SF closely held by scholars. |
| **Prototype Theory** | SF has X tendencies. |
| Concepts are not definitional; rather, they are held in statistically calculated mental states of probability, typicality, and tendency against the sufficiency of the constituents encoded as properties (Landau 1982; Margolis and Laurence 1999: 27, 2007: 195–196, 2021; Rosch and Mervis 1975). | **Complications** Genre betrayal, bends, and blends. Fast discernment might be inadequate. From revealing a supernatural aspect to the impossible twist ending, what might feel at first like SF can eventually and surprisingly morph beyond it well after being quickly recognized. “That’s no moon.” **Analysis** While SF can be recognized through impression, quick thinking might too generously categorize. **Evaluation** Reject as standalone theory. Retain in dual theory. Cultural production allows for quick recognition of narratives, but further evaluative means are sometimes required for categorization. |
| **Theory–Theory** | SF has essential qualities X or hidden properties Y. |
| Concepts are held in inferential, explanatory mental states that almost scientifically test theories against essential properties, descriptions, and the roles of these concepts in | **Complication** Theories fail without enough experience. Slow |
Table 1: (continued)

| Theory | Discussion |
|--------|------------|
| relation to others (Margolis 1999; Margolis and Laurence 1999, 2007: 198, 2021; Murphy and Medin 1985: 290). | discerrment. From insane computers to amorphous space monsters, the permutations would be astounding and the genre blends compromising. “You’ve gotta be kidding me.” |

**Conceptual atomism**

Whereas the earlier models imagine concepts structurally or decompositionally in relation to other concepts, conceptual atomism denies concepts structure and relation to other concepts by proposing that mind-world relations determine the content of concepts (Margolis and Laurence 1999: 60–62, 2007: 202–205, 2021).

**Theory**
SF is determined by how X is sustained in one’s mind by the world.

**Complication**
Anything can be SF if learned as SF. While learning SF by its exemplars would be ideal, learning SF to be either SF/Fantasy or SF/Action from stores or coming to understand SF as comic book superheroes from popular culture might not be. “You’re looking for alien abduction horror? Okay, science fiction is on the action/fantasy shelf.”

**Analysis**
While SF can be recognized through history, imprecision from mistaken transmission might lead to miscategorization.

**Evaluation**
Reject as standalone theory. Retain as a vehicle to supplement theory–theory through categorical exemplars. While cultural production allows for mind-world relations to promote learning SF through examples, clusters of examples can aggregate into a theory (e.g., trees).

**Theory**
SF is quickly identified and carefully confirmed, either sequentially or simultaneously.

**Complication**
Identification procedures can be vague, and
Each system has its advantages and disadvantages, but I submit that the dual theory carries the greatest potential for recognizing SF because it can rely on both (prototypical) fast impressions and (theoretical) reasoned considerations supported by real-world relations. After a fashion, while certain features of a hotel key direct you to which hotel the key belongs (qua prototypes), only the right notches and ridges against the right pins will open the right door (qua theory). This approach allows the public and scholars to recognize (or reject SF) either culturally or formally. Ultimately, though, it democratizes and personalizes one’s

Table 1: (continued)

| Theory                              | Discussion                                      |
|-------------------------------------|-------------------------------------------------|
| procedure” (such that certain information leads to rapid categorization) and a “core” (such that certain information ties to references and thoughts). For example, prototype theory could serve as the identification procedure while theory–theory could serve as the core (Margolis and Laurence 1999: 33 and 46, 2007: 197; Murphy 2002: 25; Osherson and Smith 1981: 57; Smith and Medin 1981: 20). |
| cores can be inadequate or imprecise. “Trust but verify.” |
| Analysis                            | While SF can be recognized through similarities, stronger or measured consideration is often warranted. While a fast calculation might determine that a narrative looks realistic, a theory might falsify it as SF. Likewise, a fast calculation might determine that a narrative looks like SF, but a theory might falsify it as fantastic. |
| Evaluation                          | Retain. Only the dual theory can moderate our quick categorization with deeper discernment. |
| Family resemblance theory          | SF can be X if X looks similar enough to SF like Y and Z. |
| Complication                        | Genre betrayal, bends, and blends. Including parodies and the supernatural, what might be seen as close to other SF might not truly be. “Hear me out: Zombies, but on Mars.” |
| Analysis                            | While SF can be recognized through impression, resemblances might lead to mis-categorization. |
| Evaluation                          | Reject as standalone theory. Cultural production allows for us to observe similarities, but resemblances do not socially baptize authenticity. It could be available as a supplement to exemplar clustering. |
knowledge of SF, whereafter people can recognize SF, whether it deviates from academically classical definitions, as ends, while relegating the productive means that created it to verification and criticism.

### 3.3 Modeling SF as a recognizable concept

Section 3 first builds a cognitive architecture for recognition then builds a cognitive model of concept recognition. Both systems must now functionally be joined for the recognition of SF as a concept to work. Whereas recognition is an inferential mental state precipitated by a sensorial, perceptual experience that is cognitively reasoned to be identical to, similar to, or typical of a previous perception, to the extent that recognition of concepts is possible, and to the extent that both models can be represented structurally, they could be integrated. This subsection merges the cognitive architecture of recognition (Section 3.1) with the two cognitive models of concepts that work with SF (Section 3.2) to structure recognition of SF.

Just as the cognitive architecture of recognition scans the past for an encounter with the experience engaged in the present, so too do we see the reliance on the past for cognitively modeling concepts. There are enough common features for a shared structure to recognize concepts between models of recognizing and concepts such that I can map both onto the same cognitive architecture for recognizing SF in Figure 2.

One cognitively models then recognizes SF qua concept through experience. First, one must encounter SF that is sustained through a mechanism to learn it as a narratological category, whereupon one stores it in memory as an exemplar of SF. Second, one must again experience SF, whereupon its probability, typicality, and tendency to the previous perception contribute to and are quickly assessed against the emerging prototypes built on the exemplars experienced, while, simultaneously, the same exemplars contribute to and are measured by a newly coalescing theory of SF qua frame (Bowman and Zeithamova 2018: 2612; Grishakova 2009: 189; Medin and Schaffer 1978: 209; Murphy 2002: 74; Nosofsky 1988: 707; Rosch and Mervis 1975: 574). This process, of course, follows the Salthean model of development and evolution, such that predictability attaches to prototypicality, irreversibility to learning, and the accumulation of historical information (qua Batesonian difference) to the theoretical. The model will continue to refine the prototypes and the theory based on experience, whatever the modality (Bauer and Just 2019: 531; Musz and Thompson-Schill 2019: 565), naturally through clustering, for: (1) the more frequent the encounter with a category, the more we learn “about its members, including about their perceptual
properties” (Weiskopf 2015: 241), which aligns with our understanding of the interplay between the fast perception of prototypes, nonconscious cognition, and cognition to the extent that “the processes nonconscious cognition uses to discern patterns are constantly in motion, reaching metastable states as patterns are discerned and further reinforced when temporal matching with the reverberations between neural circuits cause them to be fed forward to consciousness” (Hayles 2017: 24); and, (2) tying into Peircean semiosis and the theory–theory, “Sf images become iconic through repetition” (Attebery 2013: 9). SF is, thus, learned through recognition. To reinforce the foregoing ways in which SF is learned to be recognized the following section addresses how learning models align with concept theories.

### 3.4 Learning categories through models

Across cognitive science, scholars have developed various theoretical ways to model how concepts are learned structurally and through which areas of the brain, including the following, which map to the foregoing theories and attach to SF in the following ways explored in Table 2.

Just as the recognitional model requires a dual theory for prototypes and theory, so too does learning the concept of SF require the same, which only suggests the clustering model. It is, therefore, most likely that we learn SF in the same way we learn trees without definitions: prototypes through exemplars. To the extent that prototypes and exemplars activate multiple systems, then for our purposes, the clustering model should be seen, *ipso*
Table 2: Learning models and cognitive neuroscience.

| Learning models          | Cognitive neuroscience                                                                 | Discussion                                                                 |
|--------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| **Rule-based models**    | **Prefrontal cortex**                                                                   | **Concept theories**                                                         |
| In these models, category | The prefrontal cortex supports “rule-based category learning,”                          | Classical, Theory–Theory                                                    |
| determination is based   | by leveraging working memory “to support maintenance of rules and new hypothesis      | **Evaluation**                                                               |
| on logical rules that     | testing,” but it is “better viewed as supporting rule-based reasoning during          | Likely activated either during scholarly activities whereby one learns SF |
| are discovered through    | category learning than as a dedicated category learning system”                       | definitionally or when supporting the development of theories.              |
| a rational hypothesis-   | (Love 2013: 343–345).                                                                 | **Implication**                                                             |
| testing procedure” that   |                                                                                       | Recognitional Support                                                       |
| satisfies “all of the    |                                                                                       | **Mechanism**                                                              |
| positive examples of a    |                                                                                       |                                                                             |
| category, but none of the |                                                                                       |                                                                             |
| negative examples of the  |                                                                                       |                                                                             |
| category” (Love 2013:     |                                                                                       |                                                                             |
| 343–345).                 |                                                                                       |                                                                             |
| **Prototype-based models**| The occipital lobe processes prototypical visual information                            | **Concept theories**                                                         |
| In prototype-based models, | involved in “implicit learning (i.e., learning without awareness)” but is limited to | Prototype, Family Resemblance                                               |
| category determination is| a single prototype extraction, not discrimination, thereby suggesting it “better     | **Evaluation**                                                               |
| based on a summary of     | viewed as a perceptual priming system than as a general mechanism for acquiring       | Likely activated as a recognitional assistant during the normal course of   |
| representatives, an average| category knowledge” (Love 2013: 351–352).                                             | social production.                                                         |
| of properties and members (Love |                                                                                       | **Implication**                                                             |
| 2013: 345–347).          |                                                                                       | Recognitional Support                                                       |
| **Anterior hippocampus** | Since “the anterior hippocampus…[supports] novel decisions based on generalized     | **Mechanism**                                                              |
|                          | representations abstracted across experiences” and since “exemplar models generally   |                                                                             |
|                          | predict better classification of old items” (Bowman and Zeithamova 2018),            |                                                                             |
|                          | prototypes (inspired by exemplars) attach to the hippocampus through memory. It       |                                                                             |
|                          | might not do so alone, though, for both the “ventromedial prefrontal cortex and      |                                                                             |
|                          | anterior hippocampus” have been shown to “[track] abstract prototype information”     |                                                                             |
|                          | (Bowman et al. 2020).                                                                |                                                                             |
Table 2: (continued)

| Learning models          | Cognitive neuroscience                                      | Discussion                                      |
|-------------------------|------------------------------------------------------------|-------------------------------------------------|
| **Exemplar-based models** | Striatum and midbrain dopaminergic areas                   | Concept theory                                  |
| Whereas prototype-based models store the average of a category, exemplar-based categorizations are based on all training instances such that similarities, differences, prevalence, and substructures are retained for calculation (Love 2013: 347–349). | The caudate nucleus supports procedural learning through corrective feedback in pertinent circumstances (Love 2013: 352–353). Nevertheless, it also “stores the gradual accumulation of knowledge regarding stimulus–outcome associations, integrated over many trials.” Generally, “the basal ganglia are specifically necessary for learning of associations” and “in particular, have been linked to probabilistic category learning in humans” (Shohamy et al. 2008). | Atomism, Theory–Theory Evaluation Likely activated as a recognitional assistant during the normal course of social production. |
|                         | Inferior frontal gyrus and lateral parietal cortex         | Implication                                     |
|                         | “The inferior frontal gyrus and lateral parietal cortex tracked specific exemplar information” (Bowman et al. 2020). | Recognitional Support Mechanism |
| **Clustering models**   | Medial temporal Lobe                                       | Concept theory                                  |
| As a compromise between the prototype- and exemplar-based models, cluster-based models suggest that categorization is based on distributive clusters of instances such that regularity tends towards prototypes and irregularity tends towards exemplars (Love 2013: 349–350), the latter of which “are organized according to their similarity on the most relevant features” (Mack et al. 2018: 32). Moreover, recent research has also shown that “under some circumstances, both prototype and exemplar representations may be apparent within the Medial temporal Lobe stores and retrieves memories and facts, “each of the major fixed representational forms (e.g., rules, prototypes, exemplars) [have] been ascribed to the function of the MTL by different groups of researchers,” which parallels the contextualization of clustering learning models (Love 2013: 353). | Dual Theory Evaluation Likely activated as a recognitional procedure through the normal course of social production. It is also likely activated in the active learning course of social production (i.e., upon reflection, questions, and teaching). Moreover, the role of the hippocampus in memory must not be undervalued in learning and recognition. |

**Implication**

This is most likely the recognitional mechanism for SF, such that the Dual Theory of Recognition (Section 3.3) for
facto, as a multiple systems model. Thus, when we say that SF is cognitive, that it is through cognition that we view SF, we must remember that multiple systems are activated by learning SF and that, beyond cognition, we also have recognition. When we socio-cognitively learn SF by its exemplars and the prototypes that emerge from estranging nova and the theories we build thereon, we learn SF through multiple pathways that connect through and to the hippocampus. The related systems track and process visualizations, contexts, rules, exemplars, prototypes, and clusters. We need not exclusively look to SF’s narratological ends to discuss cognition. Indeed, we can, instead, discuss novalogical excitement across multiple systems of consciousness (after Hayles 2017). Thus, while we learn SF through prototypes, which are supplemented by exemplars that cluster to permit a theory to develop that we can summarize into features—howsoever humanly imprecise, imperfect,
and individualistic—it is not only the domain of cognition any more than trees could ecologically be the forest.

4 Conclusion

The deliberation of a jury, the distribution of a vaccine, the electoral college, obtaining state secrets, destroying enemy ships, the bomb, and the coup d'état: real power lies in the means. The paradigm need not be success/fail but intent/deviance. This is not to say that ends never matter but that structuring structures—through the predictability and irreversibility of development qua means—shape outcome containers, frames whose significance (Anderson and Merrell 1991: 3) can only attach to process when the evolutionary deviation is profoundly immeasurable. In this way, power and process are entangled with the production of ends such that creation, destruction, control, or discipline qua outcomes can only ever be secondary to the technologies thereof, for means achieve goals. Thus, the means, motive, and opportunity to write SF matter more than the possibly fantastic ends of the not-so-dead author tried in absentia.

This article considers whether our conceptualization of SF could be changed by considering how we recognize it. To that end, it questions the ontological investment scholars might make in the genre as a collection of ends. The project disabused us of any idea that SF can be described, defined, detailed, or have any necessary or sufficient conditions, parameters, or properties. This posed two problems: how do we recognize it, considering; and, what are we essentially recognizing, then?

In the introduction, I promised to show that what we recognize will be answered through how we recognize SF. To that end, in Section 3.4, I relayed how certain learning models tie to certain areas of the brain. Since SF has certain qualities that do not execute only one learning model, multiple models and brain areas are required. One area of the brain was shown to have the capability for multiple pathways thereinto coextensive with the capability of memory storage and retrieval, but in a way that did not exclude the other areas of the brain required. This combination, retrospectively, can only tie to the cognitive architecture articulated in Section 3.3, in which the recognition of SF is dependent upon memory storage and retrieval for prototypes and the exemplars that form the basis for theory. Likewise, this recognitional capability, retrospectively, depends on a dual theory of prototypes and theory–theory as articulated in Section 3.2, which mirrors the dual theory in Section 3.4. Thus, Section 3.3 has both upstream and downstream articulations with
dual theories dependent upon prototypes and theory–theory. If how we recognize SF is through prototypes and theories, then what we recognize is the presence of prototypes subject to the generic intent of their creative modality. The complication that their presence can, at times, too closely approach if not reach the fantastic is mitigated by relegating their unproblematic emergence to Salthean development (qua means) and fantastic complications to evolution (qua ends). The way in which science fictional prototypes present is by and through a creative mode whose “predictable, irreversible change[s]” are cognitively estranging nova. Individually, recognizing science fictionality is function of how closely prototypes developmentally attach to cognitively estranging nova for a theory to register if not verify their proximity to exemplars. This is not a definition; this is an understanding: people learn to recognize SF by assigning essence to clusters of prototypical and theoretical feature summarizations when creative modality is the only reasonable option.

The SF scholarly discourse community will continue to have scholarly definitional and descriptive disagreements over means and ends. Others, some famous, some dead, and some both would be opposed to the foundations and treatments proposed herein. There are hundreds of citations that, in turn, cite thousands of others in cognitive science; that I found one way through the labyrinth does not mean that there are no other shorter, elegant, better, or novel alternatives. It is my hope that future work in neuroscience, from brain imaging to learning models, will have considerable bearing on the future of this topic. Until then, I encourage readers to keep noticing how SF develops before it evolves and how the people around you recognize it, even so. What prototypes emerge? Better yet, which SF narratives do you no longer recognize?

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