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Author

Keane, Jondi

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Art and the Realization of Living: The cognitive reuse of neural networks

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Jondi Keane

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Context:

The proliferation of Art-Science collaborations

As a creative arts practitioner, it is important to hear so many researchers from cognitive science, philosophy and psychology offering their perspectives on the intersection of their research with art. This paper was part of a panel on *Embodiment/Evolution/Art*, which brought together practitioners with a strong interest and understanding of science to address the way evolutionary process consists of recursive, dynamic activities that operate on the conditions of selection and self-organization.¹

This conference comes at a time when many Art-Science programs are proliferating around the world and many science researchers and philosophers are engaging with art practitioners, are curating art exhibitions, weighing in on art and evolution.²

This paper will claim that art interacts and acts upon current understandings of embodiment and enaction in ways that can re-orient theories of cognition to include these theories themselves as affordances for action. This recursive move is consistent with art practices and affect research design, research culture and knowledge production. The result would require re-consideration of the uses of art in science research in which art would push beyond its artefacts, its spectacular productions and critiques, to emphasize the role of art within enactive systems.

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Art and enaction; Art as enactive research

The key aspects of enactive theories cognition that pertain to arts practice describe the co-constructive relation of the organism and the environment in the shaping of a common world and, more importantly, how each action attunes and realigns the configuration of organism, person and environment.

Not all art aims to be enactive. Art that sets up situations in order to deliberately intervene in the linking (coupling/ uncoupling) of components of the organism-environment, becomes part of an ongoing dynamic system, strives to become enactive. Art as an enactive practice focuses on devising ways to move within and across scales of action, modes of sensing and modalities of existence. It is the boundaries and extent of the reconfiguration that requires further attention.

Art considered as the cognitive reuse of neural networks

This paper argues that art is a mode of re-entry and recursion. Art has the capacity to prompt re-orientations of sensing, thought and feeling (through the affects/effects of making on organism-environment relationship). In this way, some art practices and processes are more aligned with enactive processes. Art becomes enactive research when it uses environmental objects (including the ideas, processes and techniques made available through research in the arts, humanities and science) to deliberately re-enter the relationships between organism, person and environment. *The potential of art is the cognitive reuse of neural networks.*³

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This assertion presupposes that cognitive function is an embodied activity and neural networks are the anatomical basis through which overall aims and goals of an activity are expressed and implemented. The aim of such an approach attempts to move art away from its operation as an object or artefact (whether enclosed and withdrawn or entangled in a system of relations) towards its multivalent potential, which is to make oneself a daily research project. To achieve this aim, researchers must recognize that they enact forms of cognition and produce new cognitive modalities as a function of their endeavors.

In order to build upon the research and insights that science offers, it is important to extend the discussion to a more complex investigation of art as a mode of recursion-with-a-difference. That difference being: art has reached a point in its history in which one of its most significant potentials is *the capacity to deliberately and explicitly design projects and processes that prompt the reuse of neural networks: a practice of embodied cognition.*

One might mine the history of art to find evidence of neural reuse as a by-product of artistic activity and the uses of an artwork. The same neural networks used to recognize a urinal in a public toilet are used to recognize a urinal as art in a public art gallery. It is now possible to suggest that the techniques of art often exceed the “work of art” to include the conditions of its own formation, in particular, the organism-environment relationship and the dynamics of social cognition, which will be fleshed out with examples below.

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Re-imagining art as enactive research to include recursive art practices begins address how creative arts research might be understood in relation to traditional and alternative forms of knowledge production, acquisition and distribution of knowledge. Certainly, not all art is enactive research. Clearly, not all enactive research is creative arts research. However, if we consider the reflexive character of art practices to be the intensified interaction with how research is situated and embedded within a dynamic system of relations, then it aligns with the research aims of enactive theories of cognition. For an art work to be recursive, it must re-enter the space of a distinction. For example, art that questions its own status as art by re-entering the notion of 'what constitutes art'. It is for this reason that other formulations are needed to adequately address the complexity of enactive systems and the way that a 'distinction' can be re-entered via recursive techniques that art offers.

One approach to re-entry is the dilation of distinctions we take for granted such as the distinction between figure and ground. The term “organism-person-environment” was coined by the artists-turned-architects, Arakawa and Gins (2002: 3) to make it possible to rethink (re-enter) these joined-but-separate entities.⁴ Arakawa and Gins’ work exemplifies the potential of art, pointing to the heuristic actions, pragmatic enterprises and degrees of freedom, which the organism-person-environment might exercise.

Therefore, it must be argued that cognitive science and enactive theories of cognition meet creative practices precisely at the point *where cognitive reuse of neural networks* is intensified, made

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perceptible and used as way to re-enter and interact with the separation and joining of components that would be identified as organism, person or environment and all the combinations therein: organism-person-environment, organism-person, organism-environment, etc.. Art as a mode of re-entry is the first step to folding together art-practice-as-research and enactive research.

Recursion:

History, Evolution, Art

The implication of art, understood as enactive research, is far reaching. The potential contribution such practices may have impact upon the study of perception and action, multi-modality of knowledge acquisition in embodied and social cognition as well as historical and evolutionary processes. In fact, the way history as one such practice of (human) recursion into evolutionary processes, can be viewed in this snapshot:

Georg Wilhelm Friedrich Hegel “declares”: history necessarily repeats itself;

Karl Marx “corrects” Hegel: “what begins as tragedy returns as farce”; Jerry Fodor “riffs” on Marx: “what begins as philosophy comes back as cognitive science”.

To this lineage another version must added: What begins as neural re-use comes back as creative cognition or more precisely, the *practice of embodied cognition*.

Two things are important to note here regarding the way art practices are positioned in relation to studies of cognition and modalities of recursion. First, the way cognition is described does not and cannot hold for all cases, even with the margin of error for determining invariance. Whenever a theory of cognition is proposed or a lived experience is naturalized by scientific investigation, it

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seems obvious that the description does not cover all cases. For the arts, the anomalies and exceptions invite exploration. The arts have always been more concerned with proliferation of difference than with the production of invariance. This means it may be possible to know *how cognition has happened but not how it might happen next*. Second, that knowledge practices (e.g. information made available through research sciences) attunes an organism-person to particular modes and trajectories of action inflecting the way they co-construct a shared world, which is a level and type of complexity and engagement preferred in the arts.

The relative accuracy of a knowledge system does not determine whether or how information will be acted upon. As soon as information becomes available as an environmental object it affords use, misuse, reuse and revision. This is the basis for considering art as enaction, whereby persons recursively interact with their cognitive states, directly or indirectly. Recursion occurs directly through cognitive therapy, sensory substitution, or cognitive interface, body practices of mindfulness, meditation, yoga, cross-training, visualization, etc., and indirectly by devising and placing objects, prompts, design features into an environment to challenge the rituals of perception and action and exercise cognitive and neural plasticity.

The conscious, deliberate attempts to reconfigure sensing, conceptual and perceptual processing, and the relation of the virtual and actual, provides a way to think about how art might exceed its historical limitations to appropriate, modify, anticipate, circumvent, circumnavigate embodied patterns. Through the deliberate recalibration of the values of different coupling/decouplings

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within the organism-person-environment configuration, art brings embodied activities (attention, selection and perception decision and judgement) into new and generative relationships.

Modes of Recursion

For the production of generative relationships to become beneficial, the practice of re-entry into an existing dynamic system must operate on the conditions that maintain an organism-person-environment. The aim is to inflect the intra- and inter-action in order to shape the world differently. This allows art to also be considered for its ability to re-enter and catalyse future conditions, e.g. for an “adjacent possible” or for its exaptive potential that may emerge from deliberate operations on modes of recursion.

Stuart Kauffman, in *Investigations* (2000) defines the “adjacent possible” as the “all those molecular species that are not members of the actual, but are one step away from the actual” (142). He links Darwin’s pre-adaptation problem to the inability for researchers to pre-state the circumstances and context-dependent causal consequences of parts, for all possible organisms (131). Gould and Vrba explain pre-adaptation or exaptation as the situation where “in an appropriate environment a causal consequence of a part of an organism that had not been of selective significance might come to be of selective significance and hence be selected. Thereupon, the newly causal consequences would be a new function available to the organism” (130). Kauffman sees the need to “rebuild evolutionary theory [from] two sources of order in biology – self-organization and selection” (2000: xi) and Gould and Vrba provide insight into the process

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which might modify them.

Recursion and special consideration

Is art to be awarded special consideration—as an activity outside the flow of time; diachronic to events? Or is art to be enveloped in a flat ontology (Delanda 2004) as one activity amongst the plethora of others, each with its own particularities and histories? Is Art, as recursion, a more intense form of naturally occurring processes or does it indicate a purposefully devised intervention and re-entry into distinctions that have biological and cultural significance? Do experiments on the coupling and decoupling of processes, features, traits and values influence selection?

To answer these questions, it must be decided whether art is able to conduct experiments that yield insight into the conditions that hold an organism-environment in-place and/or create situations that enter into the dynamic field of events. By using a host of techniques that shift the boundary conditions (based upon distinction-based selections), art has the potential to strategically move from a specialized autonomous ambivalent activity to an activity on equal footing in an in dynamic relationship with all others. Rather than position art outside of the world on which it comments (art for art’s sake), or subject to the same measures and scrutiny, it is more useful and consistent with enactive theories of cognition to suggest that the opportunistic living organisms exploit mobility. Viewed in terms of art history, this evasiveness is practical and perhaps skeptical of its own value. Viewed in terms of art practice, the movement from inside to outside, “special” to “everyday”, generates a force and impetus that is untapped by remaining firmly positioned as this or that.

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Art enacts manoeuvres that gerrymander, couple and decouple entities and relationships, reversing embedded systems of meaning or changing the system of relations that affect identity boundaries. For example, in the same way that a soccer ball changes any environment into which it is introduced (a lounge room for instance which immediately re-organizes furniture and walls into goals and boundaries) ⁵ so too can an environment be activated to change an object, (a gallery changes a urinal into an artwork). By making art an activity that stands outside life, diachronically positioned in time and spatially positioned (as a model of life) art tries to become indifferent. By folding art back into life rendering it an aspect and inflection of life activities, art cannot separate the act of observation from the partaking—diminishing or enhancing culture, society, history and discourse of which it is a part. Therefore, the *movement between one mode of existence to another* (art, not-art, art as life, life as art) is made provisional through the situatedness of the movement. This movement and not only the established processes and positions affect the dynamics of the enactive system.

To this end, Arakawa and Gins deliberately decided to give up their individual artistic pursuits as painter and poet. They explicitly decided to position their architectural practice on equal footing with all other endeavors without the special treatment that art sometimes uses as an alibi (2002: xviii). Their notions of daily research through procedures and procedural architecture were dedicated to asking questions that enable an organism-person to “move within and between its own modes of sensing ... and scales of action” (2002: 58, 63). As Kauffman notes: Autonomous agents coevolve and “persistently stumble onto new ways of making a living with one another and exploit those

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new ways. The biosphere’s advance into the adjacent possible is just exaptation over and over again.” (Kauffman2000: 151). Art—as the practice of embodied cognition—is an organism-person-environmental undertaking to build questions in a 360-degree manner. So, what would an artwork that re-uses embodied knowledge towards the production of exaptive traits, niche construction and adjacent possibles look like?

Example: Procedural architecture / exaptive environments

Artists-turned-architects Arakawa and Gins gave up painting (Arakawa was Duchamp’s protégé) and poetry (Madeline was esteemed poet) to build procedures that might prompt exaptive consequences, causing of parts of organisms—not of adaptive significance in the normal environment of the organism—to become activated.

Ubiquitous Site / Nagi’s Ryoanji / Architectural Body is a permanent installation of the Nagi Museum of Contemporary Art. It sits on a hillside on a mound. The 70ft. x 30ft. tube structure is built (so that the ends are positioned along North-South axes, tilted at 17 degrees). There is no level place from which to determine the angle visually. The higher South-facing end is covered in semi-transparent material letting in sunlight but blocking the view into or out of the Tube. To enter the work, one must go into the museum entrance walk 300ft on the ground floor which is partially set into the hillside. At the end of the corridor is another small corridor to the right leading to a room in which a tilted black tube connects floor to ceiling that contain a tilted spiral staircase. Ascending the stairs around and on a slant to enter the lower, dark end of *Ubiquitous Site*. Once inside the

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tilted tube the floor is divided diagonally by the colors grey, green and red. Two sea-saws accentuate the tipped and unsettled feeling in the space—one on the floor, the other on the ceiling. On the curved walls are two scale versions of the famous garden from Ryoanji Temple in Kyoto.



Figure 1. Exterior views of Nagi Museum of Contemporary Art, Gifu Prefecture, Japan with Arakawa and Gins’ permanent installation, *Ubiquitous Site Nagi’s Royanji, Architectural Body*, 1994 (tubular structure on the right). Reproduced with permission of the museum © Nagi MOCA.

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Figure 2. Two interior views of *Ubiqutious Site*. Dimensions: 70ft. (length) x 30ft. (diameter). Left: looking down the tilted tube (North facing). Right: looking up the tilted tube (South facing). Photo: Courtesy of the Nagi Museum of Contemporary Art ©1994 Estate of Madeline Gins. Reproduced with permission of the Estate of Madeline Gins.



Figure 3. Zen rock garden, Royanji Temple, Kyoto. (Photo by Jondi Keane)

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As a result of the composition of architectural features, it is very difficult to judge level and hence to maintain balance because the visual cues have been decoupled from with haptic/ proprioceptive feedback. There are none of the usual visual anchors to the outside or that carry through from other built-environments. The last time a level surface was encountered, it was inside the museum before ascending the tilted spiral stair. It is also difficult to judge the rake of the tube. It seems steeper from the high end. It also becomes difficult to judge distances between objects, size, and specific location of people in relation to the interior objects. The subtraction of visual access to the horizon makes it difficult to stabilize one’s own location. The dismantling of perceptual cues, habits and rituals show how ideas are associated with experiences and impact upon the stability of oneself.

The space confounds the reification of self through definite locatability in space. This link is stretched further when the meaning of Ryoanji rock garden is considered. The intersection of perceptual, conceptual and cultural structures complicates the way one engages and hence perceive the “quotation” of the work inside *Ubiquitous Site*. Ryoanji is constructed with a viewing platform. The fifteen rocks in the garden are positioned so that from any one vantage the contemplator cannot see them all. One of the lessons of the Zen garden is that, even from a vantage point of contemplation—outside the world being contemplated—it is impossible to comprehend the entirety of the world.

Ubiquitous Site offers a different lesson through the opportunity to understand the movement from

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an outside point of view to an interior one as an event in and of being-in-the-world. This re-contextualization asserts a non-dualistic, existential ontology of the body. Arakawa and Gins do not set up an exterior viewing platform offering instead two versions of the same garden, rotated 180degrees on each side of the tube. This existential condition is in stark contrast to the removed position of contemplation. The presence of two scaled-down Royanji gardens in the *Ubiquitous Site*, still does not afford a view of the entire garden. One is too close and unable to take in both perspectives and therefore must operate within the midst of things, “tentatively constructing towards a holding in place” (Gins and Arakawa: 23, 47-50, 73-80).

As Evan Thompson in his keynote presentation at the *Body of Knowledge* conference noted, “If cognitive systems include different cultural practices, the two systems can have different properties even if the brain neural networks are the same. Cognitive activation is not cognitive properties.” (2017 keynote). The perceptual engagement with *Ubiquitous Site* would be complicated by the conceptual-cultural disposition of the persons attending to the environment.

In an existential ontology, amplified by the purposefully constructed built environment) the “person” is a set of recursive movements resulting from changing boundary conditions, rather than an enduring metaphysical essence or organismic invariant. The “person” as cognitive structure is built up from intra- and extra neuronal interactions becoming a screen that interpolates between organism and environment making their interactions perceptible. In this way art makes the “person” perceptible as a technology (an organism-environment technique) that can challenge the

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organism-person’s commitment to closure, stasis or withdrawal.

Arakawa and Gins understood the movements across organism-person-environment and attempted to benefit from all of the body’s events and extents. They were quick to utilize any and every process, activity and approach available for use or reuse. Depending on which scale of action one would like to explore, going around the organism-person is often a more direct path to re-entry than making direct suggestions to the organism. Placing a question to the organism to be encountered from the outside, “parlays indirectness” (Arakawa and Gins 2003: 20). Initiating change via the “person” now extends to the procedures that go around/outside the organism, via the feature of the environment to re-enter the person.

These circum-inter-ventions and dynamic mis-alignments, aim to put the “person” in contact with the ground of its own activity where fabulation, as much as biology, affects selection. If cultivated into a practice, a relationship with the anatomical basis of cognitive function would emerge to affect the use and reuse of neural networks.

Recursion and the autopoiesis of “as if”.

I am particularly interested in a loose thread in Maturana and Varela’s description of the autopoietic system. In their influential text, *Autopoiesis and Cognition* (1980) an elision or ellipsis occurs, revealing a fictive thread which appears as the phrase “as if”, which, in my view, unravels autopoietic *autonomy* turning it into what the poet Robert Duncan calls *fictive certainty* (1985: 9).

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The explicit use of “as if” appears several times in the Introduction to the book, but the section below cites the first time “as if” is used in a specifically to link the organism’s interactions with itself to evolutionary processes. In the opening essay, the “Biology of Cognition”, Maturana states:

The nervous system, by expanding the domain of interactions of the organism, has transformed the unit of interactions and has subjected acting and interacting in the domain of ‘pure relations’ to the process of evolution. As a consequence, there are organisms that include as a subset of their possible interactions, interactions with their own internal states (as states resulting from internal and external interactions) *as if* these were independent entities, generating the apparent paradox of including their own cognitive domain within their cognitive domain. In us this paradox is resolved by what we call ‘abstract thinking’, another expansion of the cognitive domain. (Maturana 1980: 13, emphasis added)

If we accept that “abstract thinking” consists in the inclusion of cognitive domains within the cognitive domain or the ability to include ‘interactions with their own internal states *as if* these were independent states’ (1980: 13, emphasis added) – *then*, some elision or affect has taken place for which the term “as if” stands in.

From the point of view of a creative practitioner, such an affective elision is used as creative impulse (creative cognition) to affect outcomes that would not be the same if a strictly descriptive causal interpretations adhered to. Obviously, there is nothing inherent in the “description of an internal state” that would cause it to be mistaken for an external state. It is the swinging door of the “as if” that permits a move from automatic function to self-affecting, intra-neuronal interference. This suggests there is more to story than the inclusion of one cognitive domain within another. It is “how” this type of inclusion (the process, mechanism/ anatomical basis of the joining) operates that

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leaves room for creative cognition to flourish and initiate creative evolution.

Although there is not time/space to develop this more extensively here, in *Autopoiesis and Cognition: The Realization of Living*, “as if” is deployed 25 times.⁶ The paradox generated by the organism’s ability to include its own interaction with descriptions as if these belonged to an independent domain cannot be explained entirely by an observer remaining “in a domain larger than that of the descriptions allowing us, in a recursive process, to describe ourselves describing ourselves” (1980: 14). It is the specificity of the description and the movement (mode of inclusion) that concerns the practice of embodied cognition. When Maturana states that reality is a “fiction of the purely descriptive domain” ... “valid in the correspondence between description and describing system” (1980: 52), he opens the door to *self-experimentation* that potentially affects the use (re-use) of descriptions to initiate new interactions.

Self-experimentation

It can be argued that any cognitive process can be appropriated, re-described and selected as newly significant. The trick, or techniques, is to transform one’s automatic interaction with the right (suitable) prompt. This is the double edge of uttering “as if”. By saying “as if” to oneself, two things become evident: the stated proposal is not true since I have acknowledged it is “as if” X were the case, but at the same time, the success of the proposal depends on it being acted upon “as if” X were true. The crucial difference is the expectation of an emergent activity *not* the accomplishment of the proposal. The proposal “I can fly” might result in a person taking up paragliding, or

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trampolining, or studying aeronautics, or writing about training a dragon.

Action, taken as the result of a prompt, occurs differently when it dynamically passes through impossible goals without irony, using “as if” as leverage for cognitive processes to interact with each other in new ways. Ideas, system of relation, and affordances, too, can become potentials for action, and once their enactive effects/affects begin to shape the environment, they become available to directly perceived, experimented with and reused.

The virtual or fictive mode enables *affective experimentation*. John Rajchman, in his discussion of affect, suggest the link between affect and self-experimentation: “Affect [in Spinoza] is the sensation of what favours or prevents, augments or diminishes, the powers of life of which we are capable each with one another; and it is in something of this same ‘ethical’ sense that “Deleuze proposes to extract clinical categories (like ‘hysteria’ or ‘perversion’ or ‘schizophrenia’) from their legal and psychiatric contexts and *make them a matter of experimentation in modes of life in art and philosophy*, or as categories of a philosophical-aesthetic ‘clinic’” (2000: 132). There are many exemplars of self-experimentation that prove valuable model for a practice of embodied cognition.⁷

In this way, self-experimentation involves work on the automaticity of one’s own organism with implications for deliberate neural reuse and pre-empting adaptations by devising conditions that could be exaptive. Art expands the ways one can work on these conditions opening movement within and across the boundaries of the organism-person-environment.

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Conclusion: Radicalization

If enactive theories of cognition are to become more than a mode of analysis or an interpretive system for determining invariance and meaningful consequences, cognitive scientists must become reflexive and acknowledge that their practices take part in and affect enactive process. This means the any knowledge practice (including cognitive science) must be understood as a factor within production of knowledge. This would suggest that reciprocally, cultural practices, such as art, affect the dynamics of enactive systems and processes. By understanding that enactive relationships, including research activities, cannot be turned off, quarantined or stopped from forming continuous recursive re-entries, would mean that the findings of researchers will reflect the re-invention of inventiveness and the production of uniqueness and difference, modulation and change.

Anthony Chemero explains that, what is “radical” in *Radical Embodied Cognitive Science*, “very roughly, is the thesis that cognition is to be described in terms of agent-environment dynamics, and not in terms of computation and representation” (2009:x). He goes on to say that “To defend radical embodied cognitive science, one must take up what I call the *dynamical stance*, a methodological commitment to explaining perception, action, and cognition dynamically and without referring to representations” ... “blissfully meta-physics free” (xi).

There are blissfully metaphysics free processes already at work in art through its interactions with the overlapping of past and future, virtual and actual, which goes by a less contentious name: the imagination. Brian Massumi provides an instructive way of thinking about imagination as a form of

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enaction, when he describes the imagination as the “mutual envelopment of thought and sensation, as they arrive together, pre-what they will have become, just beginning to unfold from the unfelt and unthinkable outside: of process, transformation in itself.” (2002: 134). If one mode of auto-affection is a radicalization of movement within domains of cognition, then the “free radical” of transformative description can be deployed in *the practice of embodied cognition*.

Cognition does not happen in only one way. Single accounts cannot take into consideration that other theories of cognition complicate dynamic cycles of perception and action that goes into co-constitution enactive systems. It is crucial to recognize that embodied cognition makes use of all kinds of cognition including computational representational, directly perceived and enactive dynamics. The enactive theory of cognition must be understood as distinct from the uses of enactive notions in practice that model and shape a shared world they are also studying.

What needs to be enactively researched is the movement within and across the repertoire of cognitive practices. These might include but are not limited to: inhibiting autonomic functioning through awareness of one’s own sensorium and cognitive processes (as in cognitive therapy); undercutting the homeostatic relationship of organism-environment (through risk); reusing neural networks (mismatching affordances by using impossible goals to prompt unanticipated results); the parlaying of the organism-environment dynamic (by circumnavigation, going outside the organism alter the condition of the environment that will affect selection and self-organisation) and; moving between neural networks deployed when imagining, fabulating, appropriating into intra- and extra-neural contexts.

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These manoeuvres develop heuristically and are exercised pragmatically. They constitute a creative cognitive in order to generate alternative biological niche constructions and potentially, *the realisation of living*, on new terms.

Ultimately, creative cognition will inflect the selection components for biospheres that “persistently increase the diversity of what can happen next” (Kauffman 2000: 4, 5). Art would aspire to become regarded as skilled interventions which, more and more, are the stuff of everyday social cognition and everyday practices.

Embodied cognition becomes “radical” when its potential is mined - as a cognitive function that provisionally frees neuronal networks from their place in the cognitive system. If cognitive function might be defined here as an organism-environment’s sensitivity to overall embodied activity, then part of its functionality would be to develop any environmental support, includes those that might circumvent the limitations of embodied, enactive, embedded, expanded cognition. To achieve this, an intra- and extra-neuronal practice must ensue; one that radicalizes cognition by recasting the potential of art as experimental techniques for the reuse of neural networks.

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Figure 1. Exterior view of Nagi Museum of Contemporary Art, Gifu Prefecture, Japan with Arakawa and Gins’ permanent installation, *Ubiquitous Site, Nagi’s Royanji, Architectural Body*, 1994. Photo: Courtesy of Nagi Museum of Contemporary Art © Nagi MOCA. Reproduced with permission of museum Director Mr Kishimoto.

Figure 3. Two interior views of *Ubiquitous Site*. Dimensions: 70ft. (length) x 30ft. (diameter). Left: looking down the tilted tube (North facing). Right: looking up the tilted tube (South facing). Photo: Courtesy of the Nagi Museum of Contemporary Art ©1994 Estate of Madeline Gins. Reproduced with permission of the Estate of Madeline Gins.

Figure 3. Zen rock garden, Royanji Temple, Kyoto. Photo by Jondi Keane

End Notes

¹ In addition to the topic of this paper, Margaret Wertheim’s (Independent Scholar, Co-Founder IFF) discussion of the Coral Reef Project; Christine Wertheim, (Cal Arts, Co-Founder IFF) unpacking of the visual and diagrammatic symbolic logic of Peirce and; Victoria Vesna (UCLA) discussed the integration of evolutionary biology, artificial life, spatial sound, mechatronic art and interactive technologies in her collaboration with physicist, Takashi Ikegami (University of Tokyo) *Bird Song Diamond*.

² A case in point is the current exhibition at MONA in Hobart (5 Nov 2016- 17 April 2017) *On the Origin of Art*, with guest curators Steven Pinker, Brian Boyd, Geoffrey Miller and Mark Changizi who propose various conjectures on art’s origin—Art is a by-product of other adaptations and a pleasure technology (Pinker); Art is a functional signalling system for attracting a mate (Miller); Art is cognitive fine tuning through which to increase mastery of world (Boyd) and, closest to the proposition explored in this paper; Art as nature harnessing of evolutionary brain mechanisms for new purposes by mimicking the environment and the instinct to engage with other humans (Changizi). In his recent book, Alva Noe states: “Art, really is an engagement with the way our practices, techniques and technologies organise us ... a way to understand our organisation and inevitably, to re-organize ourselves” (2015: xiii). See their curatorial statements on MONA website: <https://mona.net.au/museum/exhibitions/on-the-origin-of-art>

³ For a discussion of cognitive reuse such as the reuse of motor neurons as mirror neurons, see Gallese, V., & Sinigaglia, C. (2011). “What is so special with embodied simulation”. *Trends in Cognitive Sciences*, 15, 512- 519.

⁴ For a discussion of the terms “organism that persons”, “organism-person-environment” and “architectural body”, see Gins and Arakawa (2002:1-4). Their “procedural architecture”, devised to examine the extent of the separability and inseparability of organism-person-environment.

⁵ In his discussion of the logic of relation in *Parables for the Virtual* Brian Massumi (2002: 68-88) comments that Michel Serres, Bruno Latour and Pierre Levy all use the soccer ball to discuss the relation of subject to object and individual to collective (2002: 71). Objects can open prefigured space to bottom-up perceptual processing, forging unanticipated relationships.

⁶ Maturana and Varela note that the observer only describes himself describing (29). They note that “phenomenologically the linguistic domain and the autopoietic domain are different domains and although one generates the elements of the other, they do not intersect” (120).

⁷ There are many people who, in response to their disabilities from birth, illness or injury, have developed ways to interact with the embodied processes. Exemplars discussed by Arakawa and Gins include Helen Keller, Ian Waterman and Karl Dahlke (2002). Other self-innovators include Daniel Kish who taught himself echo-location techniques and the subjects of Bach-y-Rita’s sensory substitution work and Ramachandran’s mirror box experiment for phantom limb. Instances of brain plasticity and robustness include survivors of impalement: Eduardo Leite in 2012 and Phideas Gage and injured soldier Lev Zassetsky, see clinical biography by Luria 1972.