AI SENTIENCE IS JUST AROUND THE CORNER: SOLARIS 2, A CREATIVE-AI SCORE AND PUNK ROCK BAND WITH HUMAN IN THE LOOP

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ABSTRACT

This paper presents the results of a five-year research project, focusing on the creation of an autonomous punk rock improvising artificial intelligence (AI) that features a digital score. Central to this AI is a live performance ensemble called *Solaris 2*, comprising AI-generated bass, drum machine, and guitar, as well as human musicians. To develop *Solaris 2*, we built an unprecedented dataset that captured specific physiological parameters from a series of professional musicians. We developed a hive of neural networks trained on the resultant dataset, which was used to couple the musical core of *Solaris 2* with a digital score, enabling human musicians to play along with it. The results obtained from the interaction of human musicians with *Solaris 2* are surprising, as they indicate that human musicians perceive *Solaris 2* as a competent improviser who acts and responds in real-time to the musical space (*musicking*). This led us to the third stage of the research, which we present here as the conceptualization of *Solaris 2* as being close to a sentient Creative-AI system.

1. INTRODUCTION

Creative-AI has been a field of theoretical and practical encounter between the authors of this research. For over twenty years, we have been exploring diverse topics, including the application of AI in experimental processes and various artistic languages. Since we began working together in 2016 and established a Creative-AI Research Lab at a previous institution, our research efforts have focused on models that utilise a bottom-up topology. For this, we start with specific problems and move towards general models, always having creative processes at the heart of our projects. This bottom-up approach focuses on human experience over the more pervasive top-down approach of recreating the artefact of sound, music or art.

Our research indicates that the creative application of AI in symbiotic environments, where human creativity and AI-driven creative forms coexist and share spaces and processes transparently and in real-time, is an effective way to leverage new methods and visions [1]. This path and our interest in music led us first to create *Solaris: A Jazz-AI ensemble*. In this, the AI performed the piano, bass, and drum machine along with human musicians. Together, they symbiotically generate the improvisation in real time and are part of a universe of musical meaning (*Musicking*) inserted into a flow of musical creation. *Solaris 2* presents a step forward in terms of the digital score component and a departure from jazz.

2. CURRENT STATE OF THE ART AND MOTIVATION

Performance modelling of music has been a research challenge for some time, and more sophisticated real-time solutions are being developed. However, there is a lacuna in the systems and knowledge around performance modelling from an embodied, bottom-up perspective.

From a symbolic modelling perspective, the bulk of computational models attempt to codify musical expression in terms of mathematical formulae or symbolic programs, unlike our research, which aims to stimulate creative relationships. For example, the Cancino-Chacón model focuses on enabling machines to perform music that can be perceived as expressive [2]. It achieves this by manipulating musicking artefacts such as pitch, phrases, and timing into expressive parameters.

The most modelled parameters within these systems focus on loudness, articulation, ornamentation, and timing. These are generally controlled using the MIDI protocol, and in popular music genres such as folk, jazz, and pop [2]. A common concern with music performance modelling is performance generation, rather than in-the-loop real-time interaction. For instance, the Music Transformer system generates realistic accompaniments and performance given a melodic line input [3]. However, in the limited literature surrounding this topic, it appears that improvisation and variation are usually ignored when modelling

classical music performance. However, other styles (jazz and some folk traditions) consider them essential aspects of expressive performance [2].

3. FOUNDATIONAL CONCEPTS

3.1. Can an AI play music in the loop with humans?

Musicking and *flow* are the two main theoretical concepts that guided the development of *Solaris 2* [4][5]. The application of both led us to realize that sentience applied to AI could be linked to the practical context in which artistic creation occurs. We used the idea of *musicking* to construct meaning in the musical pieces created by *Solaris 2*. *Musicking* is a term coined by Christopher Small to define music from the perspective of doing, as the word "music" lacks a corresponding verb. For Small, *Musicking* is the process of making music by participating in all the acts involved, whether composing, performing, listening, or dancing [4]. He emphasizes that from the point of view of *Musicking*, the construction of musical meaning-making is to be found in the relationships forged within these creative acts [4]. In this way, musical meaning is generated through the emerging relationships between the actions, materials, behaviors, and agents that comprise these acts, such as people, algorithms, sounds, space, and time [6]. Through *Musicking*, musicians can undergo a process in which their sense of bodily self dissolves, and they become music. Csikszentmihalyi's theory of *flow* also supports the argument that the acts involved in making music should be considered immersive and corporeal experiences [5]. The author defines flow as a state in which people are so involved in a particular activity that nothing else seems to matter.

Solaris 2 was designed to be considered an integral part of the *Musicking* experience by stimulating an acute sense of being in the same immersive flow as human musicians. From this perspective, there is no hierarchical distinction between human musicians and the AI in *Solaris 2*, all of whom are central to the *Musicking* decision-making process. In *Solaris 2*, humans and AI are engaged in the shared endeavor of *Musicking*, sensing each other's activities and being attuned to the flow of their shared environment, which is the musical world. This view is supported by the widespread understanding that the act of making music does not consist of merely emitting sounds but of engaging in a bodily experience of becoming the sounds created in the flow of musical creation [6].

The project's first phase, spanning 2019 to 2020, involved the creation of an unprecedented, embodied dataset that captured the multidimensional interrelationships of professional musicians playing a jazz standard piece. The process of capturing and creating this dataset, as well as a detailed analysis of its results and training the neural networks, has been detailed in three other papers and book chapters [7, 8, 9]. For *Solaris 2*, this has been expanded to allow the system to play other genres, such as Punk Rock.

3.2. Experimental process

Having built a new dataset that captures the essence of *Musicking* and *flow*, we began to ask many questions about the nature of this Creative-AI and how to develop it for real-world applications. Generating ideas is an integral part of the music improvisation process. Hargreaves observes that in generating musical ideas during improvisation processes, different sources can be used initially, and the subsequent selection of sources is context dependent [10]. Starting from a vast repertoire, it is narrowed down within a specific context. Could *Solaris 2* make this cut, generating new ideas from a previous repertoire? Is there room for what Bloom calls “influence” [11]? The author describes the process of influence as the struggle of an artist to overcome the influence of their precursors, creating an art of their own. Could *Solaris 2* create something so unusual that its human peers could consider it a novelty?

Another crucial factor is the relationship between improvisation and embodiment. Music, for all its cognitive aspects, is highly embodied, and this becomes evident in the hands of the guitarist, the mouth and breath of the flautist or trumpet player, or the dance of a drummer, the way the musicians’ bodies move when they perform, and so on [12]. One of the factors that makes music so embodied is its interactive aspect, the unified way the musician connects with their instrument and into musicking. Embodiment is also a result of our natural response to music. Jazz audiences tend to make their involvement with the music explicit through physical signals, such as clapping their hands or stomping their feet [12]. Additionally, developing skilful musical agency involves assuming and assimilating various body positions, postures and movements [13]. This is particularly important for improvisation, since there is a phenomenological aspect to musicians’ body attitude that informs their peers about various musical elements [14].

3.3. The problem of embodiment

Since music is such a bodily activity, we faced the problem of embodying *Solaris 2*. Although our dataset represents the embodied performance of musicians, which is undoubtedly present in how *Solaris 2* is integrated into *Musicking*, it was necessary to embody the system in its performance, thereby avoiding the phenomenological sensation that *Solaris 2* was merely a computer producing musical notes.

The field of Embodied-AI studies is vast, bringing together researchers from diverse fields [15, 16, 17]. Unsurprisingly, this field’s central feature is the widespread conviction that intelligence should be embodied and conceived in terms of physical agents – biological or artificial – that act in the real and social world. Given this perspective, much of the work and research in the area involves designing and constructing robots or other types of artefacts. One of the reasons for the transdisciplinary nature of Embodied-AI is that intelligence has a strong connection with behaviour and interaction with the real world, just like music!

3.4. Embodied approach to *Solaris 2* AI

To conceptualise the theoretical hypothesis of this project into a real-world situation, it was necessary to conceptualise an AI architecture that mirrored aspects of *Musicking*. In short, as it is not the remit of this paper to outline the AI design in detail, we designed a modular design of:

- Layer 1 - Percept input and formatting. This module manages all the real time input data from a single audio input and sends it to the AI factory and gesture manager for processing.
- Layer 2 - AI Factory. This module generates streams of data from the four neural network models in the AI factory. Each of these models are created using 2D recurrent neural networks that have been trained on single features of the dataset. For example, a single point of the pianist's movement with the related arousal data from that individual. This is a free-flowing loop with all RNN's predicting live. The purpose is to generate a constant flow of predicted data from each model, emulating a busy mind negotiating options inside music-making.
- Layer 3 - Gesture manager. This module chooses one of the outputs from the AI factory (layer 2), or live input stream (layer 1) and holds this stream for a few sections before randomly choosing the next.
- Layer 4 - Belief system. This module takes the single output stream from the gesture manager (layer 3) and uses its value to determine which instrument will play and which note to play. It also sends conditions to the visual generator to convey its inner state.

3.5. Embodying *Solaris 2* through a digital score

The next stage of the project involved developing strategies for embodying and communicating *Solaris 2* with the real world, i.e., the human musician and the audience. This phase resulted in the development of a graphic interface for the project, which functions like a digital score (Figure 1), working in conjunction with the sonic aspect of the AI. This digital score phenomenologically informs the human musician through a visual language, providing sensory information about the mood of the rhythm section that forms the core of *Solaris 2*'s AI.

A digital score is characterised as a technically mediated communication interface that enhances the representation of ideas in music [6]. The digital score developed in this phase enables *Solaris 2*'s AI to communicate its presence, behaviour and responses to the outside world. As such, it helps stimulate the sensation of joint action when performing with human musicians. In our participatory observation process, we noticed that from a human point of view, notions of self-representation within musicking together in *Solaris 2* gain new representations, mainly through the mediation generated by the continuous interface, which is a constituent part of the digital score. The digital score helps define the space for *Musicking* to take place, establishing a constant link between the artificial and human minds, both of which are endowed with the ability to make mental representations, and providing a space for creative invention.

Just as the movements of the bodies of human musicians improvising indicate to their peers the general atmosphere of the musical piece, the visual forms of the digital score inform human musicians of the internal movements of *Solaris 2*'s AI architecture, thereby giving a "body" to this artificial musician. It is important to emphasise that *Solaris 2*'s digital score differs from a classical score, which brings detailed information on how the music should be performed. *Solaris 2*'s digital score is a set of abstract shapes and colours that provide a feeling, along with the sound, about the piece in question, open to interpretation and improvisation, and embracing the affectual and phenomenological properties of the media. In this way, the communicology of *Solaris 2* unfolds through the sounds produced and the visual representations of its internal state, as represented in a digital score. The digital score is projected for the human musicians to interact with when performing.

Figure 1. *Solaris 2'* visual interface, displaying a frame of its digital score.

4. A NEW TAKE ON SENTIENCE IN CREATIVE-AI

AI sentience has become an important topic of research, discourse and public debate considering the remarkable progress and capabilities not only of Large Language Models (LLMs) but also in expert systems, such as *Solaris 2*, which employs an entirely different approach to AI.

AI sentience is not related to the technology used to train models, but rather to how the AI is designed, perceived by users, and the quality of its outputs. *Solaris 2*, even without employing LLMs, can generate cultural artefacts – music – of such high quality that it is difficult to distinguish from human-composed music. The fact that Solaris 2 does not employ LLMs is a design decision, as discussed in [7, 8, 9]. Additionally, LLMs typically require user prompts to generate responses, lacking the ability to initiate interac-

tions independently [18]. They can mimic human language, but do not possess the capacity to engage in nuanced social interactions, such as *Musicking*, missing the capability to generate culturally relevant content beyond their training data.

Let us take as our starting point the concept that we want to dismantle: The idea, still dominant in AI studies, that the most pertinent question to be answered is whether "AI is sentient" [19]. This question is based on the Cartesian assumption that consciousness, sentience, and personhood are closely related terms, stipulating that language is a reliable indicator of consciousness. The primary interest of this approach is to define what consciousness is and whether an entity possesses it.

Our main question is: Can a system like *Solaris 2*, which is embedded with a level of intelligence and able to play in real time, in the loop with humans, be considered sentient? Sentience (from the Latin *sentire*, to feel) means the ability of beings to feel sensations and feelings and have conscious perceptions of their surroundings and what happens to them. Scholars across various disciplines and fields have long grappled with questions of sentience, including those in philosophy, psychology, and sociology. Sociologists, for instance, have a long history of considering sentience [18]. The scientific study of sentience, which is usually related to the possession of conscious experiences, including genuine feelings of pleasure and pain, is highly contentious [20].

The concept of sentience emerges in traditional narratives to describe the distinctions between plants and animals that were apparent to the ancient world [21]. Aristotle's account of sentience, for example, emphasizes the unique sensitivity of animals compared to plants [22].

Recent theories of consciousness, such as the "global workspace theory" [23] and the "attention schema theory" [24], indicate that we might not be far away from creating genuinely conscious systems, and machine sentience would require only incremental changes or piecing together existing technology in the right way.

One of the key issues with understanding sentience and demonstrating its existence at a scientific level is that the concept relates to a being's thoughts, feelings and emotions, none of which can be fully understood by physiological processes or anatomical structures [20]. As a result, sentience is often described as anthropomorphic assumptions, in other words, the attribution of human characteristics to animals or AI. The "carnal sociology" framework for ethnographic research has a similar approach, arguing that humans and animals are sentient because we are "endowed with senses, exteroceptive, proprioceptive, and interoceptive; she senses of what her[1] sensorium captures" [20]. There are no elements of physical or visual anthropomorphism in *Solaris* 2. There is no android or robot replacing humans, and the visual score is entirely composed of abstract shapes, which is a conscious design decision.

On the other hand, an AI sentient system should feature embodiment, world- and self-models, recurrent processing, a global workspace, and unified goal hierarchies [26]. Global workspace theory is a cognitive architecture and theoretical framework for understanding consciousness, developed to explain both conscious and unconscious processes qualitatively [27]. From this list of features, *Solaris 2* is characterised by embodied world- and self-models, recurrent processing, and unified goal hierarchies.

As an embodied agent, *Solaris 2* is completely integrated within the extended physical system of the human players and the audience, actively perceiving through listening and reacting to them, and participating in the process of *Musicking*, as discussed above. Its ecosystem comprises an AI factory, a gesture manager, and a belief system that provides both world- and self-models, working in a recurrent mode that continually processes its *Umwelt* in real-time, enabling creative collaboration with humans in *musicking*. The concept of *Umwelt* is pivotal. Conceptualised in the realm of biology, it defends that every creature inhabits a world of its own [28]. The structure of this inner world is primarily determined by the species to which a creature belongs, its physiology, behaviour, and environment, but this world discloses itself only through individual subjective experience. As such, these worlds are both private and unique to each subject. *Umwelt* refers to these worlds of subjective experience. Every ecosystem is composed of a combination of dialogue, dispute, and arguments of distinct *Umwelten*, which reinforces the importance of our concept of a symbiotic existence between AI and humans, where artificial intelligence and humans interact in real-time, sharing transparent processes and decisions, with collaboration as a critical concept. This design also takes a collaborative approach that considers the non-human (*Solaris 2*) perspective and *Umwelt*.

One of the primary driving forces behind *Solaris 2* is to challenge and enhance human creativity through an embodied digital score informed by its *Umwelt*, which is shared within the *Musicking* ecosystem. It is within this ecosystem that we can discuss *Solaris 2* exhibiting elements of sentience. The potential for technology to complement rather than replace human experiences and practices, providing new grounds to enable, reimagine, and reorganize how we understand ourselves, how we conceive the meaning of "human", and how we define meaning in new creative practices, working with novel sentient forms of intelligence [21]. The human *Umwelt* needs to be reimagined in terms of how we interact with complex technological systems, reconciling human and machine interactions and enabling new and more advanced forms of autonomy and self-expression in an AI-enhanced world.

[1] "she" refers to a hypothetical person in the original text.

One relatively neglected challenge in ethical AI design is ensuring that AI systems evoke a degree of emotional and moral concern commensurate with their moral standing, as even non-sentient or partially sentient systems can already provoke substantial and intense emotional responses in users [26]. Hence, AI systems should not be morally confusing, meaning that the ethically correct way to treat them should be evident from their design and obvious from their interface. AI systems designed to interact with humans should have their sentience clearly defined and be designed to elicit an appropriate emotional response in their users. Regarding *Solaris 2*, our design is transparent, well-documented and clear. Our moral ambition with it is not to replace humans with machines. As stated before, *Solaris 2* has been designed to collaborate as capable musicians in an ensemble. To do that, we employ, as one of our strategies, a matrix with which to interpret George Russell's Lydian Chromatic Concept of Tonal Organisation [29]. Beyond that, the music it creates is built on the relationships formed in the musicking space.

We believe that the definition of sentient AI needs revaluation to encompass broader forms of intelligence and emotional responses. Sentience is often underestimated in non-human agents [21]. Various modes of feeling transcend human experience, and the term should be accepted as an open-ended way of describing a wide range of aptitudes. Estrada problematizes the actual "AI discourse", which posits both machines and humans as abstract agents with idealized capacities that can be compared and evaluated in absolute terms through abstract measures like "intelligence", advocating for a more pragmatic flexibility in our recognition of artificial agency and sentience, accommodating the myriad ways these artifacts show up in our actual lives [30]. The author suggests that recognising sentient AI fundamentally depends on a shift in our attitudes towards AI agents, confronting our status as mechanical agents, which requires breaking the Western Cartesian way of thought that led to modernity.

4.1. A new take on sentience in creative AI

The views of René Descartes, whose philosophical and scientific beliefs led to the creation of Cartesianism, on sentience outside the human sphere are well known, especially about animals. Descartes believed that animals are just complex living machines, responding to external stimuli in the same way that machines react to specific triggers. In his 1636 Discourse on Method, he contends that even if animals sometimes behave as if they have some desires, feelings, sensations, or other mental states or processes, we should not be deceived by these appearances, as they do not correspond to anything genuinely mental [31].

It was not until the 18th-century Enlightenment that philosophers began to accept the notion that animals have feelings. In the last 50 years, the concept of animals being sentient, or "capable of experiencing positive and negative affective states", has become a topic of great interest to biologists [32].

Descartes developed an ontological thesis about the kind of thing minds are as features of the world and an epistemological thesis about how things of that kind could be known, making a fundamental distinction between minds, which think, and everything else, which is at most a machine. To explain how the human mind inhabits a body, he states that the human body is merely a machine, but made by the hands of God, who unites a rational soul to this machine, advocating a form of dualism in which mind and body are mutually exclusive categories [31]. "Minds" are things that can think, where access to minds can be secured using a faculty known as "introspection", which is a kind of inward perception of a person's mental states [33].

Later, Descartes says that the rational soul is a "thinking thing", something that doubts, understands, affirms, denies, is willing, is unwilling and also imagines and has sensory perceptions [34]. Although Descartes never adequately resolves the question of how perception occurs, he consistently places sentience and consciousness in the category of the mind, which is restricted to the rational soul of human beings.

[19] highlights the fact that debates around AI and sentience have historically taken the early modern period, and Descartes in particular, as a starting point. In this view, a sentient AI is impossible, as it would just be a complex device reacting to external stimuli without being aware of its actions. Alan Turing was aware of these limitations when he introduced what has come to be known as the computational conception of the mind, which inverts the Cartesian account of machines as mindless by turning minds themselves into special kinds of machines, where the boundaries of computability define the boundaries of thought [33].

Hull summarizes the problems with the Cartesian approach to AI:

"Whatever theory of mind underlies current AI work, this Cartesian attitude is persistent in a number of deficiencies in the literature on AI that have been the subject recent of critical attention. It persists in the tendency to look at algorithms in isolation, without paying attention to their deployment in algorithmic systems. It persists in the tendency to treat "fairness" as a formalizable concept that can be operationalized independently of its context. It persists in the isolation of technical academic work on AI from other disciplines that are more concerned with social impacts. And it persists in the quest to determine whether an AI is conscious at the expense of assessing its current socio-political implications. Whether or not an AI can be conscious or sentient in the Cartesian sense may well turn out to be unknowable." [19]

The author concludes that in the face of all this uncertainty, we need an alternative, proposing "the Hobbesian Alternative, replacing the Cartesian question – 'is AI sentient?'– to a more Hobbesian one: 'How should we regulate AI systems that behave as if they are sentient?" [19]. Hull also suggests this alternative based on the assumption that Thomas Hobbes extended a mechanistic treatment of

the body into the mind as well, making Hobbes' mechanistic account of thinking seem initially attractive from an AI standpoint, because it explicitly reduces thinking to computation [19]. Such an alternative is promising, and Hull develops it further in his paper. However, we would like to propose a third approach, more aligned with our theoretical and practical research considering *Solaris 2*.

5. AI AS A TYPE OF MIND

Our proposal asks, "What Sentience in Creative AI is for?" This allows us to explore the idea of creative collaboration between human and artificial minds, the kind of collaboration we observe in *Solaris 2*. To achieve this, we need to understand how AI can be considered a form of mind. We do so based on Charles Sanders Peirce's theory of synechism.

Synechism is the branch of Peirce's metaphysics that deals with continuity, the connection between mind and matter:

"I carry the doctrine [continuity] so far as to maintain that continuity governs the whole domain of experience in every element of it. Accordingly, every proposition, except so far as it relates to an unattainable limit of experience (which I call the Absolute), is to be taken with an indefinite qualification; for a proposition which has no relation whatever to experience is devoid of all meaning" [35].

The philosophical conception that underpins synechism is generous, as it does not separate mind, spirit, and body, matter, breaking with a Cartesian tradition. In the Peircian conception, the human mind differs from other mental forms, such as those observed in AI, in that it is the most plastic reality in the entire known universe, possessing the most significant level of malleability for change [35].

The semiotic field of sign processes, from computers to living systems, has often been analysed in Cartesian dualisms: "tool vs instruments", "instruments vs machines" and above all "machines vs living beings". Rather than confirming these dualisms, Peirce describes this field as a continuum of symbolic processing from the simplest to the most complex. Among the less complex systems are those mediated by instruments or technical devices, such as a thermometer or an automatic traffic system. The most complex semiotic systems occur in living beings. According to synechism, there is no separation or division, but differences of degree between nature and culture, the organic and the inorganic, the natural and the artificial.

Synechism should be understood as continuity between mind and matter, the latter also being a form of mind, but more exhausted and tired, especially if placed next to, for comparison purposes, the human mind. This connatural aspect enables a communicational flow between the various types of minds we observe in the universe, including AI. The mind in artworks allows contemplation or listening to be a dialogue and not just a discourse or narrative to be observed or listened to. Similarly, there is an active mind in *Solaris 2*, a sentient mind that engages in *Musicking*. Synechism is a crucial concept for understanding Peircean metaphysics, based on the pragmatic idea of continuity and evolution, as observed when human musicians play along with *Solaris 2*.

Everything that makes up the universe is a mental form because its physical laws are derived from psychic models, so the great law of the universe is the law of the mind [35]. This law is found in the tendency to generalize and form associations, which is also the tendency to acquire habits, itself a habit. All of reality is governed by the law of mind, that is, the law to acquire habits from the purely physical world to the human mind, with the difference, as we have noted, that the human mind does not submit to the law in the same rigid way that matter does [32]. That is why matter is a mind so locked into habits that it ceases to exhibit the same spontaneous behavior that is abundant in the human mind. This is particularly true for objects that retain their solidified form, such as stones. However, AIs like *Solaris 2* exhibit a very spontaneous and diverse pattern of behavior with remarkable plasticity, resembling the human mind.

Synechism reinforces the possibility of the existence of a creative sensibility in Creative-AI systems like *Solaris 2* because no matter how exact the theories are and how highly predictive they are, the more precise the instruments, techniques, methods and expertise employed by the researcher in the search for truth, the more deviations from the norm will be found, i.e. the more variables and irregularities the object will reveal [35]. Peirce's originality lies in the fact that he attributes this not only to errors of human nature, i.e., imperfections on the part of the observer, but also to a chance present in the object of study, which is alive and pulsating.

Peirce brings us the realization that everything we can know is purely mental since intelligence can only act on what is intelligible. Synechism opens the door to a more comprehensive understanding of sentience in AI. The connaturality between representation and the real object eliminates the Cartesian barrier between subject and object, between consciousness and the world. This free boundary is already present in Peircian phenomenology, as all phenomena, under its prism, pass through interiority – phenomena as they are – and exteriority – appearance, or how we perceive phenomena – in an undifferentiated manner. To understand and utilize the doctrine of synechism, we must admit that if the material and embodied universe is provided with habits of conduct in the form of natural laws, we must conceive of it as a form of mind.

Performing with *Solaris 2* establishes a semiotic way of communicating with the sentient mind that exists in AI.

6. CONCLUSIONS

We present an argument for reconsidering the potential for sentience within a specific context and from a particular perspective. We believe that one way to develop a proper

symbiotic creative ecosystem between AI and human musicians is to meet in the domain where the creativity is happening, namely, inside musicking. Our research appears to indicate some traction here, as both the Creative-AI and the human were embodied, acting in real-time, and able to represent symbols mentally.

Going one step further, we assert, based on Peirce's synechism theory, that current AI constitutes a type of mind. It is this characteristic that makes it possible for AI to communicate with the human mind and for a sentient ecosystem to emerge, especially if the AI is reaching outside its black box and sensing the world through appropriate percepts. Peirce's synechism assumes that continuity always prevails, and the assumption of such continuity is of fundamental methodological importance. Minds are continuous entities, constantly changing and in a state of perpetual flux.

We acknowledge that this is just one experiment and one instance of Creative-AI cooperating symbiotically within a single context. However, due to the openness of our approach and our guiding hypothesis of sentience, we found that – while engaged in musicking – the musicians who participated in the experimental practice seemed to thrive with *Solaris 2*.

7. REFERENCES

1. F. Poltronieri, "Towards a Symbiotic Future: Art and Creative AI," in *The Language of Creative AI*, C. Vear and F. Poltronieri, Eds., in Springer Series on Cultural Computing, Cham: Springer International Publishing, 2022, pp. 29–41.
2. C. Cancino-Chacón, M. Grachten, W. Goebl, G. Widmer, "Computational models of expressive music performance: A comprehensive and critical review", *Frontiers in Digital Humanities*, 5:25, 2018.
3. C. Huang, A. Vaswani, J. Uszkoreit, N. Shazeer, I. Simon, C. Hawthorne, A. Dai, M. Hoffman, M. Dinculescu, D. Eck. *Music transformer*. arXiv preprint arXiv:1809.04281, 2018.
4. C. Small. *Musicking: The Meanings of Performance and Listening.* Wesleyan University Press, 1998.
5. M. Csikszentmihalyi. *Beyond Boredom and Anxiety: Experiencing Flow in Work and Play*. Jossey-Bass, 1975.
6. C. Vear, *The digital score: musicianship, creativity and innovation*. London: Routledge, Taylor & Francis Group, 2019.
7. C. Vear and F. Poltronieri, "Crafting Artificial Musicians: Building Solaris as a Co-operative, Perceiving and Creative AI," in *Artificial Media*, N. Zagalo and D. Keller, Eds., in Springer Series on Cultural Computing, Cham: Springer Nature Switzerland, 2025, pp. 215–239.
8. C. Vear et al., "Building an Embodied Musicking Dataset for Co-creative Music-Making," in *Artificial Intelligence in Music, Sound, Art and Design*, vol. 14633, C. Johnson, S. M. Rebelo, and I. Santos, Eds., in Lecture Notes in Computer Science, vol. 14633., Cham: Springer Nature Switzerland, 2024, pp. 373–388.
9. F. Poltronieri, "Towards sentience: A path through jazz, datasets and digital scores" in *Proceedings of the 29th International Symposium on Electronic Arts. ISEA2024 Everywhen Proceedings. Volume 1: Academic Papers*. Queensland University of Technology and ISEA International, 2025
10. W. Hargreaves. "Generating ideas in Jazz improvisation: Where theory meets practice" *International Journal of Music Education*, 30(4), pp.354-367, 2012.
11. H. Bloom. *The anxiety of influence*. Oxford University Press, 1973.
12. S. Torrance, F. Schumann. "The spur of the moment: What Jazz improvisation tells cognitive science" *AI & Society* 34, pp.251-268, 2019.
13. W. Bowman, "Cognition and the Body: Perspectives from music education" in Liora Bresler (eds) *Knowing Bodies, Moving Minds. Landscapes: The Arts, Aesthetics, and Education, vol. 3.* Springer, 2004.
14. D. Sudnow, *Ways of the hand*. Harvard University Press, 1978.
15. R. Chrisley, "Embodied Artificial Intelligence", *Artificial Intelligence*, 149(1), pp.131-150, 2003.
16. R. Pfeifer, L. Fumiya (eds), *Embodied Artificial Intelligence. International Seminar*. Springer, 2004.
17. R. Pfeifer, "Embodied Artificial Intelligence 10 Years Back, 10 Years Forward" in Reinhard Wilhelm (eds) *Informatics. Lecture Notes in Computer Science*. Springer, 2001.
18. A. Alvero and C. Peña, "AI Sentience and Socioculture,", *Journal of Social Computing,* vol. 4, no. 3, pp. 205–220, Sep. 2023.
19. G. Hull, "Unlearning Descartes: Sentient AI is a Political Problem", *Journal of Social Computing*, vol. 4(3), pp.193-204.
20. H. Proctor, "Animal Sentience: Where Are We and Where Are We Heading?" *Animals,* 2(4), pp.628-639, 2012.
21. Z. Papacharissi, *A networked self and human augmentics, artificial intelligence, sentience*, Routledge, 2019.
22. A. Ducharme, "Aristotle's Mark of Sentience," *Apeiron*, vol. 47, no. 3, Jan. 2014.

23. S. Dehaene, *Consciousness and the brain*. Penguin, 2014.

24. M. Graziano, *Rethinking consciousness*. Norton, 2019.

25. L. Wacquant, "For a sociology of flesh and blood", *Qual. Sociol.,* vol. 38, no. 1, pp.1-11, 2015.

26. E. Schwitzgebel, "AI systems must not confuse users about their sentience or moral status", *Patterns*, vol. 4, no. 8, p. 100818, Aug. 2023.

27. B. Baars, *A Cognitive Theory of Consciousness*. Cambridge University Press, 1988.

28. J. von Uexküll, D. Sagan, and G. Winthrop-Young, *Foray into the worlds of animals and humans: with a theory of meaning*, University of Minnesota Press, 2010.

29. G. Russell, *George Russell's Lydian chromatic concept of tonal organization*, Fourth edition. Brookline, Massachusetts: Concept Publishing Company, 2001.

30. D. Estrada, "AIdeal: Sentience and Ideology," *Journal of Social Computing*, vol. 4, no. 4, pp. 275–325, Dec. 2023.

31. D. René, *Discourse on Method*, Hackett Publishing, 2014.

32. I. Duncan, "The changing concept of animal sentience", *Applied Animal Behavious Science*, 100(1), pp.11-19, 2006.

33. J. Fetzer, "Peirce and the Philosophy of Artificial Intelligence", *The Commens Encyclopedia: The Digital Encyclopedia of Peirce Studies*, 2004.

34. R. Descartes, *The philosophical writings of Descartes*, Cambridge, 1984.

35. C. S. Peirce, *The Essential Peirce, Volume 1: Selected Philosophical Writings (1867-1893),* Indiana University Press, 1992.