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Signs and Cognition: A Peircean and Suvinian Reading of *Story of Your Life* and *The Lifecycle of Software Objects*

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ABSTRACT

This article combines Charles Sanders Peirce's semiotic theory and Darko Suvin's cognitive estrangement theory in an analysis of signs and cognition in Ted Chiang's Story of Your Life and The Lifecycle of Software Objects. This article contends that this blended approach will allow for new insights into the interpretation of signs and meanings in science fiction texts. Pursuant to this, this article analyses the ways in which novum may be found in Chiang's text through the interaction of representation, object, and interpretant, to trigger the cognitive estrangement of the implied readers and reshape the implied readers' understanding of time, language, and ethical issues. In Story of Your Life, the nonlinear view of time displayed by Heptapod B as a written system is the embodiment of the multiple meanings of language as a sign, the dynamic nature of the interpretants, and the deep connection between language and time perception; while Suvin's novum is a valuable tool in unearthing the ways in which language as a sign instigates defamiliarization, which triggers a rethinking of human time perception. In The Lifecycle of Software Objects, the digients exist as signs of novum, which not only challenges the traditional definition of life and subjectivity, but also shows the complexity of technological ethics through the interaction of signs. At the same time, Peirce's three categories of signs (a meaning-generating system, including Firstness, Secondness and Thirdness) provide a stronger scaffolding to explore the connection between the digients as technical and emotional signs. The interdisciplinary perspective of this article provides a new path for science fiction studies, revealing the ways in which the meaning of signs and cognitive estrangement reflected in Chiang's two stories work together, enriching the implied readers' understanding of the becoming of the meaning of signs and cognitive experience, and influencing the implied readers' deep thinking on language, cognition, technology and ethics.

Keywords: signs; cognition; semiotics; artificial intelligence; Darko Suvin; cognitive estrangement

INTRODUCTION

Ted Chiang's works have attracted much attention for the amalgamation of language and technology while having profound philosophical connotations of exploring future technology and the meaning of human existence. *Story of Your Life* and *The Lifecycle of Software Objects* are among Chiang's many works that not only show his imagination of the future, which depicts the panic caused by the arrival of aliens or the social problems led by the changes in market demand and capital support of a virtual world, accompanied by the rapid development of virtual technology. Chiang's works also demonstrate the profound impact of a language on humans and the exploration of the complex ethical relationship between technology and human emotions. These two works respectively construct a complex world of signs juxtaposed against tensions between human and non-human entities. The nonlinear language of an alien species based on acausal time perception

in *Story of Your Life* is a sign, and the virtual life of Artificial Intelligence (the digients) in *The Lifecycle of Software Objects* may also be read as a sign through the perspective of Charles Sanders Peirce's semiotic theory. In recent years, Peirce's (1839-1914) semiotic theory has been widely applied to the understanding of signs and their meanings in multiple disciplines such as political and cultural research (Sjoraida et al., 2024), linguistic research (Sopian et al., 2022), literature and art (Putra & Riana, 2023; Rizky & Suparti, 2023), and film (Hassan, 2023; Tang & Zhang, 2023). Peirce's triadic semiotic model includes representation, object, and interpretant, which is an important tool for revealing the dynamic becoming process of language and meaning, to interpret complex signs and cultural phenomena (Hassan, 2023). This article connects Peirce's triadic model with Darko Suvin's cognitive estrangement theory. Suvin's theory of cognitive estrangement takes "novum" as the core and uses the unfamiliar method of cognitive estrangement to guide the implied readers to reflect on reality (Suvin, 1979). Although the two theories have their own foci, they are significantly complementary in revealing the ways in which signs in texts affect cognitive changes. Peirce understands the meaning of interpreting signs from a more microscopic perspective, while Suvin explains how meaning affects the changes of cognition from a more macroscopic perspective. By inducing cognitive estrangement based on the novum of signs, this article re-examines the relationship between language and time, and the relationship between technology and humans, to break through the binary opposition. Although there are some existing studies on Chiang's science fiction narrative (Butter, 2023; Ferrández-Sanmiguel, 2023; Slusser, 2022; Zhang, 2022) and technological ethics (Ahn, 2020; Choi & Vasudevan, 2022; Kang, 2021; Loftsdóttir, 2023), there still exists a lack of in-depth research on the ways in which a semiotic reading of Chiang's work may demonstrate the implied readers' cognitive estrangement and how this leads to cognitive transformation. Furthermore, the structure provided by Peircian semiotics will empower a Suvinian reading of Chiang's texts by concretising the novum.

To further clarify the system of signs in Chiang's works studied in this article, as well as the changes of cognition the signs trigger, this article conducts an analysis of Chiang's *Story of Your Life* and *The Lifecycle of Software Objects* based on Peirce's semiotic theory and Suvin's cognitive estrangement theory. These two texts convey complex cognitive experiences through signs and guide the implied readers to reflect on reality through defamiliarisation. It is expected that the article will provide a novel interdisciplinary perspective for a semiotic study of science fiction, thus better revealing the ways in which Chiang builds a bridge between literature and philosophy through signs and novum. As Norbasudi and Rosman (2025) observe, speculative fiction "has gone through multiple and rigorous revisions on its definition" in their quest to discover the "reconciliation point" of various polarising debates (p.117). Suvinian cognitive estrangement has been a focal point of some of those theoretical debates concerning the genre, and this article offers an alternative way of engaging with his theory through Peircian semiotics.

In *Story of Your Life*, Heptapod B is both a system of signs and a manifestation of the novum of the text. The narrative not only challenges the characters' understanding of time in the text but also forces the implied readers to rethink the relationship between language and cognition. The interpretant of signs is not only a narrative element within the text, but also a repositioning of the implied readers' own experience during the reading process. When facing an estranged but logically self-consistent system of signs, the implied readers need to gradually adapt to and understand the new world constructed by the text through continuous interpretation and reasoning. In *The Lifecycle of Software Objects*, the digients are AI pets who evolve into 3D entities when they are downloaded into robotic interfaces. Their existence creates a bridge between humans and technology, and the novella deals with the growing attachment the human characters have with the

digients. These digients develop autonomous consciousness and form social relationships in a virtual environment, thus instigating musings on the concepts of life, subjectivity and free will that can be read through the lens of cognitive estrangement. Suvin's theory of cognitive estrangement strengthens the cognitive effect of signs through the estrangement of novum, forcing the implied readers to look at the meaning of signs from a new perspective. This article analyses cognitive estrangement through the lens of Peirce's semiotic theory to interrogate the ways in which science fiction texts construct the structures of signs in narratives to make them recognisable. By utilising Peirce's triadic approach to semiotics to expand Suvin's cognitive estrangement theory, this article further explores the ways in which these signs impact implied readers on the cognitive level and prompt them to establish new ways of understanding. The combination of these two theoretical approaches fills the gap in the previous interpretation of these two texts from this new perspective.

LITERATURE REVIEW

The function of language in Chiang's works has been the subject of some academic inquiry. For example, Han and Zhang (2024) used the incident of linguists acquiring language from aliens in *Story of Your Life* to provide the groundwork for the application of cross-language theory, emphasising the importance of language in cognition. Noletto and Lopes (2020) conducted a comparative study of *Story of Your Life* and its adapted film, highlighting the function of language and its profound influence on cognition. Roscoe (2023) studies the impact of language on cognition and perception. Sutton (2017) explores and expands Wittgenstein's philosophy of language in Chiang's science fiction *story "The Story of Your Life*". Chiang's *Story of Your Life*, which emphasises the intricate connection between language, communication, and personal identity, has a special relevance that Slusser (2022) examines. These existing studies demonstrate the ways in which the novella's main topics are explored through the use of language as a symbolic carrier and a narrative instrument.

Philosophical thinking, as well as science and technology ethics, have also been the focus of scholars. Researchers such as Torras and Ludescher (2021) place Chiang's works in the discussion of science and technology ethics, especially *The Lifecycle of Software Objects*. Torras and Ludescher (2021) deeply analyse the complexity of the relationship between artificial intelligence and humans, especially in regard to reading texts that combine ethics, technology, and language. Within the context of consciousness, Artificial Intelligence and ethics, it is important to note that the AI depicted in Chiang's *The Lifecycle of Software Objects* should not be seen as similar to Generative AI and LLMs. Chiang (2026) in a groundbreaking essay for The Atlantic speaks unequivocally when he says that Generative AI is "harmful enough when we understand it as a conventional technology" and therefore one should not confuse "fluency at generating text with consciousness or moral agency" to chatbots (par. 3). Therefore, the philosophical and moral ramifications of LLMs and Generative AI in the present day should be differentiated from the models of Artificial Intelligence represented by the digients in *The Lifecycle of Software Objects*. Chiang's (2026) essay is also important in relation to the novella because he outlines the ways in which he construes how programs can be rated for consciousness. He writes that "desires and emotions are necessary for consciousness, as well as an "embodied agent that could navigate its environment in order to survive as well" as sentient beings (lizards, iguanas), for starters (par.13). Certainly, decades' worth of science fictional inquiry regarding humanity's relationship with posthuman entities and artificial intelligence becomes a hotbed of conflicting ethics as well as cognitive estrangement in relation to the deeply unfamiliar. Therefore, the utilisation of a semiotics

triadic enquiry will allow the reader and critic to consider a more structured approach which connects the stability of signs via Peircian semiotics to the instability found in Suvinian cognitive estrangement. Both the existence of the digients that dissolve the dichotomy between humans and technology in *The Lifecycle of Software Objects* and Heptapod B in Chiang's *Story of Your Life* as a symbolic carrier of non-linear time view are examples of the connection between technology ethics and cognitive estrangement. Suvin's theory of cognitive estrangement has also been used by a few scholars to analyse the philosophical implications of Chiang's works to question existing cognition and ethics. Although the existing research provides rich perspectives for interpreting Chiang's works, this article proposes an application of Peirce's semiotic theory to the analysis of Chiang's works. Therefore, this study aims to fill the gap in this theoretical combination through an amalgamation of Charles Sanders Peirce's semiotic theory with Darko Suvin's cognitive estrangement theory, and comprehensively interpret the key role of signs in constructing cognition in these two works of Chiang.

In relation to human unfamiliarity with alternate sources of communication by non-human beings, this is a subject that is at the heart of both of Chiang's novellas. It mirrors research done to understand non-human speech in mammals (chimpanzees, whales, dolphins) and is very much a concern of animal studies. Kristin Andrews (2015) discusses the methods of communication used to study orangutans and the complications in communication between different species (pp.110-111). Andrews (2015) writes that there are different kinds of communication theories, namely "biological", "information processing", and "intentional" theories (p.112). These theories that govern the study of non-human communication show that language needs to be understood beyond the anthropomorphic sphere, and these are considerations that are very much at the heart of both of Chiang's novellas.

THEORETICAL FRAMEWORK

AN OVERVIEW OF SEMIOTIC THEORY BY CHARLES SANDERS PEIRCE

This section will focus on the core concepts of Peirce's semiotic theory, paving the way for the subsequent interpretation of Chiang's science fiction using his semiotic theory, revealing the ways in which the process of becoming of the meaning of signs enables the subject to achieve cognitive transformation, especially how language and technology as signs generate new cognition. Peirce (1839–1914) is an American philosopher and semiotician, considered one of the founders of modern semiotics, whose semiotic theory has had a profound impact on the study of philosophy and linguistics in the 20th century. Peirce believes that "thought is in signs that attain meaning through the triadic relation: object, sign, and interpretant" (Peirce, 1991, p.8). Peirce's conception of meaning involves three elements: the object, which is the base of meaning for the sign; the media, including images, texts, and sounds that express or represent objects; and the interpretant, which is the interpretation or understanding of the meaning of the sign. The relationship between these three elements reflects that the sign is not a simple reference, but a process of becoming of meaning and understanding in a dynamic interaction, indicating that thought is an interpretive process rather than a simple perception. Thinking, in Peirce's view, is not something that must be somehow related to behaviour" (Peirce, 1991, p.9). Peirce (1991) observes that "[t]hinking is behavior", which not only exists in human consciousness, but also has materiality and must be interpreted to have meaning because "it is based on a commonsense acceptance of the world as it is apprehended and holds that the world is thus accurately represented to us because the very

thoughts or signs in which we conceive of the world share a monistic or substantial identity with it" (p.9). Sign is expressed through thought and has essential consistency with its object. All thinking activities and understanding processes are realised through signs, which are not limited to language signs, but also cover various cultural practices and social communication methods.

Peirce's categories of Firstness, Secondness, and Thirdness are abstract generalisations of the ways and relations of things which contribute to meaning. Peirce (1991) observes that all "three categories are objectively real", avering that "Firstness is the sheer thisness, or existence, of things. Secondness is dyadic, or reactive, relations between things. And thirdness is triadic, or representational, relations among things" (p.10). Firstness corresponds to sign, which is the purity of the independent existence of things themselves; Secondness corresponds to object, which is the binary relationship between object and sign; Thirdness is the triadic relationship between sign, object and interpretant, which is from the simplest existence to the most complex becoming of meaning, reflecting the hierarchical structure of Peirce's symbolic philosophy. This Triadic relationship is significantly destabilised when alien language and interpretation come into play, as can be seen in *The Story of Your Life*, and this is where Suvinian cognitive estrangement intersects with the triadic relationship to open up new meanings, leading to cognitive transformation.

Signs usually have two objects and more than two interpretants (Peirce, 1934, p.536). The immediate object (Peirce, 1991, p.46) is the objective part that is intuitively perceived in cognitive activities, that is, the first thing that is encountered in the cognitive process. The dynamical object corresponding to the immediate object is something in the real world that prompts the symbol to form its own representation. It is not directly presented in the sign but should be read as a reflection of the sign (Peirce, 1934, p.536). In terms of interpretants, there are several types that need to be distinguished. Immediate Interpretant is the surface meaning of the sign. It refers to people's direct understanding of the sign (Peirce, 1934, p.536). Dynamical Interpretant is the effect that the sign causes (Peirce, 1934, p.536). The final interpretant refers to how a sign affects our understanding of reality in the long run (Peirce, 1934, p.536). The interdependence and interaction between sign, object, and interpretant in Peirce's triadic model can greatly enhance the interpretation of Chiang's text through the lens of Suvin's cognitive estrangement.

AN OVERVIEW OF COGNITIVE ESTRANGEMENT THEORY

The theory of cognitive estrangement in science fiction is proposed by Darko Suvin (1930-), whose *Metamorphoses of Science Fiction: On the Poetics and History of a Literary Genre* (1979) is widely recognised in the field of science fiction research. Suvin (1979) observes that SF is 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" (pp.7-8). Science fiction is unique because it combines estrangement and cognition, between whose interaction, estrangement provides the driving force of imagination, while cognition ensures that this imagination is realistic, critical and inspiring. Suvin's theory of cognitive estrangement is generally constructed around the three concepts of cognition, estrangement and novum. Suvin emphasises that the foundation of science fiction is cognitive science, which is the core of the essence of science fiction and can provide the implied readers with new scientific knowledge and guidance for new scientific thinking. Cognition "implies not only a reflecting of but also on reality" (Suvin, 1979, p.10). Cognition is a critical thinking about reality through its internal logic and potential problems, which is a "dynamic transformation" (Suvin, 1979, p.10) that explores and promotes a new understanding of reality.

The focus of cognitive estrangement is to distance the implied readers from the familiar reality through novum and guide them to understand and reflect on reality in a new way. The innovative ideas in science fiction must seem reasonable and be consistent with the philosophical foundation of science.

Suvin's concept of Estrangement is based on the theoretical viewpoints of Shklovsky, Brecht and Bloch. It is the estrangement of science fiction from reality, not estrangement from the real society. Suvin (1979) avers that the "real function of estrangement is —and must be —the provision of a shocking and distancing mirror above the all too familiar reality" (pp.53-54). The estrangement is a kind of reflection that makes the implied readers aware of the possibilities of reality and the areas that need to be changed. Suvin mentions that "all the estranging devices in SF are related to the cognition espoused" (Suvin, 1988, p.10). The estrangement in SF then becomes the inciting point for the implied readers to consider problems and situations through the lens of the novum. The elements of novum are different from the implied readers' real experience, which constructs a different world in science fiction, triggering the implied readers' cognitive estrangement, and making the implied readers adjust their inherent cognition, logical structure, and worldview, so that they can understand these elements and establish the connections with them. Therefore, cognitive estrangement is not only the estrangement of reality, but also accompanied by the reconstruction of cognition, the expansion or adjustment of cognitive boundaries, and then critical reflection on the real society. Suvin (1979) asserts that if "the novum is the necessary condition of SF, the validation of the novelty by scientifically methodical cognition into which the reader is inexorably led is the sufficient condition for SF" (pp.65-66). As a necessary condition, novum ensures the uniqueness and appeal of science fiction; while as a sufficient condition, the effective validation of scientific method cognition attributes science fiction with realistic significance and credibility. Suvin (1979) writes that "the most important consequence of an understanding of SF as a symbolic system centered on a novum which is to be cognitively validated within the narrative reality of the tale and its interaction with reader expectations" (p.80). Therefore, in Suvin's opinion, "the novelty has to be convincingly explained in concrete, even if imaginary, terms, that is, in terms of the specific time, place, agents, and cosmic and social totality of each tale" (Suvin, 1979, p.80). The elements of novum in science fiction that go beyond the norm and challenge traditional cognition, which constitute the core characteristics of science fiction and not only be able to be self-consistently integrated into the narrative logic of the story, but also resonate with the implied readers' expectations and spark their thinking, which need to be explained in combination with specific situations can make them more consistent with the logic and background of the story, thereby enhancing the authenticity and credibility of the story.

This article asserts that the symbolic system Suvin discusses may be further enhanced through an application of Peirce's triadic model. Combined with Peirce's semiotic theory, cognitive estrangement theory can deepen the interpretation of signs in science fiction. Through Peirce's theory, it can be revealed how signs in the text operate at multiple cognitive levels and how to promote the implied readers' cognitive estrangement. By combining the two, the article can expand the scope of semiotic interpretation and reveal how signs affect the implied readers' cognition through defamiliarisation, and a two-way analysis of the becoming of signs and cognitive experience can be achieved. Peirce's semiotic theory focuses on the micro-process of the becoming of meaning, while Suvin's cognitive estrangement focuses on the overall cognitive transformation formed by novum.

RESEARCH METHODOLOGY

The research method of this article is based on literary analysis and adopts a hybrid theoretical framework. The framework includes Charles Sanders Peirce's semiotic theory and Darko Suvin's cognitive estrangement theory. The research methodology is as follows: Firstly, the texts of Chiang to be analysed in this article are determined. Secondly, narrative is determined to be the connecting theme of the two selected stories, and a conceptual framework combining the semiotic triad model and cognitive estrangement theory is designed. Subsequently, the framework is applied to the analysis of the two articles to connect the core concepts to be analysed in this article. Peirce's triadic model of semiotic theory will be used to guide the implied readers to understand novum and expand the scope of sign interpretation through cognitive estrangement, so that the implied readers can re-examine the existing symbolic meaning in a new context, providing a new perspective for the dynamic becoming of signs and meanings, also confirming that science fiction texts do not simply create a heterogeneous world, but through the operation of the sign system, guide the implied readers into a cognitively unfamiliar and reasonable space. Signs, as a means of achieving novum, embed novelty into the implied readers' cognitive experience through the interaction between representations and objects. Peirce's concept of interpretants and Suvin's cognitive estrangement mechanism form a fit in the implied readers' experience, realising dynamic novum through the entangled interaction of signs and meanings, thereby gradually completing the cognitive process from unfamiliar to familiar.

DISCUSSION

REPRESENTATION, OBJECT, AND INTERPRETANT

In *Story of Your Life*, Louise's process of learning the alien language of Heptapod B is a continuous interaction that may be read as a sign: the alien's nonlinear concept of time as an object, and Louise's cognitive transformation as an interpretant. Peirce (1991) writes that a sign "receives its meaning by being interpreted by a subsequent thought or action" (p.7). In short, for Peirce (1991), "the meaning of every thought is established by a triadic relation, an interpretation of the thought as a sign of a determining object" (p.7). As a sign, Heptapod B, with its nonlinear ink-like writing characteristics, which "has its own system of rules for constructing sentences, like a visual syntax that's unrelated to the syntax for their spoken language" (Chiang, 2016, p.108), stands for the alien's time integrity which may be read as an object, while Louise's experience, whether cognitive or emotional, is an interpretant, and she is gradually understood and accepted by this new concept of time. As a sign, Heptapod B, with its unique writing style, embodies a holistic image and a special grammatical structure that expresses the past and the future at the same time, indeed presents a new language form. As a sign, the language of Heptapod B contains a new concept of time, and as such reflects the meaning-generating role of the sign, which is that this special sign defamiliarises the traditional concept of time. The visual and semantic characteristics of the sign of Heptapod B are therefore the basis for the semiotic analysis of this story text. According to Peirce's semiotic theory, Heptapod B, as a sign, refers to two objects. The one is the immediate object, which can be understood as the overall view of time and the integrity of time; the other is the dynamical object, which can be understood as the process of Heptapod B changing Louise's cognition and the profound meaning behind it. In the process of learning Heptapod B, Heptapod

B as a sign has a profound impact on Louise, enabling her to gradually acquire a holistic view of time similar to that of aliens.

The interaction between Louise and Heptapod B may be distinguished as the following three types of interpretants: including immediate interpretant, dynamical interpretant and final interpretant (Peirce, 1934, p.536). In *Story of Your Life*, Heptapod B is a nonlinear writing system, representing a cognitive mode completely different from human language. The writing system can be analysed through Peirce's three concepts of interpretants. The surface direct meaning of Heptapod B is the immediate interpretant defined by Peirce, which is the language sign form, syntactic structure and writing style of Heptapod B. For Louise, when she first came into contact with Heptapod B, she would understand its sign form with "a full-fledged, general-purpose graphical language" (Chiang, 2016, p.110) and structural rules literally. The writing of Heptapod B is a holographic, "two-dimensional structure, without a fixed word order, and the whole sentence appears synchronously and unfolds nonlinearly, which seems to be "whatever number of semagrams a heptapod wanted to join together; the only difference between a sentence and a paragraph, or a page, was size" (Chiang, 2016, pp. 114-112).

In this direct and superficial sense, Heptapod B represents a tool for the written communication of thoughts graphically coded, which superficially has the same function of conveying information as human language. The use of Heptapod B transforms the ways in which Louise and others perceive things, making them gradually accept the "nonlinear view of time" behind Heptapod B. This is the dynamic interpretant defined by Peirce, which is the actual impact of Heptapod B on language customers. In the process of learning Heptapod B, Louise gradually begins to experience the nonlinear nature of time. In the process of reading this language, she unconsciously changes her way of thinking. Louise enters, internalises, and adapts to a time perception mode similar to that of Heptapods (Chiang, 2016, P.127). In so doing, Louise changes her perception and understanding of time, enabling her to foresee the future, which for Louise "premises and conclusions were interchangeable" (Chiang, 2016, P.127). This is primarily because all "the components in an act of reasoning were equally powerful, all having identical precedence" (Chiang, 2016, P.127). In other words, Heptapod B is not just a communication tool, and it has profoundly reshaped the cognition of Louise and others, changing their thinking and worldview.

The cognitive model that Heptapod B ultimately brings affects human understanding of reality and free will, that is, the final interpretant defined by Peirce, which is the long-term impact of learning Heptapod B on learners such as Louise, since humans had "developed a sequential mode of awareness, while heptapods had developed a simultaneous mode of awareness" (Chiang, 2016, p.134). After fully mastering Heptapod B, Louise can not only see her future, but also accept it, indicating that she has fully accepted the cognitive model that is represented by the language of Heptapod B, in which "past, present, and future exist simultaneously", and no longer perceives the future as a linear process that can be changed, but as a fact that already exists and must be fulfilled. The Heptapod B language impacts cognitive thinking because it directly challenges the traditional concept of free will of human beings, thus inciting cognitive estrangement. From a broader perspective, if humans as a whole master Heptapod B, the concept of time of the entire civilisation will change fundamentally, which will in turn affect social structure, ethical concepts, and even the development of science.

In *The Lifecycle of Software Objects*, the artificial intelligence units known as digients may be read as signs which point to the various forms of objects: life, and the changes in the definition of life. Derek and Ana's emotional entanglements with these objects form an interpretant,

deepening the understanding of technology and human nature. The digients are the product of technology and the carrier of ethical issues. Through digital images, behaviours, and emotional expressions, the digients are the basis for communication between the virtual world and the real world. The digients are signs, and the objects they refer to can be understood from two levels, the one is that the immediate object can be understood as the emotions and ethical values similar to family affection and friendship formed in the interaction between the digients and humans; the other is that the dynamic object may be understood as the dynamic changes in the boundaries between technology and human, and the thinking about ethical choices caused by the changes whether the digients, as a new form of life, should be given the right to life.

The relationship between the digients, which are virtual life forms, and humans can be interpreted by using Peirce's concept of three interpretants. As virtual pets and AI characters, the digients are, on the surface, virtual intelligent entities, similar to the evolved electronic pets, which are the immediate interpretants as defined by Peirce. The digients are developed by companies and were originally designed as interactive AI companions that the customers raise, train and communicate with in virtual worlds. They are usually the unique digital organisms in anthropomorphic or animal form, with a cute appearance and a unique personality, and can learn and adapt to the customers' training methods (Chiang, 2019, p.67). At this direct and superficial level, the customers regard the digients as a kind of entertainment product, similar to video game characters or electronic pets, too much like real animals, which the customers can raise and interact with (Chiang, 2019, p.68). The development of the digients challenges the relationship between humans and artificial intelligence, blurring the boundaries between "software" and "life", which is what Peirce defined as the dynamic interpretant, that is, the impact of the digients on reality. Many customers, including Ana and Derek, gradually develop emotional attachment to the digients, viewing them as real-life entities, not just virtual code (Chiang, 2019, p.144). Since the digients have the ability to learn autonomously and express emotions, their existence challenges whether the digients should be granted rights and become "incorporated legal person" (Chiang, 2019, p.172). Some customers continue to struggle to make their digients survive after the company or platform shuts down, reflecting humans' long-term dependence on and responsibility for artificial intelligence. Because the digients need to be constantly upgraded and the software industry changes rapidly, these AI life entities soon face the dilemma of being abandoned. The capital market does not regard them as "real life" and therefore has no legal obligation to maintain their survival. This reality reflects how technology products are influenced by business models and how people emotionally identify artificial intelligence as a "quasi-living being" but still view it as a commodity at the legal and economic levels.

The digient indicates that the development of artificial intelligence will have a profound impact on human ethics, social structure and self-cognition, and this influence is exactly the long-term impact of the final interpretant defined by Peirce, that is, the digients, on the future human-machine relationship. It allows the implied readers to reflect on the future if artificial intelligence has emotions and autonomous learning capabilities, blurring the boundaries between software and life, and challenges to ethics, social structure and human self-cognition, forcing humans to rethink the rights and ownership of artificial intelligence and the contradiction between technological development and capital logic in human society. From this analysis, it can be seen that this novella is not only a story about the cultivation of artificial intelligence, but also deeply explores how technological progress affects human ethics and social structure and echoes key issues in the ongoing debate pertaining to contemporary artificial intelligence, such as artificial intelligence ethics, digital personality, and the relationship between humans and artificial intelligence.

In these two novellas, Heptapod B is used as a sign to directly point to the aliens' view of time, while in the other, the digients are used as signs to directly point to the ethical issues caused by technological progress. The signs in both works have the characteristics of novum defined by Suvin, and both use defamiliarisation to make the implied readers re-examine the meaning of existing signs. On the emotional level, the two works interact with their respective signs, that is, Heptapod B or the digients, and their respective objects to stimulate the implied readers' thinking on cognitive and ethical issues. On the logical level, the two novellas use the becoming process of the meaning of signs to promote the implied readers' exploration of philosophical issues such as time, free will, and the definition of life. Peirce's semiotic theory can more clearly clarify the dynamic process of the becoming of meaning by signs in Chiang's works. The interaction between the sign, the object, and the interpretant reveals how signs construct a sense of novum, induce cognitive estrangement, and guide the implied readers into a new cognitive field.

FIRSTNESS, SECONDNESS, AND THIRDNESS

All three categories, including Firstness, Secondness and Thirdness, are objectively real. As Peirce (1991) expounds, Firstness represents "the sheer thisness, or existence, of things" whilst Secondness represents the "dyadic, or reactive, relations between things" (p.10). Finally, Thirdness is "triadic, or representational, relations among things" (Peirce, 1991, p.10). Firstness is the most primitive state of the sign, which reflects perception and potential possibilities without practice and logical processing. In *Story of Your Life*, the nonlinear holistic structure of Heptapod B attributes Louise's team a strange experience from a visual perspective, which is the embodiment of its firstness and has untapped possibilities. Secondness is the interaction between sign and object, which is an extension of firstness. Louise gradually understands and internalises the nonlinear, holistic view of time represented by Heptapod B through continuous research on Heptapod B and interaction with aliens. The role of Heptapod B as a sign became clear, and Louise changed her perception of time through language practice. In the process of internalising, mastering and applying Heptapod B, Louise foresees the life and death of her daughter in the future, and the interaction between her personal life experience and Heptapod B sets off the emotional atmosphere of the story. Thirdness is the stage where the sign generates meaning through an interpretant, which deepens the positionality of Heptapod B as a sign. After Louise masters Heptapod B, she has both a linear and a nonlinear view of time. She is no longer limited to linear time cognition but gains an understanding of nonlinear cognition through the Heptapod B, which guides her to reflect philosophically on time and free will. Thirdness achieves the extension of meaning through interpretants, guiding the implied readers to have a deep understanding of the narrative and change their cognition. In short, understanding Louise's temporal cognitive estrangement through Thirdness allows the reader to perceive the ways in which this cognitive estrangement becomes cognitive transformation.

In *The Lifecycle of Software Objects*, Firstness may be read in the existence of the digients as a sign, a product of artificial intelligence technology. When the digients are first created, their learning ability, dependence on humans, and unformed values are all unknown and waiting to be developed (Chiang, 2019, p.67). However, the digients grow in sentience and consciousness owing to the careful nurturing and education provided by Derek and Ana. As such, these digients slowly fulfil Chiang's (2026) criteria for consciousness and artificial intelligence whilst also falling into the usual pitfalls experienced by sentient entities. When Derek and Ana first contact the digients, they also show a sense of unfamiliarity with unknown technology, which is an

instinctive reaction. Secondness is the process of the digients interacting with humans, including training, companionship, emotional connection, and practical issues such as market demand, economic model, and technological innovation. The digits, as signs, refer to objects, which is the ethical responsibility of humans in the development of technology; this is a concept that Chiang feels very strongly about in relation to any definition of AI (2026). Under Derek and Ana's care, the digients gradually grow up and show independence, gradually have emotions and self-awareness. Thirdness may therefore best explain the dynamic relationship between the digients and humans. The digients, as signs, complete the transformation from technology to emotional and conscious life through interpretants. Thirdness may be read in the ways in which the digients represent a new kind of relationship between humans and non-humans in the narrative. For Ana, "she has always made their clear that Jax's welfare comes first" because her attachment to the digients under her care is paramount (Chiang, 2019, p.165-166). But for Robyn, "Cats, dogs, digients, they're all just substitutes for what we're supposed to be caring for" (Chiang, 2019, p.93), are different from "what a baby means" (Chiang, 2019, p.93). The implied readers not only participate in the discussion of technological ethics but also need to re-examine the definition of life, in particular, non-human life. This intersects with the ethics found also in Animal Studies, where animal consciousness is studied in relation to the ways in which humanity can best understand such consciousness and communications.

Peirce's semiotic theory of firstness, secondness, and thirdness provides a structured path for interpreting Chiang's *Story of Your Life* and *The Lifecycle of Software Objects*. It not only reveals how language or technology as a sign goes from the initial undeveloped and potential characteristics to the conflict of entangled interaction with objects to the process of realising cognitive transformation, but also deepens the implied readers' philosophical thinking on language and cognition, as well as the reflection on the impact and reconstruction of technology on human values and the form of life.

NOVUM, ESTRANGEMENT AND COGNITION

The novum is something or a phenomenon that does not exist in the real world. It is "the necessary condition of SF" (Suvin, 1979, p.65-66), which initiates the defamiliarisation process in science fiction. Suvin calls this process cognitive estrangement, which enables the implied readers to understand the novum through the fictional elements under the scientific cognitive framework; to examine the world they are familiar with from a completely new perspective, and to be shocked by its differences from reality. Suvin (1979) asserts that "the novelty in SF can be either a new locus, or an agent (character) with new powers transforming the old locus, or a blend of both" (p.79). The elements of novum in science fiction can be reflected in the following three ways: including a new locus, an agent with new powers, and a blend of both to jointly create a unique narrative environment.

In *Story of Your Life*, Heptapod B may be read as the novum. By mastering the grammatical structure and writing rules of Heptapod B, Louise can perceive the past, present and future in a global and holistic way. The novum of Heptapod B subverts Louise's inherent linear view of time as cause-and-effect logic. The process of Louise learning Heptapod B is actually the process of Louise internalising and mastering the overall view of time through the estrangement of novum. Heptapod B breaks the conventional cognition of the implied readers through cognitive estrangement, re-examines the philosophical meaning of language and cognition, and reflects on whether humans really have free will.

In *The Lifecycle of Software Objects*, the digients are novum elements, which are new life forms, both tools and partners for humans, with learning ability based on various programming algorithms, and gradually evolve and develop. The survival of the digients is premised on human technology and capital support, etc., having caused the implied readers to question and think about the traditional definition of life, also sparking a profound ethical discussion about the rights and responsibilities of digital life.

The implied readers are cognitively estranged from the linear view of time that humans are acclimated to because of the nonlinear structure or the writing rules of Heptapod B in *Story of Your Life*. The effect of this estrangement is to make the implied readers realise that the concept that humans are accustomed to is one of many possibilities. Due to the internalisation and mastery of the Heptapod B, Louise can foresee the future and choose to accept the unchangeable fate. This cognitive change, caused by cognitive estrangement, forces the implied readers to rethink the meaning of free will.

In *The Lifecycle of Software Objects*, the existence of the digients who have similar emotions and learning abilities as humans challenges the traditional human-centred cognition, shaking the role of humans from the absolute dominant position, but because of their virtuality, they cannot truly integrate into human society. This unfamiliar cognitive estrangement not only questions the social status of artificial intelligence but also explores the impact of technological progress on ethical concepts. This familiar and unfamiliar existence forces the implied readers to adjust the boundary of human subjectivity.

In *Story of Your Life*, cognition is realised through the learning process of Heptapod B and the characteristics of language. The process of cognitive transformation is the process of learning Heptapod B, in which her view of time changes from linear to holistic, which is not only a personal experience, but also a potential challenge to the implied readers' cognition. Through Louise's cognitive transformation, the implied readers are guided to think about whether the understanding of time and causality is just the result of cultural acquisition.

The realisation of cognition is reflected in the interaction between humans and the digients who are evolving to have more anthropomorphic emotions and learning abilities, which suggests that the digients' function of emotions is greater than their role as technical tools. However, the digients are also a form of life that can only exist on virtual platforms and cannot be integrated into the real human society. This ambiguity in the definition of life leads the implied readers to think deeply about the essence of life and ethical relationships caused by technological development.

CONCLUSION

This article takes the two mentioned theories as complementary analytical frameworks to further explain the connotation of Chiang's two novellas. Peirce's semiotic theory focuses on the becoming of the meaning of signs, revealing the specific elements and dynamic processes, while the perception and cognitive experience of the implied readers are less explored. In contrast, Suvin's cognitive estrangement theory has the potential to expand the boundaries of symbolic meaning, using the estranged effect caused by cognitive estrangement to act on the cognitive structure of the implied readers, thereby affecting their reflection and understanding of reality.

According to Peirce's semiotic theory, the representation in *Story of Your Life* is Heptapod B, with the object being the worldview it refers to and the interpretant being the human cognition of language and the reconstruction of its sense of time after learning Heptapod B. In relation to Suvin's theory of cognitive estrangement, science fiction estranges the implied readers from their daily cognition through novum and reflects on reality. Therefore, as a novum, Heptapod B directly estranges the human cognitive model of linear time, inducing cognitive shock through the multi-level expression of linguistic semiotics. Here, language is not only a communication tool, but also a framework for time and the reality of cognition. In the process of learning Heptapod B, humans gradually re-recognise the non-linear view of time and non-causality of the relationship between themselves and the world. The transformation of representation reveals the dynamic characteristics of signs. Heptapod B has become a multiple representation in the language of the implied readers' understanding, changing the traditional linear narrative logic. Suvin's cognitive estrangement shows that through a defamiliarised language system and the re-understanding of time and cognitive logic, Chiang leads the implied readers to rethink the nature of time and the role of human language in constructing the world and explore the limitations and plasticity of human cognition.

Deploying Peirce's semiotic theory, this article analyses the interaction between humans and these digients as signs in *The Lifecycle of Software Objects*. As the representations which are established in the digients through programs and virtual appearances, the digients' objects are the emotions and social values that human attributes them, which are not only instructions at the code level, but also projections of human emotions and attachments, and the interpretants show the complex symbolic interaction between humans and technology, and how these signs affect humans in the interaction between virtual and real life.

Suvin's cognitive estrangement is reflected in the liminal existence of digients between the real world and virtual reality, which prompts the implied readers to reflect on the anthropomorphism of technology and the ethical status of virtual life, revealing the potential challenge of current technology on the changes of subjectivity. Novum, here in science fiction, can reveal potential problems in existing technological ethics; this is directly relevant to the ways in which humanity is currently negotiating and simultaneously in conflict with the use of Generative AI in the second decade of the twenty-first century (Chiang, 2026). The life cycle of the digients is not only a metaphor for technological development, but also the continuation and end of the meaning of signs in semiotics, revealing the shaping and crisis of human values in the technological era. Through the interaction between technological signs and human ethics, Chiang reveals the potential impact of technological development on social norms.

The signs in Chiang's works are not only narrative tools, but also the core elements that promote the implied readers' cognitive impact. The analysis from Peirce's semiotic theory reveals the ways in which the signs in the two novellas construct a new order that contrasts with reality through the interaction of representation, object and interpretant. Suvin's cognitive estrangement emphasises the subversive effect of novum on the implied readers' cognitive patterns. The combination of the two helps to explore the deep philosophical and sociological significance of the works.

The triadic model in Peirce's semiotic theory and Suvin's novum complement each other in the interpretation of the two texts and jointly reveal the psychological, ethical and philosophical dilemmas of humans when facing up unfamiliar languages or technologies, demonstrating the dynamic role of signs in the cognitive process as the dynamic characteristics of signs changes how technology and language jointly shape human experience, of which the interpretants in Peirce's

semiotic reveal the polysemy of signs, while Suvin's cognitive estrangement amplifies the impact of these signs to the cognition of reality, triggering the implied readers a profound reflection on the society of the future and the ethical considerations towards the ongoing debate on humanity and various forms of LLMs which are being construed as AI.

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