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4E Cognition and the Mind-Expanding Arts

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Abstract

Examining imagination, 4E cognition and the arts together expands our understanding of them all. 4E cognition is a framework that comprises the theories separately known as embodied, enactive, embedded, and extended cognition. This paper draws on research in cognitive science (including 4E and recent predictive processing approaches), ideas in phenomenology, and artworks from *The Extended Mind* exhibition (2019–20). The artworks offer diverse reflections on 4E cognition, as well as revealing personal, political and ethical benefits and issues predicated on a 4E cognition perspective. This approach further provides a way of defending the epistemic value of the imagination and of unpacking the four key puzzles associated with its relationship with the arts regarding its production of emotional response, imaginative resistance, and moral persuasion, and the paradox of our attraction towards horror and tragedy. The arts are a valuable mode of inquiry into the nature of cognition and neglect of their relevance negatively impacts understandings of the mind.

Keywords: *distributed cognition, extended mind, imagination, arts, predictive processing, contemporary art*

4E Cognition and the Mind-Expanding Arts

Miranda Anderson[1]

Introduction

4E cognition is the term for a framework that comprises the theories separately known as embodied, enactive, embedded, and extended cognition. Examining imagination, 4E cognition and the arts together increases our understanding of them all. I make a case for this claim through an exploration of how these four perspectives on cognition help us unpack the nature and value of the imagination and offer a richer understanding of the artworks in *The Extended Mind* exhibition (2019–20).[2] The exhibition featured contemporary artworks that reflect on the ways in which aspects of the world beyond our brain, such as our bodies, objects, language, other people, ideas and

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2 *The Extended Mind* exhibition was curated by Miranda Anderson, Tessa Giblin and James Clegg at the Talbot Rice Gallery in Edinburgh; this was supported by Arts and Humanities Research Council funding led by Anderson as Principal Investigator under Grant AH/SO1070X/1. The associated off-site performance piece by Myriam Lefkowitz, entitled Walk, Hands, Eyes (Edinburgh) was supported by Creative Scotland. The symposium at which an earlier version of this paper was presented was supported by the University of Stirling, the University of Edinburgh, the Royal Institute of Philosophy and the Scots Philosophical Association (https://www.trg.ed.ac.uk/event/interdisciplinary-symposium-art-extended-mind).

institutions, expand our cognitive processes. Mind-expanding – spatially, durationally and, more generally, in terms of our capacities – hold implications for how we understand the arts. It also provides a grounding for and suggests modes of transforming current educational models. The exhibition works discussed include paintings, sculptures, conceptual art, video installations and performance art; but the interpretative methods outlined here are applicable to any artwork.

In their influential paper 'The Extended Mind' (1998), Andy Clark and Dave Chalmers deploy a hypothetical thought experiment: while Inga uses her biological memory the neurologically impaired Otto uses his notebook to recall how to find the Metropolitan Museum of Modern Art. Otto's beliefs and behaviour are guided by his notebook, just as Inga's are by her biological memory. Hence, they claim that thinking does not just happen in the head.[3] Traditionally, philosophy relies on such thought experiments to substantiate theoretical claims. If we accept that the mind is not just in the head then it follows that thought experiments need not just be abstract hypotheses but could take an array of forms. Unlike Inga and Otto who never actually get to MOMA, *The Extended Mind* exhibition invited people into an art gallery to discover expressions of all kinds of 4E cognition

3 Clark and Chalmers claim parity between internal and external cognitive resources, which provoked a debate around whether 'the parity principle' necessarily implied that the cognitive function performed by an extra-neural resource must be functionally identical to that performed by a neural one in order for it to be counted as cognitive. Adam and Aizawa (2011: 13) take this stance as a basis for arguing against extended mind claims: 'We take the point here to be that there is no principled difference among these cases'. However, there is no such implication in the original heuristic, since Clark and Chalmers (1998: 8) only claim: 'If, as we confront some task, a part of the world functions as a process which, were it done in the head, we would have no hesitation in recognizing as part of the cognitive process, then that part of the world is (so we claim) part of the cognitive process.'

there. This article attempts to recreate aspects of that visitor experience. Encounters with the artworks make clear that the common modern assumption in everyday life and cognitive science that the default starting place is the brain,[4] and that it then has to be proved that the body and world count as cognitive, does not hold true when you consider notions of the mind in the arts, where we see a diverse variety of expressions of 4E cognition taken as the default.

Imagination's epistemic value has recently been argued for in cases where it operates under constraints like those of a scientific experiment.[5] For example, Amy Kind (2018: 18) argues that 'when we constrain our imaginings to fit the facts of the world as we know them, we are using an epistemic procedure that is much more akin to scientific experimentation than it is to mere flights of fancy'. Here I want to defend the significance of the imagination's role in what may appear the 'mere flights of fancy' of engagement with artworks: I argue that the importance of such engagements lies in their capacity to *open up* the kinds of methodological, habitual and enculturated constraints that are incumbent on being in the world.[6] This paper argues that our imaginations are necessarily grounded in

4 Anderson et al 2018: 'the received view is now that the brain is where the cognitive action is'; this default view is also overturned by notions of the mind in other historical periods (Anderson 2015, 2018, 2019, 2020). Also see Wheeler 2005 on substance dualism in contemporary cognitive science.

5 The meaning of the word imagination itself is not fixed as different periods have foregrounded or transformed aspects of its semantic range, oscillating between more positive or negative conceptualisations. Etymologically imagination relates to the word image; when introduced into English from Latin it originally defined part of the mind that was thought to work associatively on images of the world imprinted on it through the senses before they were further abstracted by reason and stored in the memory. The imagination could both lead to true understanding and mislead (see the *Oxford English Dictionary*).

6 As Montaigne (2003: 482; also see Nagel 1979) argues our imaginations too have their limits: 'To every creature there is nothing dearer and more estimable than its own

and constrained by our 'life-worlds',[7] *and* that it is due to this that they can extend and widen our cognitive horizons. Through harnessing and enhancing our cognitive capacities, particularly our imaginative ones, the arts make possible the realisation of more reliable, nuanced and wonderous minds.

Nowadays the mind is often equated to the brain. Such views have led to reductive interpretations of art by the field of neuroaesthetics due to a universalizing neurobiological focus, which conflicts with the relativist postmodernist theories that have dominated the arts.[8] Instead 4E cognition claims that the mind spans brain, body and world: the mind is not just brain-bound, nor does it occur merely through information flow or internal processing mechanisms (as in classical cognitive science), or sociocultural forces (as in postmodernism). 4E cognition's inclusive middle path neither denies the importance of the brain's role, nor that of different cultures and traditions, creating the possibility of productive dialogue with the arts and humanities, at the same time as grounding notions of the mind in the physical body and material world.

Yet, despite its expansiveness, the sciences have tended to present 4E cognition in terms of problem-solving, and as necessarily beneficial, rather than realising the

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being…and each relates the qualities of all other things to its own qualities. Which indeed we can extend or shorten, but that is all; for beyond that our imagination cannot go.' Hence the importance of the specially created affordances that the arts offer our imaginations and which provide a means to trigger catalytic cognitive leaps.

7 See discussion below of Husserl in regard to the use of the term 'life-world'.

8 Anderson (2015) comments on postmodern sociocultural constructivist theories eliding of the body and the natural world and their domination of discussions of the mind and self in the arts and humanities. Onians (2020: 44) recently discussed this issue in relation to the creative arts: 'In recent decades many art historians have handed over control of the materials they study to theorists whose narrative around the "social construction of culture" does provide them with important new analytical tools but reduces the range of the explanations they can offer by effectively excluding influences from "nature".'

negative aspects and ethical issues that can arise, or fully considering the significance of separability and distinctness. Engagement with the arts enables an interrogation of such constraints and has generated another term that adds to our capacity to conceive the nature of such brain-body-world experiences: 'fission-fusion cognition' (Anderson 2015a). Fission-fusion cognition expands our conceptual grasp by specifying that cognition is composed of the *merging and dividing* of cognising clusters out of ad hoc brain-body-world elements, with fissions between different aspects of mind commonly associated with an individual, as well as fusions that extend beyond an individual and are cooperative with another entity. Unlike distributed cognition, fission-fusion cognition highlights the positive nature of limits, separations and distinctions, as well as of openings, mergings and continuities occurring across time and space. This concept of an ever-changing array further illuminates our interrelatedness – entities share in metamorphosing constituting elements rather than having only a single core from which they are extended – and it highlights that the distinctness of each cognitive array and particularity of each living entity is of value as much as our capacity to interconnect with others and the world. Paradoxically fissions as well as fusions can enable deeper understanding of our holistic embodied natures and emergence from wider sociocultural and natural ecologies. Each mind, each self and each period exhibit a mix of idiosyncratic features and those that are expressed in, and so shared with, other minds, selves and periods.

This stance has implications for how we conceive of philosophy itself: it recollects Husserl's (1970 [1936]: 59) critique of its truncated scientific focus, and demand for a return to a reflection on the 'life-world' and 'historical background'. Given the entanglement of the culturally and biologically situated aspects of the mind implied one should not expect that the full scope of knowledge about the

mind could be achieved merely through current cognitive scientific methodologies. As well as simply illustrating ideas in cognitive science, the arts and humanities themselves contribute to our understanding of cognition. For instance, the artworks discussed here help bring to light the kinds of personal, political and ethical issues predicated on a 4E perspective that are often neglected in cognitive scientific accounts.

Despite the artificial constraints in its recent conceptualisation that have resulted from the term 4E cognition emerging from the classical computational perspective that dominated cognitive science from the mid-twentieth century to the early 1990s, its roots and workings span the phenomenological as well as the cognitive scientific traditions, combining experiential and empirical perspectives. It therefore offers a more inclusive basis for understanding the roles of aesthetics, the arts, and the imagination in diversifying, widening and extending the intentional arcs whereby we orient ourselves in the world.

Intentionality was defined by Brentano (2015 [1874]: 92) as the mind's 'direction toward an object'.[9] Yet it need not be understood in a top-down, unidirectional way, nor as excluding affective and physical states (Crane 1998, Colombetti 2013). Merleau-Ponty (2012 [1945]: 137) explains his adoption of the term 'intentional arc' as follows:

> the life of consciousness – epistemic life, the life of desire, or perceptual life – is underpinned by an 'intentional arc' that projects around us our past, our future, our human milieu, our physical situation, our ideological situation, and

9 *The Stanford Encyclopaedia of Philosophy*'s entry on 'Intentionality' describes its origins in the Latin term *intentio* defined as the mind's directedness at a present, existent, absent or non-existent object; 'intentionality' was later adopted by Brentano as the defining mark of the mental.

> our moral situation, or rather, that ensures that we are situated within all of those relationships.

Merleau-Ponty captures the continuity across intentional levels, from physical to sociocultural forms, when he describes the way that when moving through a familiar space I know that 'looking out the window involves having the fireplace to my left', or if I am chatting with a close friend 'each of his words, and each of mine contain, beyond what they signify for someone else, a multitude of references', such that 'each gesture or each perception' is 'situated in relation to a thousand virtual cooordinates' (2012: 131). The vitality of each 'mental panorama' thus comprised lies in its combining flux of 'sedimentation and spontaneity' (2012: 131, 132). Expanding and contracting across space and time, our thought-worlds are persistently shapeshifting, resonating with, and providing bearings on the nature of reality and on the specific vantage points from which we are experiencing it. When composing a paper such as this one finds one's thought-world reverberating with, stretching towards, and incorporating new virtual coordinates corresponding to the thinkers and things to which one is responding.[10] This widened array enriches one's thought-world – as after dancing one finds one's body resonating with a fuller and richer sense of the range of possible aesthetic movements. Artworks more generally can sweep us up into such mind-expanding experiences of being. Across our intentional levels, imagination builds on and extends the range of the conceived and the conceivable, with artworks a powerful

10 The term appropriating might also be used here, but in a different sense to that commonly used nowadays. Hofstadter (1975: xx) describes in his introduction to Heidegger, that in Heidegger's use of the term 'ereignen' (translated as 'appropriate') 'he wants to speak of an activity or process by which nothing "selfish" occurs, but rather one by which the different members of the world are brought into belonging to one another and are helped to realize themselves and each other.' A similar notion was intuited by the Stoic notion of oikeiosis (οἶκος, home, family) whereby the self is a series of rippling outwards concentric circles that appropriates to itself the body, other people and the age itself (Anderson 2016b).

means of taking us beyond our imagination's usual limits. The following sections of this paper set out the role of embodied, enactive, embedded and extended cognition in our encounters with the exhibition artworks, highlighting the role and nature of the imagination and the ways in which artworks can dynamically reconfigure our mental panoramas.

Embodied Cognition

While the concept of embodiment has been around for decades, grasping our subjective or even an objective experience of fleshy sensoriness in language, particularly academic language, seems to reduce away from bodiliness's immersiveness and polyintimacy (Anderson 2015a, 2015b, Castañeda 2020).[11] However, artworks that make evident the often non-conscious workings of embodied cognition reveal the ways in which being in a body amidst other bodies and situated in a physical world inflects our realities, our memories and our fantasies. Artworks can resurface such awareness because of their multimedia interfaces, and recall the ways in which relations and representations, including language, originate from and continue to resonate through experiences in our embodied minds in the world.

Embodied cognition is the claim that cognition is routinely shaped in fundamental ways by bodily forms, movements, states and processes. The cognitive role of non-neural physical processes has been shown by numerous experiments, such as those on the roles of body states, gestures and emotions in guiding our inferences and reason-making processes. For instance, David McNeill (2005) and Susan Goldin-Meadow (2003) have both done much work on the ways in which gestures act as ma-

11 Chadwick (2017: 55) charts notions of embodiment in qualitative research commenting that 'while Frank (1995: 27) says, "no satisfactory solution has been found to avoid reducing the body to a thing that is described" in qualitative research. This observation is still salient today, two decades of research later' and she goes on to ask 'how do we 'do' 'fleshier' research?' In my view, embodied cognition provides just such a way forward.

terial carriers for thought, lighten the cognitive load, enable more creative thinking and reveal implicit knowledge that cannot yet be articulated.[12] Such research on gestures helps to contextualize Marojiln Dijkman's *In Our Hands* (2015) which issues a call for action, though not a word is spoken [Figure 1][13]. Two huge virtual hands projecting from a screen form symbolic gestures ranging between warning about or warding off the future. Though extricated from the original bodies and contexts (such as political speeches), the hand gestures and their intentions remain eerily familiar. We can imagine the characters and settings from which they derive, and the gestures' emotional charge itself powerfully conveys a message, though separated from the particularities that speech would impose. The work makes more visible a non-linguistic way through which we think, one that is often non-conscious in everyday life. The conductive gestures of the mesmerizing hands autonomously moving, echo earlier depictions of hands in didactic emblems and paintings, often used to represent the hands of God, an omnipotent supernatural force. Viewers are put on the alert and feel singled out but without explicit instructions of what is to be done – it is left in our hands – and to our imaginations.

The abstract domain arises from embodied and environmental factors, and these are necessarily caught up in our thinking processes. Our concepts are both grounded in our embodiment and the physical world and reach beyond it. This is the *underground superstructure* that Nikolaus Gansterer explores in his 3-screen installation *untertagüberbau* (2017). The screens show him actively thinking through the ideas discussed in the science programmes to which he is listening, which themselves are

12 Such insights into the role of gestures can contribute to educational models: for example, in *Hearing Gestures* Susan Goldin-Meadow demonstrates that our gestures, like language, both enable communication and act as cognitive aids. For example, her analysis of learners' use of gestures shows that gestures enable the performance of more complex tasks by enabling their visuo-spatial and motor representation and freeing up other aspects of cognitive effort.

13 All figures are at the end of the article.

the products of accumulated knowledge processes [Figure 2]. His work shows the entanglement of imagination, perception and memory in literally feeling out new ideas, *and* our reliance on a range of onboard biological and in-the-world cognitive processes. His hands forming and reforming of physical materials, linguistic concepts and diagrammatic symbols, all amidst the random interruptions of living creatures, show the fluidly diverse concert of conceptual and diagrammatic, and embodied and environmental processes in action, and explore the interplay of structured patterns and chance in thinking. Fittingly, the snails featured in the work leave chemical information in their trails of slime, which both physically and epistemically eases the efforts of those which follow after them.

The adaptivity and relationality of neurophysiological mechanisms poise us for dynamic and intimate encounters with the world. For instance, tests involving monkeys using rakes have shown that the brain cells that would normally represent their fingers quickly come to map the rakes' spikes (Maraviti and Iriki 2004). Another way we extend experiential capacities beyond skin boundaries is what has been described as our mirror neuron system (or in terms of motor resonance). When one person watches another person performing an action, neurons fire in their motor cortex as if the watcher were performing the action themselves. Similar systems operate for language, and primal emotions, such as fear, and it has been connected to action understanding, language development, and empathy, since it grounds our capacity to take another's perspective (Rizzolatti and Sinagaglia 2008). Though, notably a response's strength depends on whether you previously have had the type of experience such that it is already in your cognitive repertoire (Calvo-Merino et al. 2005). The fact that we are all in a human body means there are general characteristics that we share, while physical, social and cultural particularities mean that there are also differences. This sharing across persons and our differences are of value, the one meaning we are not condemned to solipsism and the other that a rich and complex array of perspectives flourish. Yet this also suggests that to go beyond our repertoire driven norms, even

our imaginations can benefit from forms of cognitive scaffolding such as are provided through art encounters, whether they are composed of images, music, words, actions or other experiences.[14]

Daria Martin's works explore mirror-touch synaesthesia, where a person feels the emotional or physical sensations that they witness in someone else. In *Soft Materials* (2004) Martin's interest in empathy, touch and mirroring is explored through the emerging relationship between human dancers and robots, both of which have been trained *and* either evolved or developed to actively learn through physical experience [Figure 3]. Both the robots and humans adapt interactively to one another's movements in an uncannily tender dance. The film triggers our innate bias towards imagining consciousness as activating things that are animate – as also occurs with Dijkman's virtual hands. The camera lens concentrates our attention on parallels and contrasts between the forms, artificially focusing our eyes on dark unseeing holes at the end of long metal fingers and on wiry filaments that unnervingly brush and flick around the slender lashes of viscous human eyes. Watching elicits varying degrees of synaesthetic responses, but when cold-looking metal touches blood-flushed flesh the general instinct is to flinch. More contemplative and tentative encounters alternate with metal and flesh bodies juddering into increasingly rhythmic frenzies like new age versions of tribal ritual, creating patterns of repetitive movements from which an arm is suddenly flung, as a new phase of interaction emerges in this unequal dance. An initial sense of the naked dancers' vulnerability in terms of their fleshy form, shifts to awareness of the robots' simplicity and relative fixity despite their being programmed for adaptivity ; an adaptivity which work on embodying Artificial Intelligence has revealed to be so difficult to recreate. Though we humans do a lot of the work in terms

14 The term 'scaffolding' derives from Vygotsky (1962) who showed that language was a developmental cognitive tool and that the intrapsychological was constituted by the interpsychological. He argued that children integrate adult's prompts about actions and information, through developing the ability to use self-directed and inner speech.

of our tendency to anthropomorphize projectively, the robots' functional rigidity in contrast to our natural capacity for imaginative pretense and creative variation (even given our own tendency to fall back on patterns and systems), suggests the immense obstacles yet faced by robotics' researchers. While the humans manifesting of the robots' range more dynamically and expressively than their crude incorporations of the human dancers' movements demonstrates the sophistication of our imaginative capacity's operation through the medium of the body.

The film also recalls tensions between different 4E theorists as to how much the nature of bodies, their fleshy or metal nature, matter. While strong embodied cognition proponents argue that the particular nature of the body plays a special role, Andy Clark (2008a, 2008b) has argued that it does not. In my view the particular nature of the body sometimes plays a special role when performing a certain function or in a certain context, but need not always – and the same goes for any cognitive resource – consequently, variations in the particular nature of our bodies or of historical and cultural resources and environments can be significant but need not always be.[15] Our imaginations are one of the mechanisms that mediate the particularities of our minds predicated on our particular bodies and contexts.

Through making apparent various of the ways in which embodiment shapes cognition, the works discussed so far speak to how philosophical theories only substantiated through scientific or thought experiments can be fleshed out via artworks. They are also transformative of traditional conceptions of art, and of how we may then think about encounters with artworks, including their role in education. A recent edited collection of curators' perspectives on the need for decolonisation of the artworld not only emphasises the need for a broadening of perspective beyond the dominations of male white western artists, but also draws attention to the wider ways in which what is problematic is 'the colonised mind' (Pollock 2020). What is called for

15 Anderson 2015: 30-31; see also Anderson et al 2018-20.

is that we: 'Attune, re-attune to decolonial ways of seeing-thinking-doing-listening' (susan pui san lok 2020) through 'the practice of other ways of thinking, knowing and learning' (Vellodi 2020) in order to counteract the elision of material nature and the body (Onians 2020).[16] Artworks that foreground our minds and selves spanning of brains-bodies-and-worlds enact a decolonisation of the imagination and reveal the nature and value of our cognitive connectedness and diversity.

Enactive Cognition

This brings us neatly to the second E, enactivism. Enactivism claims that cognition is enacted (unfolds) through looping sensorimotor interactions between the agent and its environment, implying both a close relationship between perception and action, and that there is continuity between the properties of life and of mind. As Evan Thompson explains it: 'life and mind share a set of basic organisational principles, and the organisational properties distinctive of mind are an enriched version of those fundamental to life. Mind is life-like and life is mind-like' (2007: 128).[17] Enactivists argue that cognition is a sense-making process: we make sense of the environment in relation to our particular bodies and experiences; for example, this imbues our perception of objects and environments as affording certain possibilities for action. This occurs across lifeforms, modes, and levels. For example, spiders in their web become part of an intelligent system and even at the cellular level an individual cell responds to environmental vibrations by forming ruffles in their membranes that feel around them and by growing nanoscale daddy-long-leg like protrusions to investigate its surroundings (Orapiriyakul et al. 2020): the cells are arguably enacting a very basic form

16 Participatory and community art are exceptions to these norms (see Matarasso 2019); notably, the awarding of the recent Turner prize to four collectives suggests a shift in attitudes to such works in the mainstream artworld.

17 A seminal influence on the emergence of enactivism was the book *The Embodied Mind* (1991)

of sense-making. The robots in Martin's artwork can also be considered as being designed to learn through basic sense-making properties. Drawing on Heidegger, Giovanna Colombetti describes that even at the most basic level of life there is a care by an organism about its existence. An organism utilises affective-evaluative and cognitive-discriminatory capacities such that the world represents what is salient to it; in a higher-level organism these capacities manifest as mind (2013: 19).

This notion of cognition as sense-making is one that also exists in discourses about the arts in general and specifically in relation to the educational potentialities of art engagements. In Francois Matarosso's *A Restless Art* (2019) it occurs in relation to his definition of participatory art as 'democratic sense-making': in contrast to the decline 'in the power of political ideology and religion as systems for collective sense-making' he highlights 'art's sense-making potential' (Foreword, 28, 50, 238). Moreover, he defines humans as 'sense-making beings' and comments on the importance of being aware of 'other people's ways of sense-making' (36, 50). Art, Matarosso argues, provides children with opportunities to share their 'evolving sense-making safely with others' (42).

A notion of evolving sense-making is at play in the artworks of Goro Murayama, a Tokyo-based artist who has been inspired by enactivism. In his *Self-Organised Painting* series Murayama creates his canvas, using the weaving of the hemp to regulate his actions and become part of the system he is making: 'The system also keeps on generating myself. Acting makes me' (2018) [Figure 5]. While caught up creating he is in turn created, such that artist and artwork become a co-constituting and co-emerging system. Murayama (2018) offloads aspects of the creative act onto the environment as a means to probe whether human creativity can emerge from latency: 'In the world surrounded by computers and AI, the concept of order is important for human beings to reconsider their creativity, because we repeat acts and choices.' Though he follows a set of rules, the process can be affected by the nature of the ma-

terials, misalignments and mistakes, and his physical and emotional fluctuations. The emergence of variation out of a combination of systemic repetitions, error and individual expression in an environmental system further invites parallels with Darwin's theory of evolution and epigenetics. Murayama describes his works as 'simulational poiesis' to situate them in relation to forms of simulation used in scientific imaging – a technological form of imagining. While composing it, Murayama anticipates our appraisal of it, as in appraising it we may imagine his composition of it, so the viewer is caught up in the sense-making process through these imaginative acts.

Sartre (1949) describes artworks as brought forth through a reciprocal relationship between the artist and the viewer who co-constitute it. Sartre is influenced here by Merleau-Ponty who compares a work of art with our body – because it too is 'a knot of living significations' (2012: 153). Murayama's woven artworks further reflect our co-creation of and co-emergence from the wider systems in which we exist, representing the kind of mental scaffolding that is provided through the accretion of structures over time that enable as well as constrain the possibility of creativity and imaginative leaps. Artworks can both invite imaginative acts of collaborative sense-making and can make us aware of the sense-making systems in which we are already caught up and so make possible the imagining of alternatives.

Considering further the weaving of diverse strands, arguably, the mind is polythetic; a variable cluster of elements can constitute a certain feature of the mind, and their exact combination can vary. This definition explains how there can be a changing array of significant contributory factors that shape cognition across different cases and contexts. The debate about what constitutes 'the mark of the mental' continues without resolution since a defining feature is precisely the enduring adaptability of the mind and intentionality is a feature which in its expanded form also relates

more generally to life processes.[18] A cluster of combined strands can constitute a certain feature of the mind, such as an imaginative process, but the exact combination of these strands can vary, with the variation in their make-up, potentially though not always having an effect, depending on their intended function and the wider context.

Saliency can extend across more than one organism such that sense-making can be shared. Hanne de Jaegher and Ezequiel di Paolo (2007) use the term 'participatory sense-making' to describe how socially-engaged participants interactively coordinate movements and utterances in a way that both scaffolds and constrains others' activities. In Martin's work participatory sense-making is limited by the extent of the gaps between the humans and robots' capacities, which is manifested in their ways of behaving, interacting and adapting. A fuller form of participatory sense-making emerges via Myriam Lefkowitz's *Walk, Hands, Eyes (Edinburgh)* (2019)[19] in which a trained performer silently and responsively guides a closed-eyed participant around a city, in this case Edinburgh [Figure 4]. The performer holds you by one hand, with their other hand sliding from your back's centre to become an arm round your shoulders when shifting direction. Where motion continues unimpeded seamlessness arises, like monkey with rake (or writer at keyboard), except this involved nonverbal reciprocal attunements, as well as the active incorporation by the guide of the guided's ways of orienting of themselves in the world, such that these roles blurred.

Though (and because) my eyes were closed, I experienced myself as 'looking' with my whole being through a heightened array of senses. Merleau-Ponty describes that when a blind man uses a cane 'it increases the scope and the radius of the act of touching and has become analogous to a gaze' (2012: 144). The potential Merleau-

18 Wittgenstein (1999: 172) illustrates the nature of a polythetic classification, as follows: 'the strength of a thread does not reside in the fact that some one thread runs through its whole length, but in the overlapping'.

19 Other related terms used for this phenomenon are 'joint attunement' (Noë, 2015) or 'we-intentionality' (Zahavi, 2014).

Ponty suggests for parity between external and internal resources and between perception and touch are important. Yet Lefkowitz's work also makes evident the experiential richness offered by a surrogate's non-parity which can open different perceptions of embodied intelligence. Like a butterfly we can be swayed by the motions of a flower in the wind and find ourselves moving to new rhythms.[20]

While a participant on the shared walk as well as my consciousness shifting from an everyday forward-looking perspective projecting from the back of my head into a new awareness of the world as radiating out all around, and into points of interface with the guide that often melted into non-consciousness, it shifted into awareness of my feet against the rebounding pavement or spongy grass. As we wandered through a range of gradients and settings the surrounding sounds, smells and sensations seemed amplified: footfalls' rhythm on pavements, disembodied voices floating past, then the sweetly bitter depth of coffee aroma and traffic's whoosh, later replaced by a gentler swish of breeze through leaves and a sudden sense of warm sunlight on the skin, a delicately sweet scent of grass and the emotionally uplifting song of a bird rising above the background hum. The array of cognitive modes we make use of in the everyday world came more clearly into consciousness.

Taken from a predictive processing perspective, the weighting newly put on other bodily senses in the absence of sight, causes a magnification effect, which accounts for this experience of vividness.[21] Across the 4Es (and beyond), predictive processing has

20 Heidegger (1975: 9) expresses something of this in one of his poems: 'When on a summer's day the butterfly/ settles on the flower and, wings/ closed, sways with it in the/meadow-breeze'.

21 The notion that the loss of one sense led to a supplementary amplification effect in other senses, contributing to particularly distinct phenomenological and expressive capacities, was also suggested by the artist Joseph Grigley (2019) in his exhibition talk through his retelling of the story of a blind baby that learned to perfectly imitate the sound of a refrigerator or the sound of a car turning over the gravel as it is approaching the house.

recently dominated accounts of how cognition works: the mind engages in cascades of hypothesis generation based on a hierarchy of prior evolutionary and developmental experience, with the aim of minimizing the mismatch between these predictions and new experiences, with only errors propagated upward through the system, as a means of tuning future priors (Clark 2016). The myriad mind variously gives weight to internal and external factors deemed as the more reliable sources, so creating our shifting cognitive arrays.

On the walk, despite being newly without visual perception, rather than feeling threatened, a sense of safe exploration and mental spaciousness arose. There was a heightened sense of a background polyphony of environmental intentionalities in all around me, being lived or embedded in the settings I was passing through. Merleau-Ponty (1993: 67) termed this 'inverted intentionality', quoting Cézanne describing that 'The landscape thinks itself in me and I am its consciousness'. The mind feels with and through wider patterns and dynamics, which might be termed biosensibility, and this scales up to thinking with and through them, which can be termed eco-cognition.[22] Furthermore, human designed things and constructed environments are embedded with cognitive capacities and stances. For example, navigation tools incorporate expertise that enable successful navigational computations, while algorithms can problematically perpetuate – but also can help reveal – existing human and sociocultural biases (Hutchins 1995; Anderson 2010). Malafouris (2013: 142, 144) describes how our engagement with material artefacts organise our imagination (as well as vice versa): 'objects and material structures can be argued to point toward me as much as I project toward them', such that 'intentionality should be understood as a distributed, emergent, and interactive phenomenon rather than as a subjective mental state.'

22 Notions of this are prevalent throughout earlier cultures; see Anderson 2015b, Anderson et al 2018, 2019, 2020.

Our city structures further make evident the ways in which humans are particularly talented not just at evolutionarily adapting to environmental niches, but also adapt our niches to supplement cognitive and other needs. Geological, architectural, historical, conceptual and fictional domains in concert compose a place and the accreted layers are a significant factor in the constitution of our phenomenological horizons – at the same time as we participate in their perpetual reconstitution through our ways of inhabiting them. Virtual coordinates, such as those described by Merleau-Ponty, are implicit in our experience of such cognitive niches. Yet epistemic environments and paths can come to constrict more than they enablingly structure, and even the imagination can become overly sedimented into mind-manacling grooves.[23] Approaching a place, through a defamiliarizing sensory experience such as the walk, offers a revitalisation of habituation-numbed possibilities and perceptions. Several times during the walk the guide asks you to open your eyes on a scene: re-entering the everyday world from this more intense reality, the senses may momentarily judder, revealing the speed with which one is already becoming immersed in this new way of being in the world and providing a meta-perspective on it. In discussing the nature and value of meta-awareness, Thompson (2010: 19) comments that 'The ultimate aim is not to break the flow of experience but to reinhabit it in a fresh way, namely, with heightened awareness and attunement.'

As well as the walk's newly bringing forth surroundings, participants have experienced a re-emergence of submerged aspects of themselves. The layers of cognitive pathways formed over our developmental and evolutionary histories, can both make automatic or ignite our current experiences and perceptions of the world, giving them salience. All kinds of surreal experiences have been reported, as participants' imaginations have sometimes offset sensory loss by overlaying past experiences. Un-

23 As Heidegger (1975: 8) puts it in a creative work of his own, a poem: 'The evil and thus keenest danger is/ thinking itself. It must think/ against itself, which it can only/ seldom do.'

dercurrents overflow into consciousness: 'During one of my walks I opened my eyes on a lamppost with a seagull that reminded me somehow of a seaside town I had visited as a child. When I closed my eyes, I felt like I was there, and as the path I walked physically went down, the path in my mind kept going up, it felt as though all the sounds I heard were above me and I was descending into the ground. I felt the edges of the world around me blur and dissolve' (Quoted in Clegg et al. 2019). There is, then, an upweighting of memory-driven imagination. A similar upweighting can occur in love (or other heightened states, such as grief). Take, for example, Shakespeare's description in 'Sonnet 113' of the altered consciousness that occurs through a preoccupation with the beloved such that it shapes all to his image:

> Since I left you, mine eye is in my mind;
>
> And that which governs me to go about
>
> Doth part his function and is partly blind;
>
> Seems seeing, but effectually is out:
>
> For it no form delivers to the heart
>
> [...] it shapes them to your feature. (ll.1-5, l.12)

Such a case, which is one familiar to many humans, could be described in terms of predictive processing having been driven awry by love.[24] Literature, like the other arts, can also helpfully upweight particular aspects of the memory-driven imagination, in the process transforming their associational range (Anderson 2016a).

24 The upweighting and magnification effect on our predictive processing that occurs in 'Deep Dream' might be considered a crude and comic version of the romantic distortions evident in love, which in this case was programmed to simulate the effects of overly strong perceptual predictions of dogs: https://rhizome.org/editorial/2015/jul/10/deep-dream-doggy-monster/. The similar effect in love could still be considered optimal given the evolutionary importance of humans producing children or its importance in creating social bonds (notably, Shakespeare's sonnet is to a beloved young man).

More generally, Lefkowitz's work raises awareness of the ways in which aspects of one's consciousness perpetually expand and contract as we orient ourselves in the world with which we are enmeshed and illuminates some of the ways in which cognitive modes can become imbued or reciprocally generated through engagements with objects, other people or places, and techniques or styles. The term 'fission-fusion' mentioned earlier is also used by ethnology to describe dynamic social networks in which individual animals and smaller groups merge and divide with larger groups, while 'fission-fusion cognition' conveys the flexible and shifting nature of clusters of cognitive units formed across such social arrangements and brain-body-world spans more generally (Anderson 2015a). Through the multidimensional nature of our minds, the fusion of elements of consciousness during Lefkowitz's walk with the guide and the environment can simultaneously play out and be counterpointed by idiosyncratic imaginative flights, across mental space and time, as we spontaneously weave in sedimented experiences to our ongoing thought-worlds, consequently recalibrating them, in more or less considerable ways.

Predictive processing accounts have in general highlighted the overlaps and continuity between perception and imagination: for instance, Clark (2016: 84) describes that creatures are 'poised to explore and experience their world not just by perception and gross physical action but also by means of imagery, dreams, and (in some cases) deliberate mental simulations'. Michael Kirchhoff in analysing the 'inferred fantasises view' and the 'ecological-enactive view' of predictive processing argues that while both claim that 'perception and imagination are unified and dual aspects of a single strategy for prediction error minimization' (2017: 759), the latter view leads to his claim that 'perception and imagination are different in kind', because it emphasises that 'perception is embodied and world-engaging' while 'imagining is an internally realized phenomenon' (2017: 765). The idiosyncrasies of some of the imaginings evoked by Lefkowitz's artwork might initially seem to lend support to this view, in that the participant imagined going up while the actual path went down. Yet there

was an increased tenuousness with perception when imagining, though the imagined remained interwoven with the ongoing perceptual experience, in such a way that it cannot be defined as simply internal.[25] So instead this suggests that cognitive elements can both exhibit a degree of autonomy and of merging in a dynamic system, with a playing out of fission-fusion across these modes of cognitive processing. More generally, the artworks discussed in this paper make evident that imagining is not something that can be satisfactorily defined as just an internal phenomenon. As Lefkowitz (2019) herself describes her practice: 'Dance is speculating with the body, inventing fictions with the body.' Imagining like perceiving draws on and takes place through our bodies and environments, through perceptions, actions, and relations in the world, as well as through onboard mental simulations – this further indicates that there is then sharing across different forms of cognitive processes *and* distinctions between them, and both sharing and distinctions are significant and necessary.

Artworks also produce new experiences by deliberately using artefacts to trigger and interrogate automatic cognitive responses. Magali Reus creates sculptures that make us aware of the automatic nature of our habitual perceptions and actions. She reconfigures familiar objects, such as a fire hydrant, rendering them symbolic gestures rather than usable, so defamiliarising things that usually and often seemingly invisibly help us attune to or adapt our environment. Just as things and environments organise us so do habitual movements and concepts (Merleau-Ponty 2012). Alva Noë (2015: 13) discusses the ways in which 'we get organized by our habitual activities', while an art form such as choreography 'puts the fact that we are organised by dancing on display'. Artworks jolting of us into consciousness or uncertainty compare with Socrates' dialectical method, and with the phenomenological epoché: the need to bracket off everyday experience of a seemingly objective external world in order to

25 Gallagher and Rucińska's (2021) point out, for example, that even a performer mentally simulating a performance constrains that simulation in relation to the actual physical parameters of their body and the performance space.

recognise the malleable subjective nature of phenomena in our lived experience. Notably, this need not entail 'an epoché in respect to world validity' (Husserl 1970: 397).[26] From an embodied and situated perspective, as Thompson (2007: 19) observes, it can be described as 'the flexible and trainable mental skill of being able both to suspend one's inattentive immersion in experience and to turn one's attention to the manner in which something appears or is given to experience.'

In predictive processing terms, an intermedial approach can be argued to be cached out by the way in which the priors, which shape ongoing experience and are iteratively calibrated in the process, integrate the qualities of the observer and the world. There is weight to be given both to the existence of the world and to the ways in which we experience it. Imbalances in our capacity to how we weight external and internal modes can lead to psychological disturbances, such as schizophrenia (Wilkinson et al. 2017). Yet humanities' notions, such as 'the pathetic fallacy' – the projection of our emotional state onto an environment – can err too far in the other direction, by denying any agency to an environment,[27] through an overly anthropocentric worldview. 4E cognition allows for an epistemological realism, which is pluralist and recognises situatedness, yet is also committed to our access to reality despite the partial and subjective nature of each perspective. Predictive processing gives us a way to cache out how this works because our minds are at once shaped by physical, spatiotemporal and other regularities in the world and by our evolutionary and developmental histories. Worldly enmeshment and the capacity for ad hoc fission-fusion states enable our kaleidoscopically complex multidimensional minds.

26 This is the mistake made by postmodernism, and more recently by those thinkers who want to argue for predictive coding as entailing that we are akin to a brain in a vat (e.g. Hohwy 2013).

27 See Cuddy-Keane's questioning of John Ruskin's term 'the pathetic fallacy' in her analysis of works by Virginia Woolf (Anderson et al. 2020: 189-208)

A certain entropic tendency, an instinct to return to the original state of the cell or organism prior to external stimulation, a drive towards lack of excitation or to immersion in pre-existing patterns, can be counteracted by art encounters. Predictive processing conceptualises this entropic tendency in terms of the free energy principle: a drive towards minimising energy expended through minimising errors in predictions over time. However, as Hohwy (2013: 175) notes 'chronically seeking out a dark room does not minimize long-term, average prediction error'.[28] The arts are not trivial – nor are they as Steven Pinker (1997) famously described them, merely cheesecake – they are essential for optimal cognitive functioning. Art plays a vital role in scaffolding and constituting new forms of understanding and enables critical and creative thinking beyond the constraints of one's own unaided imagination, or that of sociocultural norms and conventions in which we can become inattentively immersed. In predictive processing terms, our predictions' encounter with the unexpected in art, recalibrates them and extends their range, generating more imaginative, complex and nuanced future predictions about the world.[29]

Building on the use of distributional reinforcement in machine learning, recent research has found evidence that the brain represents future rewards as a *probability*

28 This tension in predictive processing accounts is anticipated by Stoic notions of the conflict between two fundamental drives which are inversions of each other - these were Christianised by Boethius, are later evident in Francis Bacon's theories, and again much later in Freud's suppositions regarding the life and death instinct (Anderson 2007, 2016b). In these theories the will to live or life instinct is seen as a mistaken expression of the desire for unity with God through death or for a minimisation of excitation through death, which is akin to the notion of the entropic drive. Despite their persistence across Western philosophies and beyond, I do not think it is correct that the desire for perpetuation and for cessation can always be collapsed into each other in this way as simply ultimately a desire for energy minimisation and becoming a unity.

29 The importance of new horizons amidst our sedimented predictions is described by Husserl (1970: 50) along with the way that the pregiven world is the horizon of all meaningful induction and generates all our worlds – which might be taken to encompass the realm of the imaginary.

distribution, with clusters of individual dopamine neurons simultaneously representing a spectrum of different future outcomes, rather than a single average one (Dabney et al. 2020). On the level of subjective experience, this matches our tendency to oscillate between anticipating a range of outcomes – and the heavy blow to our epistemic confidence experienced when blind-sided by an outcome that was not included in our probability distribution. Prior experiences lead to the higher weighting of certain dopamine neurons in these arrays, which produces a tendency towards their triggering with a consequent narrowing of our cognitive range. Our experience through artworks of surprise, shock, dissonance, bewilderment or even wonder, offers a relatively safe opening up of our imaginations, and enables the limbering up of our dopamine arrays for more adventurous wide-ranging hypotheses about ourselves and the world – widening our experiential repertoire by taking us beyond our usual cognitive constraints. This answers the so-called paradoxes of voluntary engagement with imaginative simulations of horror and tragedy, explaining why humans seek out heightened psychological experiences of all kinds through the medium of the arts, outwith the complexities and dangers of real-life encounters with extreme (or cognitively burdensome) phenomena.[30]

In this sense engagements with art as an adult or child is comparable with the developmental potential through 'safe risk' that is offered by play.[31] Studies of the effects of play on young animals' development showed that being deprived of playmates and play led to less developed prefrontal cortexes which are associated with social interactions, impulse control and decision making (Bell et al 2010; Woolston

30 See 'Puzzles and Paradoxes of Imagination and the Arts', *Stanford Encyclopaedia of Philosophy*.)

31 'Playing creates a safe space in which the children can experiment with their relations towards others without the fear of being injured, because all these relations and feelings remain in this playing field. Children enjoy being placed in this form of safe risk and they can follow and participate in human relations and in the succession of emotions' (Raptis 2022: 21)

2021). Bell and colleagues (2010: 7) note that there is consequently a lack of modification in behaviour in relation to different social partners and contexts and that they are generally 'behaviourally more rigid'. Vanderschuren and colleagues (2016) note social play's facilitation of emotional development, creativity and cognitive flexibility, and that there is a particularly intense surge of dopamine and other associated brain chemicals in the young when they engage in social play behaviour. Play in mammals (including we humans) increases the capacity to cope with the unpredictable nature of life. The particular significance of play to the human species is evident in babies suckling of their mothers: it has been argued that whereas in other mammals the young latch on until replete if possible, in humans there is more of a playful quality that involves exploring relational dynamics and the pleasures of touch and holding (Noë 2015).[32]

Such insights support the importance of engagements with the diverse modes of cognitive playfulness that the arts enable, and relate to the supposition above about art's role in diversifying our dopamine probability distributions. Drawing on the insights of Winnicott and Nussbaum, Raptis (2022: 100) comments that the 'arts undertaken by adults perform the function of play and can prepare people for friendship and for their political and ethical life'. Adults generally become more resistant to the types of spontaneous imaginary world building that children more freely enter into which makes the forms of cognitive scaffolding the arts provide and opportunities to engage in them just as vital for us as it is for development in the young. Education can benefit from utilizing this capacity of the arts to widen our cognitive range through relatively safe imaginative engagements, as it takes us beyond our own experiences into the realms of other minds, places and times. Through research on these processes, the cognitive sciences can help to bear out the arts' significance, at the same

32 Cowley et al (2007) focus on the later stage of call and response as the baby develops and there is a playful negotiation of feeding times, remarking on the reciprocal nature of the entrainment that optimally occurs.

time as the sciences can benefit from understanding the working of our minds through their illumination by artworks. As we have also seen in this section, enactivism's notion of cognition as a sense-making process evident in and operative across diverse forms of life and materialities can help make us aware of how human consciousnesses extend across and share an array of ontological and epistemological qualities with other forms of existence.[33]

Embedded and Extended Cognition

The last 2 Es are worth exploring together since embedded cognition is a weak version of the extended mind claim. Embedded cognition is the claim that external factors (such as resources or environments) act as noncognitive aids to an internal thinking system located in the brain; so, while the external factors enable cognition, they are not themselves counted as cognitive. Extended cognition instead argues that cognition can involve a coupled system of brain, bodily and external factors: all of which count as cognitive. The embedded stance is one many more people easily agree to, but it also makes more trivial the role that the external resources play – it is not as important as the onboard neurological factors which is what does the actual thinking – the thinking system is internal and the external factors just a tool or aid. For example, in the case of Gansterer's *untertagüberbau*, the difference would consist of whether you count any of the external factors, such as his listening to the lectures and manipulating the objects and symbols as constituting (rather than just enabling) his cognitive processing and creative potential. The active nature of his reflections and adjustments in a two-way feedback loop as the work manifests, with his behaviour guided and his beliefs constituted though his artistic process spanning brain, body and world makes

33 Similar ideas emerged in the artist Joseph Grigley's exhibition talk (2019) which discusses how in our relationship with a certain river we merge into a consciousness of and are recalibrated by its particular ways of being, and he quotes from Keats, how 'if a sparrow comes before my window, I take part in its existence, and pick about the gravel'.

a case for the stronger hypothesis. Clark's (2003: 77) discussion of sketching as 'an iterated process of externalising and re-perceiving' is more generally applicable to the dynamic and open-ended process of thinking through making that occurs in Gansterer's works.

While our bodies and technologies in combination with our imaginations can help us to achieve new scales and modes of knowledge that are otherwise beyond our comprehension, several artworks in the exhibition, such as those by Agnieska Kurant and Angelo Plessas, also deal with current anxieties about technology and highlight the negative effects of it being wielded by consumerist capitalist culture, raising concerns that it is making us servile rather than super-human. Cognitive science often focuses on distribution as a way of enhancing cognition, but it is not always beneficial. Husserl's criticism that through 'the embracing of the factual sciences of the lower level', the 'total world-view of modern man' has become focused merely on achieving "prosperity" at the expense of 'turning away from the questions which are decisive for a genuine humanity' seems more pertinent than ever in the twenty-first century (1970: 10, 6). The epic scale crises we are undergoing are being tackled through fossilised thought systems which have often become more mind-manacling than mind-extending, necessitating a reorientation of human-world relations, including a rethink of the exploitative ways in which post-industrial capitalism harnesses new technologies and perpetuates colonial forms of dispossession. The artworld is complicit to the extent that it silently participates and perpetuates its values. Artworks, artists' practices, art galleries, art markets, art programs, and cultural and art histories are themselves embedded in and affect the co-selection and co-construction of our shared environment. Agnieska Kurant's works cast a critical eye on the technological distribution of cognitive tasks across networks of human minds, employing unsuspecting Mechanical Turkers to each draw a single line (*Production Line*), or unwitting termite colonies to build mounds out of coloured sand and glitter (*A.A.I.*), in order

to create her works. She compares this with the way we are exploited through our participation in social media corporations, not realising that our playbour is being harvested for profit. Kurant argues that this matters because collective intelligence is our best means of understanding cognition. She and named co-creator, John Menick, share the profits from the *Production Line* series with all the creators of it, in a way that troubles usual notions of the lone genius; though most of her co-creators remain in the dark during the process, such that it does not imply a stronger challenge to the notion of epistemic credit. Nonetheless, her works resonate with recent research in economics, such as Mariana Mazzucato's (2008) exposure of the mythical nature of the idea of individual entrepreneurs and solitary start-ups as at the heart of innovation: in many cases, value extraction has been dressed up as value creation. The artworks problematize the default location of thoughts as in an individual brain and highlight cognitive science's tendency to focus on optimistic problem-solving versions of extendedness and lack of sufficient ethical scrutiny. The 4E perspective engendered by the exhibition has in turn served to recalibrate contributing artists' understanding of their own works. Lefkowitz (2020) commented that it 'gave me another way to see my piece as itself a political action and, relatedly, to understand my rejection of the mythology of any 'natural' self that is not, in the first instance, entangled with embodied others.'

What else do we discover when we shift from only focusing on notions of information storage, abstract hypotheses, and scientific experiments to also considering cognitive engagement with artworks of all kinds? Renaissance scholar Michel de Montaigne described that for lack of a memory (like Otto) he made one of paper. Like Murayama with his canvas of entwining threads, which manifests a self-sustaining system, so in the linguistic realm, Montaigne describes a similar two-way movement, back and forth, between his construction of his book and his construction by the book: 'I have no more made my book than my book has made me – a book consubstantial with its author' (2003: 612). The mind through being produced on the

written page produces the mind which in turn produces the book. There is an important distinction here between Otto and Michel, since Montaigne often draws on his personal memories, in concert with facts about the world (like Otto) and others' ideas. Hence it is not just his sense of the world, but of himself, that is being is externally mediated. It is a narrative told to himself that plays a role in his self-understanding and self-generation, as well as expressing his capacity to learn from others' past experiences as well as his own by means of the interweaving of quotes and textual allusions into his fabric. While Otto is presented as suffering from a memory impairment, Montaigne's supplementation is indicative of our more general reliance on brain-body-world extensions.

Even when we are reading a book or listening to a story by another, especially one with rich and vivid language, we flesh out the words through drawing on our own experiences and memories, our memories are then recalibrated through the new networks of associations that emerge through our imaginative engagement. Our conceptual horizons are thereby widened and made more flexible, as discussed earlier through the lens of predictive probability distributions. Recent research has shown that we use the episodic memory not only to remember past events and predict future scenarios, but also to *imagine*: the same neural processes are applied to our own real lives and to our imaginative participation in fictional scenarios or other people's stories (Hassabis 2007; Mullally 2012). This answers the other three key puzzles associated with the imagination and the arts: that of imaginative resistance, emotional response, and moral persuasion by the arts. It is because of the imagination's intimate relation to our experiences in the world – which they then expand on through building on our existing thought-worlds – that the arts can cause emotional responses and be morally persuasive, and that there nevertheless remain limitations on what we can imagine.[34]

34 See 'Puzzles and Paradoxes of Imagination and the Arts', *Stanford Encyclopaedia of Philosophy.* While philosophical debate has tended to ascribe the notion of imaginative

A closing example I want to consider in more depth in relation to all this is Marcus Coates' film *The Trip* [Figure 6]. On the screen, the walls of a room frame a window through which we see a mundane scene below of an everyday road, down which anonymous figures journey along. The viewer is informed that they are in St John's hospice and notes the medical type paraphernalia on the left wall. As during Lefkowitz's walk I felt like I was eavesdropping on the unseen. We hear Coates and a patient Alex H. as they plan a different form of participatory sense-making and shared intentionality, with an additional layer of complexity in play by means of language, which also has the capacity to evoke perceptual and embodied simulations in a listener or reader (Bolens 2012; Anderson and Iversen 2018). Coates offers to travel to the Amazon Rainforest taking with him questions Alex would like to ask the indigenous Huarani people were he himself able to travel. Sitting quietly in the dark the viewer becomes eerily aware that they seem to be sitting roughly in the place in the room that Alex and Coates must occupy in the film world, sharing a certain equivalency of point of view.

resistance primarily to the moral domain claiming that while we can easily imagine wildly different physical realities, there are severe constraints on our capacities to imagine different moral realities, I believe that this distinction is overstated, and risks misunderstanding much of how child's play, and literary, dramatic and artistic techniques play on similarities (and distinctions) across forms and functions. For example, consider how much easier it is to imagine that a banana held to the ear is a phone than an apple, or how much easier it is to slip between the image of female genitalia and a rose rather than a sunflower, which relates both to conventions and there existing a closer physical correlation. The range of what we exhibit imaginative resistance to shifts across time and cultures whether this relates to physical or moral reality and relates to wider conventions and contexts. To the extent that there is greater imaginative resistance to certain fictional moral statements this ties into the relation of moral stances to autobiographical memory and its conservative drive towards seeking coherence of self-identity (see Conway 2005), and the fact that it also plays a role in generation of fictional domains, as discussed further below. My contention for an extent of continuity across these domains is also supported by research that shows that moral valence is grounded in our physical realities, e.g. see Casasanto 2009.

The importance of engagement with the real world in concert with use of the imagination, is suggested by the fact that Coates feels the need to make the journey rather than just make it up.[35] Opposite this work in the exhibition, Coates' *Extinct Animals* [Figure 7] is a clutch of plaster hands cast as shadow puppets that mimic the shapes of animals whose extinctions were caused by humans: the ghostly white hands failure to summon or adequately embody what has been lost serves to demonstrate the limits of imaginative powers. Coates' works more generally explore the capacity of the unconscious and pretense to enable imaginative leaps. The rich repository of our unconscious mind, he argues, can be accessed via the visual, vocal and physical imagination, narrative improvisation and through using 'tools for travelling', such as the animal-costumes he dons in some of his works (2014). In *The Trip* he functions as Alex's tool for mind-travelling (and to an extent vice versa).

When Coates returns with the story of his travels, the view of hospice room and through the window remain much the same, and though the light has subtly changed the colours remain subdued in contrast to Coates' vivid evocations of the Amazon. Research has shown similarities in neural activation by visually presented objects and verbally prompted imagery, and that eye saccades move similarly when just imagining looking at something and when they are perceiving it (Kosslyn et al 2006; Reddy et al 2010). Yet there is a discrepancy between early brain regions activated by perception and mental imagery, except where mental imagery is sufficiently rich and detailed (Cui et al 2007). Here, the screen and the heard words show us how the world before us can become like a shadow as our minds too are propelled merely via the sense-evoking capacity of storytelling to the green humid teeming vibrancy of the Amazon, such that the straight road on the screen seems to quiver on the verge of becoming the winding river.

35 As Woolston (2021) comments 'make-believe has its limits'; one limit in our imaginative simulative capacity that has been explored is the distinction between a felt versus a fake expression of emotion, with the latter leading to cognitive strain (Holodynski 2020).

The everchanging nature of imagining something – just try to hold a steady image of a familiar face or place in your mind for a minute – has long been seen as sign of its inferiority to perception (most famously by Hume), when in fact it is a strength that it is so able to be in motion and to riff off the perceived world in this way. Our niches are always subject to change, and imagination is a mediating mechanism for our enduring adaptability to them and ability to adapt them. It is easier for us to alter something in our imagination than in real life and this can serve as a relatively low-cost testing ground. In relation to its minimization of cognitive load this might be compared with the biological memory's capacity to forget as well as remember. The imagination enables our cognitive enrichment and diversification through its generative flitting, flickering and morphing, and fission-fusion relation to the real world.

The rich polyvalent nature of language, imagery and symbols common to literary texts and artworks also dynamically widen our cognitive range. Deirdre Wilson (2012) has argued that 'Relevance Theory', primarily associated with communication analysis, can usefully be applied to literary analysis with a distinguishing feature of literary texts its frequent use of weak implicatures that mean one has to range widely around one's mind to make sense of the words (whereas with the strong implicatures of everyday language one lands more immediately on the meanings). As literary readers update their hypotheses of the words' associations – their linguistic priors – an invigorated, deepened and widened semantic and conceptual scope emerges. This widening of horizons can be attributed to those engaging with artworks more generally: thus the imagination working in concert with all kinds of artworks can dramatically widen and extend our cognitive horizons across multiple intentional levels. Language reveals particularly strongly the extended nature of our minds through the ways in which it enables us to label and navigate physical, abstract and imaginary worlds.

In *The Trip* (2011) Coates gives Alex the vicarious experience of a place and a people – cognitive scaffolding for a journey into the unknown – as in turn Coates' journey is shaped by his role as seeker and storyteller on Alex's behalf. Before Coates sets off, Alex raises the question of whether one more experience matters when he is going to die soon anyway. He also suggests that the fact that someone else did this for him means it does: caring – the primordial affective-appraisal process – has entwined them, through the offer itself and latterly through the imaginatively shared journey reciprocally recalibrating them both.

Recent research on vicarious memory has shown that indirectly experienced traumatic events, for example as experienced by children of holocaust survivors, need not necessarily differ in terms of frequency or characteristics from cognitive intrusions caused by directly experienced events (Dashorst 2020); other non-traumatic forms of vicarious memory can also resemble directly experienced ones, facilitated by factors such as a mnemonic self-appropriation bias.[36] When suffering the later stages of his illness, Alex described the consoling nature of imaginatively recalling the journey.[37] Such two-way phenomenological sharing across persons, though necessarily constrained, poignantly illuminates our capacity to fundamentally shape each other through storytelling. It is an experience which we the audience, in turn, share in and take away with us through our experience of the film, which has added a further layer of meaning through its artistic creation, installation in the gallery, and inviting of us in.

36 It has been shown that people tend to appropriate other people's memories more often than they ascribe their own memories to others and retrospectively believe that their own rather than their partner's memories were shared (Hyman Jr. et al 2014; Jalbert et al 2021). Werning (2020) argues that vicarious experiences can cause neural traces that later give rise to episodic memories.

37 Coates (2011): 'Artist's note: Alex died not long after this interview. In our last conversation we continued to talk about our trip. He said that he often went down the river and into the jungle when he needed to.'

Our general state of immersion in the world seems to be held up and at a distance via the view of life going on through the hospice window, while the immersion enabled by the story, and on a metalevel by the film, are at once an extension of this and offer a reflective counterpoint. This dynamic echoes Thompson's (2007: 19) account of the epoché: 'Suspending one's inattentive immersion in experience implies the capacity to notice such immersion, and thus implies what psychologists call meta-awareness (awareness of awareness).' He further notes that the capacity to redirect attention in this manner implies and is creative of a capacity for cognitive limberness. Meta-awareness invites a recalibration of one's engagement with the world, as does the reminder of our individual biological mortality and the importance of caring and creative acts that extend beyond such boundaries.[38]

Through Coates' artwork we witness the complex arrays of ways in which forms of fission-fusion cognition are expressed in our everyday lives. Our words, creations, and the effects of our actions persist, after their enactment (and our bodily obliteration), providing conceptual structures that recalibrate others' realities and fantasies. Coates' film ends with a fragment of a story interwoven into the story, a voice from the oral Huarani tradition rings out, singing a story of the kapoc tree, associated with the origin of life; the story is composed of rhythmic patterns of syllables unfurling that – like Martin's dancers, like Murayama's threads, like our minds – suddenly shift

38 We can also rethink the nature of individual mortality through understanding that selves as well as minds extend through external resources (Anderson 2015). Clark (2013:134) has argued that non-conscious thoughts popping into our minds provides a counterargument to ascribing the term 'cognitive' only to conscious thoughts. This point can be extended to provide a counterargument to only counting conscious forms of existence as forms of life. Such ascriptions are already evident in notions of continued existence through textual forms, through biological offspring or other people, and now through virtual or robotic forms. These ascriptions are not mere metaphors as they are sometimes thought to be.

into a new phrase, till the song erupts in a high sung open-ended note, sounding a last release of surprise and wonder.[39]

Creation of the Exhibition and Knowledge Exchange Events and Workshops

To return now to the beginning and how it all came about: the collaboration between academic researchers and Talbot Rice Gallery (TRG) staff involved exploring how philosophical and humanities research about distributed cognition spoke to contemporary art and how it in turn had much to say about how these ideas are conceived.[40] Furthermore, we wanted to examine how these ideas could inform not only the content but also the methods involved in sharing and exploring them with the public and specialised groups.

Curator James Clegg, director Tessa Giblin and the rest of the TRG team started sparking ideas with us about artists and artworks that would bring the ideas to life by revealing, evidencing, and challenging current concepts of distributed cognition. As happens in the best type of collaboration, together we came up with ideas for the exhibition and forms of outreach that we would not otherwise have been able to conceive: sharing ideas, and filtering them through each other minds we came to reperceive them, batting them back and forth in metamorphosing shapes. The ways in which each of our minds had been shaped by distinct life experiences (including our

39 This closing itself contributes to the capacity of the viewer to hold the piece in their mind – things that take us by surprise retroactively enhance our memory of them (Congleton and Berntsen 2020) – as one might expect given a predictive processing account of the mind, which more generally further suggests why encounters with artworks can be so impactful.

40 Academic team: Miranda Anderson, Douglas Cairns, Mark Sprevak, Mike Wheeler; Talbot Rice Gallery staff: James Clegg, Tessa Giblin, Melissa MacRobert, Caroline Grewar, Colm Clarke, Stuart Fallon, Charis De Kock, and all other TRG staff.

educational backgrounds, themselves comprised of intellectual traditions and disciplinary cultures) ; our engagements with the potential artworks (themselves expressing the particular cognitive composition of the artists' and their current and previous conceptual, sociocultural and physical environments), and the nature of the gallery environment in which we imagined bringing together the artworks, all contributed to the nature of the exhibition.

The gallery distinctively comprises classical style Georgian and white cube spaces, with enclosed halls and labyrinthine stairs weaving between and around them and opening out onto balconies. It has one side set against the cloistered feel of the University of Edinburgh's old college set back from a busy city street, while the other looks out onto a cobbled close, embedding the gallery in the multi-layered city of Edinburgh, itself a hybrid of old and new stretching from the heights of Arthur Seat's greenly clad volcanic rocks down to the widening circuits of the sea.

High in the encircling yet open-ended 'Round Room' [Figure 8] a series of permanently looping audio recordings exploring the research behind the exhibition were made available through headsets hanging on walls to which visitors could plug themselves in. Modelling doh, at first presented as a flat thin surface layer spread across a rounded table, was available for people to explore responses to the exhibition, to others' creations, or whatever took shape through a tactile feeling of them forth, emerging over the course of the exhibition into an ever-evolving collective mindscape.

Myriam Lefkowitz and her performers descended on Edinburgh College of Art (ECA) to train guides for *Walk, Hands, Eyes (Edinburgh)*.[41] Lefkowitz then joined Plessas, Coates, Clegg and myself for a panel presentation that gravitated around considerations of the artworks alongside reflections on the ethical and political implications of distributed cognition for our ways of being in contemporary culture and so-

41 Lefkowitz's artwork was separately funded by Creative Scotland. Participation on one of the dyadic walks could be booked throughout the run of the exhibition.

ciety. As well as a formal and recorded talk, the deaf artist Joseph Grigley gave an informal talk at TRG explaining the emergence of various of his artworks out of a playful organisation of notes made by many hands across many occasions, verbal and pictorial traces of a disparate array of minds at particular moments in time, brought newly into open-ended conversation with each other and the exhibition visitors [Figure 9 and 10].[42] The exhibition culminated in a symposium bringing together the curators, philosophers, two of the contributing artists and the public to generate further interdisciplinary dialogue.[43]

Around 3,500 people came to the exhibition between November 2019 and February 2020. In a survey of 149 of those, eighty percent said they had learned something and nearly half (forty-seven percent) said the experience had changed the way they thought about the mind. Curators took groups on guided tours of the exhibition and other gallery staff were provided with training about 4E cognition and its relation to the exhibition artworks.

Engagement beyond those with the general public and academic audiences built on Talbot Rice Gallery's existing relationships with a wide range of community and educational organisations.[44] Recent decades have seen the rise of doubts about the relevance and value of the arts and humanities (Collini 2009; Nussbaum 2010). How-

42 Joseph Grigely, Artist Talk, *The Extended Mind* (2019): https://www.youtube.com/watch?v=pJDaRwNjf5c.

43 *The Extended Mind* Symposium and Public Lecture: https://www.trg.ed.ac.uk/event/interdisciplinary-symposium-art-extended-mind. Talks by Miranda Anderson, Andy Clark, Marcus Coates, Giovanna Colombetti, Myriam Lefkowitz, Jesse Prinz and Michael Wheeler. (Funded by the University of Stirling, University of Edinburgh, Edinburgh University Press, the Scots Philosophical Association and the Royal Institute of Philosophy).

44 The staff and partner organisations involved were: Zoe Jones of Crisis Scotland, the art tutor Alan Stanners from HMP Shotts, Nicky Jessop and Eve Murray of Royal Mile Primary School, Alex Dunedin of Rugged University, Margaret Zarate Hills and Ruth Switalski of Queen Margaret University.

ever, research has shown that participation in the arts has a positive effect on mental well-being; that it has the capacity to help offset childhood disadvantage; to lead to the creation of more compassionate, critical and civilized societies; and that there is currently significant inequality in terms of participation in the arts.[45] The discussions above about the role of the arts in expanding our cognitive range in this article supplements such evidence. The theory of fission-fusion cognition further demonstrates why exclusiveness narrows the diversity and fruitfulness of culture experienced by us all.

A workshop bringing together staff from community and educational organisations with the academics and TRG Gallery staff helped shape understandings of the relevance of distributed cognition to the people they work with and informed the construction of activities. Discussions with staff members from Crisis and HMP Shotts led to shared insights into the potential helpfulness of distributed cognition as a concept to the people that they work with in terms of thinking through how they manage to adjust to being without such conventional home environments. Our homes tend to be (more or less) sensorially, mnemonically, and affectively adapted by us to provide nurturing environments that in both conscious and nonconscious ways supplement our capacities to think and shape our sense of self. At times these are shared with family, friends or other people who act as (more or less) positive aspects of our 'social prosthetic systems', that is people who help us calibrate our emotions, beliefs, decisions and behaviours.[46] People in prison need to deal with confined, institutionalised and socially delimited settings which impacts a capacity to use the social and physical environment for such crucial forms of cognitive supplementation.

45 http://www.artshealthandwellbeing.org.uk/appg-inquiry/; https://beta.gov.scot/policies/arts-culture-heritage/culture-strategy-for-scotland/;https://www.gov.uk/government/topics/arts-and-culture.

46 See Stephen Kosslyn's (2006) paper on social prosthetic systems. Also see McCarthy (2013) on homeless women's need and capacity to create alternative forms of home making.

While people who are affected by homelessness lack many aspects of the more permanent home structures that can lend purpose, pleasure and ease to our cognitive lives. The workshops with prisoners involved academic talks followed by collaborative exploratory exercises with the group. The workshops with people affected by homelessness involved informal lunches, talks by the academic and curatorial team, questionnaires that invited reflection on the artworks in relation to their own experiences and lives, and then a presentation to others sharing their response to one of the artworks. Our aim here was 'the generation of knowledge rather than its extraction, through a merging of academic and local knowledge to provide marginalized groups with tools for analyzing their life condition.' [47]

A further workshop for the visually impaired community was led by Julianna Capes, a guide specially trained in communicating about artworks to such groups. A tour and talk was also provided for 'The Ragged University', which supports free peer-led learning in communities where socio-economic factors have made conventional institutional forms of education less accessible. Its coordinator, Alex Dunedin (2020), commented that it 'inspired a sense of belonging and affection which is much needed to deepen the ownership of the intellectual realm beyond the professionalised enclosures which so often obscure valuable amateur investment in scholarship [...] I would describe this experience as consciousness broadening.' Dunedin's statement aptly reflects our aim as sharing in that of the Rugged University's in terms of open-

47 See: A Tri-Pillared Approach to Research (Version 2), https://www.mcgill.ca/globalchild/tri-pillared-approach. If recreating such types of engagement, it would also be valuable where possible to involve service users into the initial consultation around the shaping of activities too, though insights from both groups emerged and generated discussions in the course of the workshops, and responses and feedback were positive. Turn out for the workshops for people affected by homelessness were consistently poor, a factor itself reflecting the unstable nature of lives, but also more optimistically (at least in one respect) as some people had seasonal work and were unable to attend, and one participant went on to create a presentation on his response to an artwork as part of a Scottish Qualification Agency task.

ing out participation in the arts and education, though much more extensive socioculturally recalibrative measures are necessary in order that the multiplicity of our diverse experiences and perspectives can enrich us all through widening our collective horizons.

A series of workshops with Royal Mile Primary School pupils, aged around 9 years old, involved a discussion about the question of what philosophy and distributed cognition are, and then a series of small group activities based around four of the artworks. Echoing Grigley's artwork, at the end of the first workshop the children used post-it notes individually and in small groups to verbally and pictorially explore responses to the artworks in the exhibitions and to generatively respond to each other's responses [Figure 11]. To close the final workshop, small groups of children also created presentations on one of the activities to the rest of the class and parents and teachers. The introductory talk and activities were later adapted into online resources for children during the Covid-19 pandemic.[48]

After being introduced to the research ideas behind the exhibition and being taken on a tour, groups of Art Psychotherapy MSc students from Queen Margaret University were invited to choose an artwork as a means of engaging people with the exhibition works. For example, one group of students developed an activity that played on the visual experience created by Willie McKeown's painting *Untitled* (2008) which creates a sense of gazing into the bright nebulousness of a haar as your eyes reach to discern is dispersed by its diffuse light [Figure 12, Right]. In resistance to our hyperreactive content overloading culture, the painting's lack of a sense of a visual endpoint leaves one reaching out, in increasing awareness of this act and relation, and brought into a reflection on this awareness. This group of students' planned activity [Figure 13] invited the participant to sit silently for twenty minutes

48 *The Extended Mind* Activity Pack: https://www.trg.ed.ac.uk/sites/default/files/2021-01/TEM%20Activity%20Pack%20REV.pdf.

with the painting and a blank sheet of paper to see what words came to them, this list was then passed to another participant who would use these words as a stimulus for the creation of a painting, thus distributing the cognitive response to the artwork, and exploring continuities and discrepancies between individuals in terms of those responses and the responses to the words used, which could then be explored by having been made manifest on paper.[49]

The workshops also evolved collaboratively across academics and curators, and ideas and artworks, and drew on the creative and critical responses of the participants. The exhibition benefited from insights from across the arts and the sciences and aimed at inviting wider consideration of how creating opportunities for more understanding of the holistic nature of the mind can counteract sociocultural and hermeneutic circles which narrow our cognitive horizons. Through evidencing and drawing on the mind-expanding value of engagement with the arts we can become more aware of and transform the ways in which we inhabit the world.

All our heart's courage is the

echoing response to the

first call of Being which

gathers our thinking into the

play of the world. . .

(Heidegger 1975: 9)

Conclusion

The exhibition itself and the events around it involved rich two-way exchanges between artists and philosophers and it is fitting to draw this paper to a close by giv-

49 The names of the art therapy students who designed this activity are: Ania Przybysz-Hunt, Hannah Forrest, Joanne Sykes, Manny Soora and Mirjam Cunningham.

ing voice to an artist's perspective about the ways a 4E cognition perspective can inform understanding of how we imaginatively engage with and create art. Coates commented that 'following my involvement in 'The Extended Mind' project, it has now become very obvious to me that processes such as embodied thinking, using each other as scaffolding for ideas, and collective imagination are absolutely central in art.... those research ideas also provided the baseline from which the viewer could create their own relationship with each work [such that] one could understand one's relationship with the work in terms of one's own processes of thought' (Coates 2020).

When we engage with artworks it is from our own particular perspective and yet they allow us to go beyond our usual imaginative range, with each style, each artist, and each work, providing distinct forms of cognitive mediation, in a way that reflects back on ourselves and the world around us, and adds to the wealth of virtual coordinates through which we more generally orient ourselves and enact our worlds. The imagination draws on and co-operates with cognitive processes that arise from and span our physical and sociocultural resources and environments. Texts, artworks and other cultural artefacts enable an expanding of our imaginations across time and space. Artworks combine in subtle knots of living signification the cognitive modes embedded in materials and methods, the mind of the creator and their context, and that of participant, spectator or reader, thereby extending and revitalising our customary mental panoramas.

As we have seen, the imagination counteracts our tendency to minimise cognitive load, via overly restrictive mental panoramas, through opening out our cognitive arrays (for example, via recalibrating probability distributions). The increase in cognitive effort this requires over the short term is offset by its widening and deepening of our cognitive repertoire. It also enables a minimisation of cognitive load through forms of imaginative (fore)play which are less burdensome than real world enactments. Both these factors are enriching of our minds and realities. The use of some of

the same cognitive mechanisms to perceive and act in the world and to imagine perceiving and acting in the world, suggests why artworks provide especially catalytic scaffolding for perceptual flights into and beyond the usual constraints of rational thinking or our own unaided imagination, while also inviting reflection on the more mundane structures that shape our lives and imaginations. Where there is a narrowing of focus in cognitive scientific accounts, it can be illuminated and countered by examination of the wide range of levels and modes of cognitive experience evident in artworks. The arts enable critical and creative thinking that can counteract the biases and limitations of our biological cognitive capacities and anthropocentric perspective – as well as that of a narrowly scientific mode of enquiry into the mind. Such engagements in turn can reawaken us to the potential of other cognitive resources, such as our technologies, not simply to echo or amplify existing constraints in our thinking but instead to inform and orient new ways of being in the world. The extent of our capacity to expand our minds across our current sociocultural and physical world, and via the cognitive scaffolding provided by earlier generations, places in question short-term individualistic ends. *The Extended Mind* exhibition is a way of reminding ourselves of the importance of the imagination and of the messy, multifaceted and already interconnected nature of our minds.

References

Anderson, M. (2007), 'Chaucer and the Subject of the Mirror', *The Book of the Mirror.* Newcastle: Cambridge Scholars Press

Anderson, M., H. Ishiguro, and T. Fukushi (2010), 'Involving Interface: An Extended Mind Theoretical Approach to Roboethics', *Accountability in Research* 17.6: 316–29.

Anderson, M. (2015a), 'Fission-fusion cognition in Shakespearean drama: The case for Julius Caesar', Special Issue: Social Minds in Factual & Fictional Narration, *Narrative* 23.2: 154–68.

Anderson, M. (2015b), *The Renaissance Extended Mind*, Basingstoke: Palgrave Macmillan.

Anderson, M. (2016a) 'Literary Distributed Cognition and Memory', History of Distributed Cognition Website, http://www.hdc.ed.ac.uk/blog/literary-distributed-cognition-memory [accessed 1 October 2020].

Anderson, M. (2016b), 'Francis Bacon's flux of the spirits and Renaissance paradigms of hybridity and adaptation', Francis Bacon on Motion and Power, ed. G. Giglioni et al. *International Archives of the History of Ideas,* vol. 218, Cham: Springer, 133–51.

Anderson, M and Gallagher, S. (2016c), 'A Pattern Theory of Love and Self in Shakespeare's Sonnets', Cognitive Futures in the Humanities Conference, Helsinki.

Anderson, M. and S. Iversen (2018), 'Immersion and defamiliarization', *Poetics Today* 39.3: 569–95.

Anderson, M., M. Wheeler and M. Sprevak (2018–20), 'Distributed cognition and the humanities', Volumes 1–4 in *The Edinburgh History of Distributed Cognition Series*, Edinburgh: Edinburgh University Press, 1–17.

Anderson, M, D. Cairns and M. Sprevak (eds) (2018), *Distributed Cognition in Classical Antiquity*, Edinburgh: Edinburgh University Press

Anderson, M., P. Garratt and M. Anderson, M. and M. Wheeler (eds) (2019), *Distributed Cognition in Medieval and Renaissance Culture,* Edinburgh: Edinburgh University Press.

Anderson, M., G. Rousseau and M. Wheeler (eds) (2019), *Distributed Cognition in Enlightenment and Romantic Culture*, Edinburgh: Edinburgh University Press.

Anderson, M., P. Garratt and M. Sprevak (eds) (2020), *Distributed Cognition in Victorian Culture and Modernism,* Edinburgh: Edinburgh University Press.

Bolens, G. (2012). *The Style of Gesture: Embodiment and Cognition in Literary Narrative*. Baltimore: John Hopkins University Press.

Brentano, F. [1874] (2015), *Psychology from an Empirical Standpoint.* Abingdon: Routledge.

Bulwer, J. (1644), *Chirologia*. London.

Calvo-Merino, B., D.E. Glaser, J. Grèzes, R.E. Passingham and P. Haggard, (2005), 'Action Observation and Acquired Motor Skills: An fMRI Study with Expert Dancers.'. *Cerebral Cortex* 15.8: 1243-4–9.

Casasanto, D. (2009) 'Embodiment of Abstract Concepts: Good and Bad in Right- and Left-Handers', *Journal of Experimental Psychology: General* 138.3: 351–367.

Castañeda, A. A. (2020), 'The Rabinal Community Museum', European J*ournal of Philosophy in Arts Education* 1.5: 68–95.

Chadwick, R (2017), 'Embodied methodologies: challenges, reflections and strategies', *Qualitative Research* 17.1: 54–74.

Clark, A. (2003), *Natural-Born Cyborgs*. Oxford: Oxford University Press.

Clark, A. (2008a), 'Pressing the Flesh: A Tension in the Study of the Embodied Mind?' *Philosophy and Phenomenological Research* 76.1: 37–59.

Clark, A. (2008b), *Supersizing the Mind: Embodiment, Action, and Cognitive Extension.* Oxford: Oxford University Press.

Clark, A. (2013) *Natural-Born Cyborgs.* Oxford: Oxford University Press.

Clark, A. (2016), *Surfing Uncertainty*, Oxford: Oxford University Press.

Clark, A. and D Chalmers (1998), 'The Extended Mind', *Analysis* 58.1: 7–19.

Clegg, J., Anderson, M. and M. Wheeler (2019), *The Extended Mind/ Walk, Hands, Eyes (Edinburgh)*, Talbot Rice Gallery, 48 pp./ 74 pp. (illustrated), https://www.trg.ed.ac.uk/exhibition/extended-mind.

Coates, M. (2011), *The Trip*. https://www.marcuscoates.co.uk/projects/94-the-trip.

Coates, M. (2014), *A Practical Guide to Unconscious Reasoning*. London: Bookworks.

Coates, M. (2020), 'Personal testimonial', 25 February 2020.

Colombetti, G. (2013), *The Feeling Body: Affective Science Meets the Enactive Mind.* Cambridge, MA: MIT Press.

Conway, M. (2005), 'Memory and the Self', *Journal of Memory and Language* 53: 594–628.

Congleton, A. R. and Berntsen, D. (2020), 'It Took Me by Surprise: Examining the Retroactive Enhancement Effect for Memory of Naturally Unfolding Events', *Journal of Applied Research in Memory and Cognition* 9: 300–9.

Cowley, S. (2007), 'Distributed Cognition: Biomechanics, Functions, and the Origins of Talk'. *Emergence of Communication and Language*. Ed. Caroline Lyon, Christopher L. Nehaniv, Angelo Cangelosi. London: Springer. 105–27.

Cui et al. 2007. 'Vividness of mental imagery: individual variability can be measured objectively', *Vision Research* 47.4: 474–8.

Crane, T. (1998), 'Intentionality as the mark of the mental', *Contemporary Issues in Philosophy of Mind*, ed. A. O'Hear, Cambridge: Cambridge University.

Dabney, W., Kurth-Nelson, Z., Uchida, N., Starkweather, C. K., Hassabis, D., Munos, R., & Botvinick, M. (2020). 'A distributional code for value in dopamine-based reinforcement learning', *Nature*.

Dashorst, P. (2020) 'Intrusions related to indirectly experienced events in clinical offspring of World War Two survivors', *Journal of Anxiety Disorders* 71.102209:1–7.

De Jaegher, H and E. di Paolo (2007), 'Participatory sense-making: An enactive approach to social cognition', *Phenomenology and the Cognitive Sciences* 6.4: 485–507.

Dunedin, A. (2020), 'Personal testimonial', 9 Sept 2020.

Gallagher, S. and Z. Rucińska (2021), 'Prospecting performance: rehearsal and the nature of imagination', *Synthese*: 1–19.

Goldin-Meadow, S. (2003), *Hearing Gesture: How Our Hands Help Us Think.* Cambridge, MA: Belknap Press.

Grigely, J. *Artist Talk, The Extended Mind* (2019): https://www.youtube.com/watch?v=pJDaRwNjf5c.

Hassabis, D., D. Kumaran, S. D. Vann and E. A. Maguire (2007), 'Patients with Hippocampal Amnesia cannot imagine new experiences', *Proceedings National Academy of Science USA* 104:1726–31.

Heidegger, M. (1975), *Poetry, Language, Thought.* Trans. A. Hofstadter. New York: Harper & Row.

Husserl, E. (1970) T*he Crisis of the European Sciences and Transcendental Phenomenology*. Trans. D. Carr. Evanston: Northwestern UP.

Hutchins, E. (1995), *Cognition in the Wild.* Cambridge, MA: MIT Press.

Hyman, Jr., I. R. F. Roundhill, K. M. Werner, C. A. Rabiroff (2014), 'Collaboration inflation: Egocentric source monitoring errors following collaborative remembering'. *Journal of Applied Research in Memory and Cognition* 3: 293–99.

Jalbert, M. C., A. N. Wulff, I. E. Hyman Jr (2021) 'Stealing and sharing memories: Source monitoring biases following collaborative remembering', *Cognition* 211.104656: 1–12.

Kind, A. (2018), 'How imagination gives rise to knowledge', *Perceptual Imagination and Perceptual Memory.* Ed. F. MacPherson and Fabian Dorsch. Oxford: Oxford University Press.

Kirchhoff. M. D. (2018) 'Predictive processing, perceiving and imagining: Is to perceive to imagine, or something close to it?' *Philosophical Studies* 175: 751–67

Kosslyn, S., W. Thompson and G. Ganis (2006), *The Case for Mental Imagery.* Oxford: Oxford University Press.

Kosslyn, S. (2006) 'On the Evolution of Human Motivation: The Role of Social Prosthetic Systems.' *Evolutionary cognitive neuroscience.* Eds. S.M. Platek and J.P. Keenan. Cambridge, MA: MIT Press. 541-554.

Kurant, A. (2015), https://www.vice.com/en_uk/article/8qvmwz/meet-the-woman-making-art-with-termites

Lakoff, G. and M. Johnson (1980), *Metaphors We Live By*. Chicago: University of Chicago Press.

Lefkowitz, M. (2019), Presentation as part of the Extended Mind Symposium, Edinburgh College of Art, University of Edinburgh, 31 October 2019.

Lefkowitz, M. (2020), 'Personal testimonial', 16 Sept 2020.

Liao, S. and T. Gendler (2019), 'Puzzles and Paradoxes of Imagination and the Arts', *Stanford Encyclopaedia of Philosophy.* https://plato.stanford.edu/entries/imagination/puzzles.html. (Accessed 12 December 2020).

lok, s. p. s (2020) Interview, 'Decolonizing Art History' Ed. C. Grant and D. Price. *Association for Art History* 2020, pp. 34–8.

Malafouris, L. (2013) *How Things Shape the Mind: A Theory of Material Engagement.* Cambridge, MA: MIT Press.

Maraviti, A. and Iriki, A. (2004), 'Tools for the body (schema)', *Trends in Cognitive Science* 8.2: 79–86.

Matarasso, F. (2019), *A Restless Art*, Dagenham: Central Books.

Mazzucato, Mariana (2018), *The Value of Everything: Making and Taking in the Global Economy.* London: Allen Lane.

McCarthy, L. (2020) 'Homeless women, material objects and home (un)making', *Housing Studies* 35:7: 1309-1331.

McNeill, D. (2005), *Gesture and Thought.* Chicago: University of Chicago Press, 2005.

Mullally, S. L., D. Hassabis, and E. A. Maguire (2012), 'Scene Construction in amnesia: an fMRI study', *Journal of Neuroscience* 32.16: 5646–53.

Murayama, G (2018), 'Artist talk: System as medium and system as motif', *Daiwa Foundation.* http://dajf.org.uk/exhibitions/emergence-of-order-by-goro-murayama/artist-talk-emergence-of-order-by-goro-murayama

Merleau-Ponty, M. (2012), *Phenomenology of Perception*. Trans. D. A. Landes. London: Routledge.

Merleau-Ponty, M. (1993), 'Cézanne's doubt', *The Merleau-Ponty Aesthetics Reader: Philosophy and Painting*. Ed. G. A. Johnson. Trans. M. B. Smith. Evanston, IL: Northwestern UP. 59–75.

Montaigne, M. de. (2003), *The Complete Works.* Trans. D. M. Frame. London: Everyman's Library.

Noë, A. (2015), *Strange Tools: Art and Human Nature*. New York: Hill and Wang

Onians, J. (2020), Interview, 'Decolonizing Art History' Ed. C. Grant and D. Price. *Association for Art History* 2020, pp. 44–5.

Orapiriyakul, W., et al. (2020) 'Nanovibrational Stimulation of Mesenchymal Stem Cells Induces Therapeutic Reactive Oxygen Species and Inflammation for Three-Dimensional Bone Tissue Engineering', *ACS Nano* 14. 8, pp.10027–44.

Pinker, S. (1997) *How the Mind Works*. New York: W. W. Norton, 1997.

Pollock, G. (2020), Interview, 'Decolonizing Art History' Ed. C. Grant and D. Price. *Association for Art History* 2020, pp. 47–52.

Raptis, T. 'Emotions in Music Education as an Ethical Issue.' E*uropean Journal of Philosophy in Arts Education* 1.7: 38–61.

Reddy, L., N. Tsuchiya, and T. Serre (2010), 'Reading the mind's eye: decoding category information during mental imagery.' *Neuroimage* 50.2: 1818–25.

Rizzolatti, G. and C. Sinigaglia (2008), *Mirrors in the Brain: How Our Minds Share Actions and Emotions.* Trans. F. Anderson. Oxford: Oxford University Press.

Sartre, J.-. P. (1949), *What is Literature?* Trans B. Frechtman. New York: Philosophical Library.

Thompson, E. (2010), *Mind in Life: Phenomenology, and the Sciences of Mind.* Harvard University Press.

Varela, F. J., E. Thompson, and E. Rosch (1991), *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, MA: MIT Press.

Vellodi, K. (2020) Interview, 'Decolonizing Art History' Ed. C. Grant and D. Price. *Association for Art History 2020,* pp. 60–62.

Vygotsky, L. (1962) *Thought and Language.* Trans. Alex Kozulin. Cambridge, MA: MIT Press.

Werning, M. (2020), 'Predicting the Past from Minimal Traces: Episodic Memory and its Distinction from Imagination and Preservation', *Review of Philosophy and Psychology* 11: 301–33.

Wheeler, M. (2005), *Reconstructing the Cognitive World*. Cambridge, MA: MIT Press.

Wilson, D. (2012), 'Relevance and the interpretation of literary works'. In A. Yoshimura(ed.), *Observing Linguistic Phenomena: A Festschrift for Seiji Uchida*. Eihohsha, Japan, 3–19.

Wilkinson, S., G. Dodgson and K. Meares (2017), 'Predictive Processing and the Varieties of Psychological Trauma', *Frontiers in Psychology* 8. 1840: 1–11.

Wittgenstein, L. (1999) 'Philosophical Investigations'. *Concepts: Core Readings*. (ed.) E. Margolis and S. Laurence. Cambridge, MA: MIT Press. 171–5.

Zahavi, Z. (2014), *Self and Other: Exploring Subjectivity, Empathy, and Shame*. Oxford: Oxford University Press.

Zeki, S. (1998), 'Art and the brain', *Daedalus* 127. 2: 71–103.

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Figures

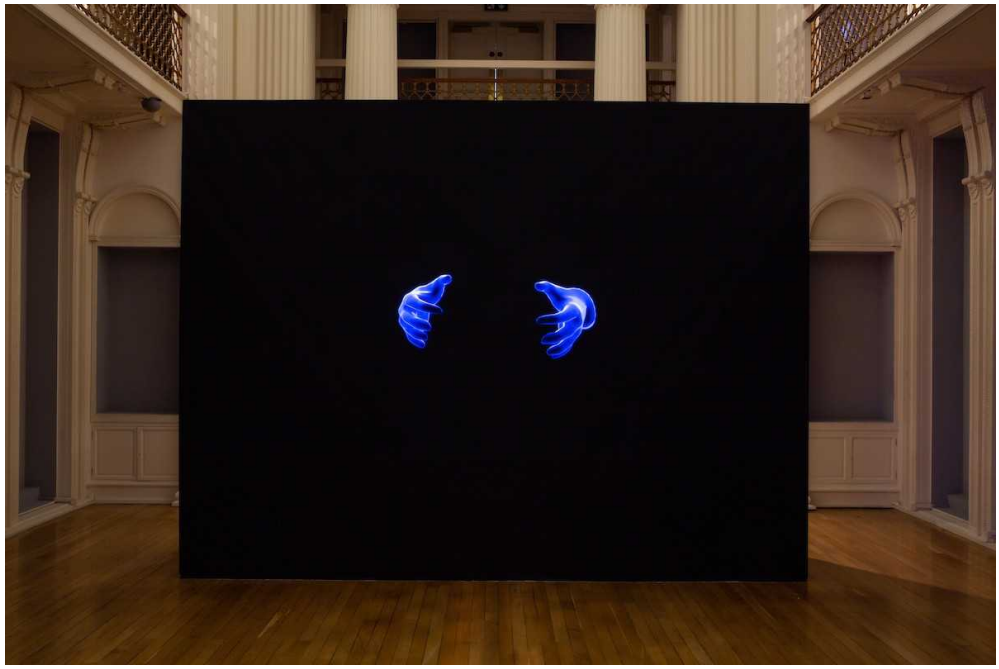

Figure 1: Marjolijn Dijkman, 'In Our Hands', 2015. Projection with binaural sound. Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

Figure 2: Nikolaus Gansterer, 'untertagüberbau', 2017, 3 channel HD video installation. Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

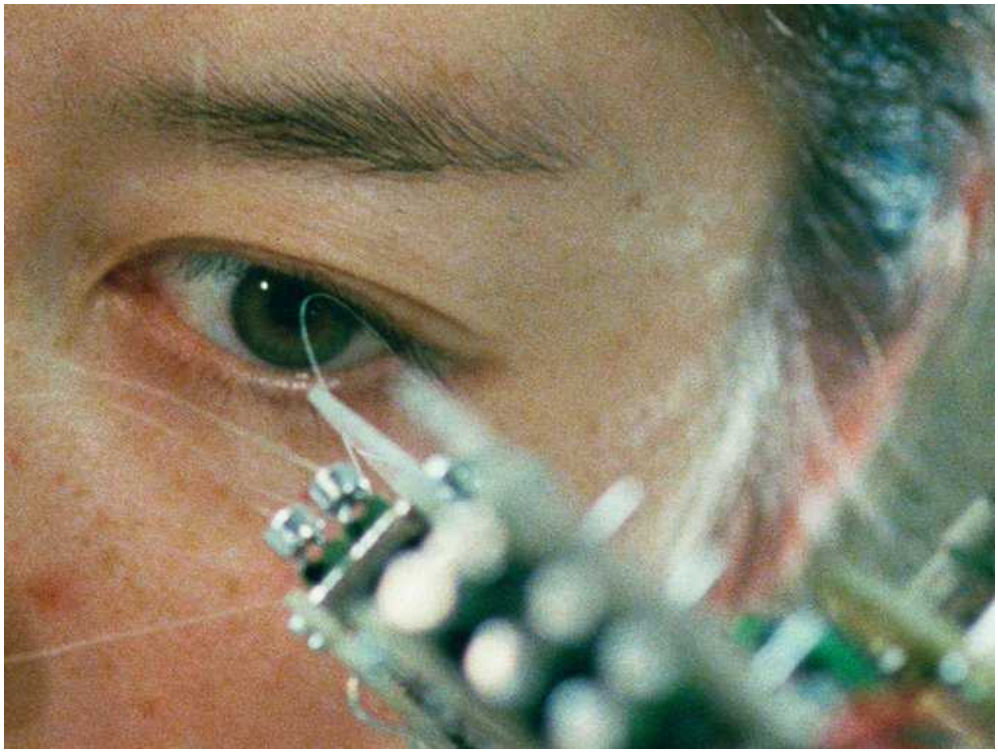

Figure 3: Daria Martin, 'Soft Materials', 2004, 16mm film [digital transfer]. Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

Figure 4: Myriam Lefkowitz, 'Walk, Hands, Eyes (Edinburgh)', 2019. Performance still. Image courtesy Talbot Rice Gallery, The University of Edinburgh

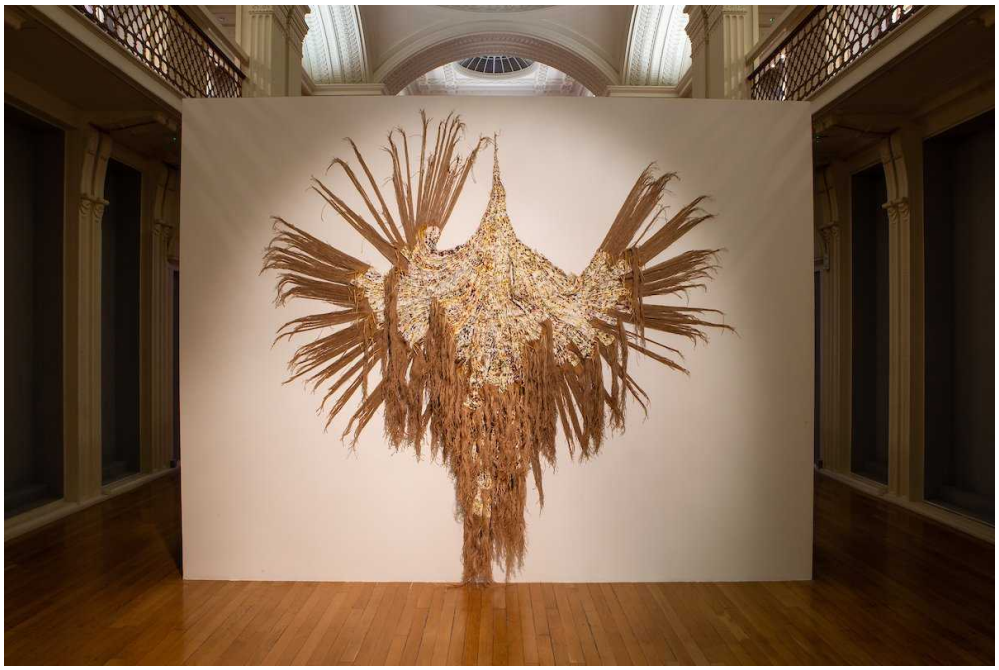

Figure 5: Goro Murayama, 'Self-organized painting [multiple of tree structure]', 2017 Acrylic on woven hemp string. Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

Figure 6: Marcus Coates, 'The Trip', 2011, single channel film. Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

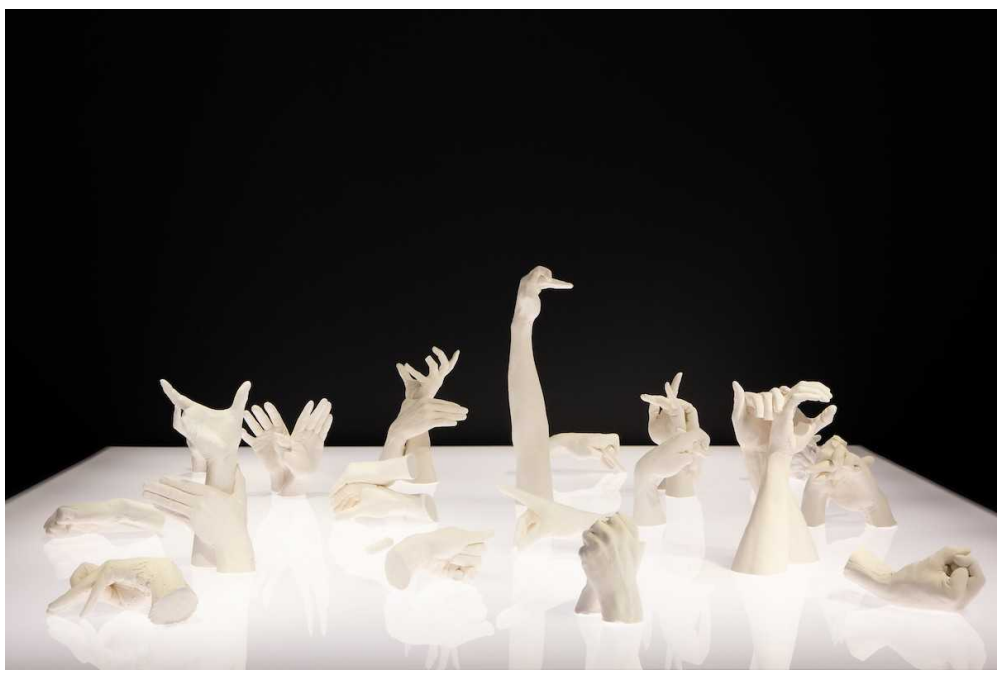

Figure 7: Marcus Coates, 'Extinct Animals', 2018, Plaster of Paris, cast from the artist's hands. Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

Figure 8: The Round Room, 'The Extended Mind', 2020. Image courtesy Talbot Rice Gallery, The University of Edinburgh

Figure 9: Joseph Grigely, 'I don't want to hear anymore', 2016, Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

Figure 10: Joseph Grigely, 'I don't want to hear anymore', 2016, Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

Figure 11: Created by children during a workshop with Royal Mile Primary School

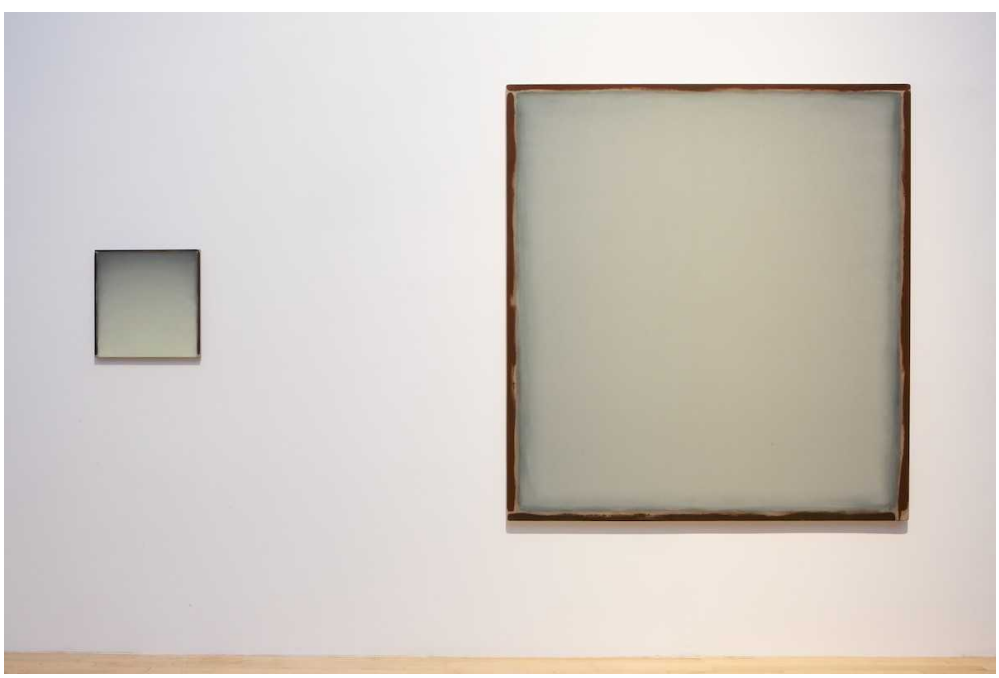

Figure 12: William McKeown, 'Untitled', 2009-2010, oil on linen; 'Untitled', 2008, oil on linen. Installation view, 'The Extended Mind', 2019. Image courtesy Talbot Rice Gallery, The University of Edinburgh

Figure 13: Created by students during a workshop with Queen Margaret University Art Therapy Students