

1 Lambros Malafouris and
2 Maria Danae Koukouti

3 *How the Body*
4 *Remembers its Skills*

5 *Memory and Material Engagement*

6 **Abstract:** *What are bodily memories made of? Where do body*
7 *memories reside and what forms do they take? What is the relation-*
8 *ship between embodied memory and material culture? This paper*
9 *adopts a material engagement approach and sets out to explore body*
10 *memory as a skilful engagement with the material world. We examine*
11 *the nature of body memory from a distributed, enactive, and trans-*
12 *actional perspective. We use the examples of bicycle riding and*
13 *pottery making to examine more closely what is changing in the way*
14 *we understand bodily memory when we approach it from such a*
15 *distributed and enactive anthropological perspective. Overall, we*
16 *wish to make a case for the primacy of material engagement over*
17 *body memory and to propose that the way a body remembers its skills*
18 *is by re-enacting them inside the world using available forms of*
19 *material culture and not by re-presenting them inside the brain.*

20 **1. Introduction**

21 Notions of body memory, or embodied memory, and related theories
22 of bodily intelligence or embodied cognition are not new. Specifically
23 within the phenomenological tradition the term body memory has
24 been used to denote the capacities, dispositions, skills, and habits
25 developed in the course of one's life that implicitly influence one's
26 present experience and action. This type of habitual memory — Henri
27 Bergson (1896/2007) refers to it in *Matter and Memory* as *mémoire*

Correspondence:

Email: lambros.malafouris@keble.ox.ac.uk

1 *habitude* and Merleau-Ponty describes it in his *Phenomenology of*
 2 *Perception* (Merleau-Ponty, 1962, p. 74) by means of the habitual
 3 body (*corps habituel*) — takes the form of an action-based conscious-
 4 ness of the past which is happening in the present and is always
 5 directed at the future and which does not represent our past, but enacts
 6 it by means of a peculiar ‘operative intentionality’ (*ibid.*, p. 122) (see
 7 also discussion in Fuchs, 2012; Gallagher, 2017). However, despite
 8 their long history in many disciplines, or perhaps because of that, the
 9 precise meaning of those terms is unclear. Even within the phenom-
 10 enological tradition, to take one prominent example, there is little con-
 11 sensus about what exactly those terms refer to and what kind of pro-
 12 cesses can be associated with them. Thus, notions of body memory
 13 should not be taken for granted. Instead, we should always try to offer
 14 some clarity about why and how we use them as well as about what
 15 kind of analytical or other work those terms are doing for us.

16 The major aim of this paper is to explore and try to clarify
 17 specifically the relationship between body memory and material
 18 engagement. We start by discussing the major varieties and problems
 19 associated with the notion of body memory. Then we present an over-
 20 view of Material Engagement Theory (MET) which forms the basis of
 21 our approach to the anthropological study of the interaction between
 22 cognition and material culture. We want to make explicit the major
 23 assumptions behind this theoretical framework and hopefully help the
 24 reader to understand why we see certain things about memory the way
 25 we do. Then, we briefly highlight some key issues about memory that
 26 we find useful to consider when thinking about the varieties of bodily
 27 memory and their relationship with material culture. In the end, we
 28 will use the examples of bike riding and pottery making to examine
 29 more closely what is changing in the way we understand bodily
 30 memory when we approach it from such a distributed and enactive
 31 anthropological perspective. Overall, we wish to make a case for the
 32 primacy of material engagement over body memory and to propose
 33 that the way a body remembers its skills is by *re-enacting them inside*
 34 *the world* using available forms of material culture and not by *re-*
 35 *presenting them inside the brain*.

36 2. Varieties of Body Memory

37 One common way that the term body memory has been used is to
 38 denote the kind of remembering that a cognitive psychologist would
 39 probably classify as procedural or implicit (e.g. Schacter, 1987). The

latter is often contrasted to our explicit conscious recollections of the past known also as ‘declarative’, ‘personal’, ‘episodic’, or ‘autobiographical’ memories (Tulving, 1993; 2000). In other words, the concept of body memory takes care of the non-conscious, the experiential, the habitual, and the kinaesthetic dimensions of memory that guide our everyday being-in-the-world (Bergson, 1896/2007; Merleau-Ponty, 1962; Casey, 1987; Fuchs, 2012). As Edward Casey puts it, body memory re-enacts the past without the need to represent it (1987, pp. 147, 178) — not at least in the technical sense that the notion of representation has in classical cognitive science.

The philosopher of dance and movement Maxine Sheets-Johnstone uses the term *kinaesthetic memory* to refer to a similar process (2007; 2012; see also Samudra, 2008). Her account, which takes inspiration from the Russian neuropsychologist Aleksandr Romanovich Luria, especially his seminal notion of a ‘kinetic melody’ (Luria, 1973), is focusing on the specific type of habitual memory created through the bodily felt distinctive dynamics of movement (Sheets-Johnstone, 2007, p. 69). In *The Working Brain* (1973) Luria uses the term kinetic melodies to describe the basic and effortless everyday movement which is precisely what is being disturbed when brain lesions cause movement pathologies. Those kinetic melodies are inscribed in the body by way of kinaesthetic memory. According to Sheets-Johnstone those bodily-inscribed kinetic melodies permeate human life ‘in a living, experiential sense, not brain events but corporeally resonant ones, in-the-flesh dynamic patterns of movement that are *initiated* — and run off’ (Sheets-Johnstone, 2007, p. 71). In other words, ‘kinetic melodies’ is an experientially-based concept rooted in the potentially ever-expandable repertoire of kinetic dynamics of life and ‘saturated in cognitive and affective acuities that both anchor invariants and color and individualize the manner in which any particular melody runs off’ (*ibid.*, p. 72).

Another major way in which the term body memory has been employed is to forge an alliance with the broader field of embodied, enacted, extended, and distributed cognition (e.g. Sutton, 2006; Sutton *et al.*, 2010; Michaelian and Sutton, 2013). We should not forget that the processes of human memory have been from the very start at the forefront of major epistemic debates in embodied cognitive science, with many influential studies trying to rethink the taxonomy, topology, and ontology of memory beyond the conventional boundaries and units of analyses. Famous examples in this context are Clark and Chalmers’ illustration of the so-called parity principle using the case

of Inga and Otto's notebook (1998) or Edwin Hutchins' (1995) paper 'How a Cockpit Remembers its Speeds', to which we return again below, that illustrates memory as a process of distributed cognition. More recently the psychiatrist Thomas Fuchs has proposed, working from an enactivist perspective, a new taxonomy of body memory differentiating among procedural, situational, intercorporeal, incorporative, pain, and traumatic memory (2012).

3. More than a Body: Two Worries

Both ways of using the term body memory have been productive and help us to better understand aspects of everyday or real-world memory. Still, some problems remain. Two major and related worries are especially relevant to our purposes in this paper.

The first worry concerns the following: any clear separation between bodily and non-bodily forms of memory implies somehow the possibility of a disembodied memory. This seems rather awkward. Is it correct to assume that semantic, episodic, or other forms of declarative memories are disembodied? We think not. Of course, there are important differences between different types of memory. Those differences are well studied and supported by empirical and experimental evidence as in the case of amnesic patients who, although unable to form and retain any new memories, may still learn new simple motor tasks. However, the fact that we seem to have the ability to consciously recollect events from our personal past without moving a muscle, only using the power of our 'internal' brain, does not imply that our ability for episodic memory and the related capacity for autobiographical memory (Tulving, 1983; 1993; Conway, 2001) are disembodied. Quite the contrary — the varieties of remembering that allow one to experience the continuity of self across time, to remember past happenings from one's life, or to travel back in time by re-experiencing events from the past are increasingly recognized as forms of context-dependent embodied simulation and re-enaction: a person remembering an event in the past re-enacts similar visual, kinaesthetic, spatial, and affective aspects to the original experience. This bodily grounding and contextual dependency of episodic and autobiographical memories explains better (we think) widely accepted assumptions in the psychology of memory such as the encoding-specificity hypothesis, which states that memory retrieval will be better/enhanced if the conditions under which the item is retrieved are similar to the conditions under which the item was originally encoded

(Tulving and Thomson, 1973). To give one specific example, both posture and facial expression facilitate recall of information or autobiographical memories if they are congruent with the encoding context (Dijkstra, Kaschak and Zwaan, 2007).

Admittedly, it becomes increasingly clear that notions of disembodied memory or of disembodied intelligence make little sense — if any at all. It seems like a paradox then that some of the most influential models in the psychology and cognitive science of memory are still grounded (implicitly or explicitly) on the assumption of such a disembodied computational mind that floats in a parallel universe of ‘internal representations’. In contrast to this ‘internalist’ view, in this paper we shall be arguing: a) that there can be no experience of memory without an active body, b) that an active body is always a situated body, and c) that a situated body is by definition *more than* a body. Current thinking in the anthropology of the body makes it clear that however one thinks about body memory this cannot be separated from its relevant socio-material and cultural environment. Human persons and their bodies primarily remember by transacting and engaging other bodies and the material world (*cf.* Sutton, 2008; Bietti and Sutton, 2015).

This latter point brings us to our second related worry. This worry concerns the ways by which discussions of embodied memory (and embodied cognition) often give rise to a kind of ‘embodied cognitivism’ in which the lived body, instead of bridging the mind with the world, forms yet another artificial boundary between an ‘interior’ and an ‘exterior’ domain. Not only that, but according to this separatist logic, the body becomes important in our analyses not for what it is, or for what it does, or for how it moves, or for how it feels, but rather because of how it is re-presented inside the brain (which seems to be — according to neuroscience — the part of our body that has memory and control over the other parts) (see Malafouris, 2016b). One area in which the operation of this ‘embodied cognitivism’ becomes clearer is that of ‘grounded cognition’ and related theories of embodied simulation (e.g. Barsalou, 2008; 2009) that we discuss in a following section.

So, we think that another pressing question for us is what we mean by ‘body’ when we speak of ‘body memory’. We will argue that if the notion of ‘body memory’ is to have any real explanatory value it ought to mean something different from the brain. This is not because the brain is not an inseparable part of the body; or because the brain is not crucially important to the formation and constitution of ‘body

memory'. Rather, it is because if, in our discussion of embodiment, we allow the brain to qualify as part of the body we run the risk of trivializing the claim that the body is crucial to the process of memory and we suspect that eventually we will probably end up with some version of brain identity theory. Although there seems to be no reason to doubt the importance of neural simulation and re-enactment of past events inside the brain, this is only a part of the process. Crucial elements remain 'un-represented' and on the 'outside'. Those elements preserve a physical or artefactual core upon which bodily and neural re-enactment will take place. The classical mistake here is to see (and thus disregard) those elements as 'external' to the memory process that matters and which is realized by the brain. Endel Tulving's notion of 'synergistic ecphory' offers a useful reminder here that, whatever one thinks about the actual nature of inner memory traces, the process of recollection cannot be reduced to them (Tulving, 1983, pp. 12–4; Schacter, 1996, pp. 56–71). As we also discuss below, memory traces, 'internal' or 'external', are mere and incomplete potential contributors to an open and context-sensitive process of remembering spreading across the body and the material world (see also Sutton, 2002; 2006; 2008; Malafouris, 2004; 2008a,c; 2010; 2011; 2013; 2015).

This form of 'embodied cognitivism', namely the limited view of embodied mind as somehow contained in, localized in, caused, and explained by the brain, must be overcome (for a more detailed discussion see Malafouris, 2016b). As John Sutton points out in his introduction to a special journal issue on *Memory, Embodied Cognition, and the Extended Mind* (2006, p. 283): 'memory does clearly require a framework which allows us to study brain and culture simultaneously.' From an anthropological perspective a notion of embodied memory reducible to brain activity is an empty concept. We understand that, at least in philosophy, there are different ways to theorize about embodiment, some of which are more radical than others (e.g. Chemero, 2009; Hutto and Myin, 2013). But we think the main problem remains: even radical embodied cognitive science remains hesitant, in our opinion, to follow the implications of its central claim for the natural extensiveness and relationality of the human mind. The major challenge stems from the fact that traditionally philosophy and the cognitive sciences find it hard to incorporate the cultural specificity of material ecology of mind, or the historical variability of cognitive ecology, into their analysis (for a more detailed critique see Malafouris, 2018a,b; Ihde and Malafouris,

2018). Although a number of recent papers within this enactive domain have actually attempted to fill this lacuna (e.g. Hutto, 2015; Zahidi and Myin, 2016; Hutto and Myin, 2017, pp. 204–5), the inclusion of ‘materiality’ within the radical enactive paradigm is only in its earliest phase. In the famous phenomenological example of the blind person with the stick, the stick has received far less attention than it actually deserves. Yet, the example of the blind person’s stick offers an intuitive way of thinking about the complex interactions between brain, body, and the world. The transactional character of the relation between the blind person and the stick provides a diachronic point of reference for advocating an ontological continuity between mind and matter. It also helps us to reconceptualize the profound embodiment, ecology, and plasticity of the human mind. The analogy of the stick refers to the thoroughly relational and sensuous prosthetic becoming by which humans learn to identify, attend, and transform their world. This is where Sheets-Johnstone’s kinaesthetic thinking in movement (2007; 2012) meets the enactive logic and primacy of material engagement (Malafouris, 2015; 2016a; 2018a).

4. The Matter of Memory: A Material Engagement Approach

The formation and varieties of body memory, the role they may have in the production, transmission, and re-enaction of skills, social practices, and forms of material culture or techniques, has been a central concern in cognitive archaeology¹ and anthropology (Connerton, 1989; 2008; Rowlands, 1993; Bloch, 1996; Forty and Kuchler, 1999; Kwint, Breward and Aynsely, 1999; Mack, 2003; Malafouris, 2004; 2008a,c; 2011; 2015; Jones, 2007; Sutton, 2008; Malafouris and Renfrew, 2010; Ingold, 2012; 2013). Material Engagement Theory (MET) is grounded in both traditions of research (Malafouris, 2004; 2008b,c; 2009; 2010; 2013; 2018a). The aim of this theoretical framework has been to integrate theoretical insights and empirical findings from a wide range of disciplines (across the humanities, social, and cognitive sciences), trying to develop a new

¹ The archaeology of mind essentially comprises of two major trends or fields of cross-disciplinary research. One field is concerned with the evolution of human intelligence and the second is concerned with the study of the nature of the relationship between cognition, affect, and materiality in the course of human becoming (for a brief review and references see Iliopoulos and Malafouris, 2014).

1 ‘undisciplined’ form of philosophical anthropology sensitive to the
2 material, social, and affective dimensions of human cognitive life and
3 to the study of their transformation across time and space. Naturally
4 the emphasis falls on relational and situated processes as they become
5 realized in different timescales (see also Gosden and Malafouris,
6 2015). We use the word ‘process’ in the strong ontological sense that
7 speaks of the primacy of ‘becoming’ as in process philosophy. Simi-
8 larly the word ‘mind’ is used in the extended, distributed, situated, and
9 enactive sense that speaks of the continuity between mind and matter,
10 nature and culture, but also cognition and affect (Malafouris, 2015;
11 2016a,b; 2018a). We do not follow or fully subscribe to any particular
12 thinker or school of thought, instead we try to build upon, revisit,
13 rethink, and recontextualize several key ideas which can help us to
14 think about the relationship between cognition and material culture on
15 the basis of archaeological and anthropological material. The theory of
16 material engagement bridges those influences critically and con-
17 structively, providing a method to conduct our analyses across the
18 scales of time.

19 The basic commitment and aspiration of this relational theoretical
20 framework is to change the way we think about the mind by bringing
21 materiality — that is, the world of material things and signs — firmly
22 into the cognitive fold (Malafouris, 2004; 2013; 2018a,b).

23 To that end, Material Engagement Theory incorporates three major
24 working hypotheses, each one targeting a different but complementary
25 aspect of human becoming — i.e. cognition, signification, and agency.
26 In summary: a) *the hypothesis of the extended mind* explores the con-
27 stitutive intertwining of cognition with material, b) *the hypothesis of*
28 *enactive signification* explores the nature of the material sign not as a
29 representational mechanism but as a semiotic conflation and co-
30 habitation through matter that enacts and brings forth the world, and
31 last c) *the hypothesis of material agency* explores agency not as a
32 human property but as the emergent product of situated activity
33 (Malafouris, 2013; 2018).

34 Thus, where classical cognitive science sees flows, processing, and
35 propagation of information, MET sees flows, processing, and propa-
36 gation of energies (this is closer to the original meaning of informa-
37 tion in the context of cybernetic theory than its later transmutations in

computational theory).² The suggestion here is that instead of thinking about memory as an internal activity based on internally stored information, it will be more productive to view it as the interaction or transaction (a kind of dynamic causal coupling) between heterogeneous but complementary resources, forces, and processes that continually influence each other's meaning and direction of change.

The anthropologist Edwin Hutchins was probably one of the first to propose that the unit of analysis for memory needs to expand beyond the individual brain and body to include interactions with other people and the physical environment (natural or artificial). His famous 1995 paper 'How a Cockpit Remembers its Speeds' illustrates that process of distributed cognition by looking at the process of memory as it happens in the context of modern aircraft. He writes:

In much of the cockpit's remembering, significant functions are achieved by a person interpreting material symbols, rather than by a person recalling those symbols from his or her memory. So we must go beyond looking for things that resemble our expectations about human memory to understand the phenomena of memory in the cockpit as a cognitive system... The cockpit system remembers its speeds, and the memory process emerges from the activity of the pilots. The memory of the cockpit, however, is not made primarily of pilot memory. A complete theory of individual human memory would not be sufficient to understand that which we wish to understand because so much of the memory function takes place outside the individual. (Hutchins, 1995, p. 280)

While one may disagree with Hutchins on some points (esp. relevant to the nature and importance of mental representations, the meaning of information and information processing, and the ontology of memory traces), his main strategy as defined in his distributed cognition

² A detailed discussion of the history of the concept of *information* and the related uncritical conflation of *computation* with *information processing* lies outside the scope of this paper (for a good overview see Piccinini & Scarantino, 2010). Suffice it to say that the simple and common way to understand information is by reference to semantic representational content and meaning. Information, on this view, is a message, or the content of a message, that is transmitted from a sender to a recipient. But this was not the usage or meaning attached to the concept of information when it entered the sciences of mind. Rather, the concept of 'information' enters the sciences of mind by way of cybernetics (as developed in the 1940s by Norbert Wiener, Ross Ashby, John von Neumann, and Claude Shannon). Now the cybernetic use of information is far more specialized, inherently dynamic, and importantly it has nothing to do with semantics and meaning. On the cybernetic construal information is about *differences that make a difference*.

approach has initiated a new thoroughly decentralized understanding of memory and by extension of selfhood. Hutchins' approach in this paper may not have been as radical as we may wish. His main objective has been to construct a methodological bridge between the information processing properties of individuals and the information processing properties of a larger system, such as an aeroplane cockpit or a ship. In that sense, distributed cognition remains a distributed computational system. From a more radical enactivist perspective one could question both the centrality of representation and the centrality of information processing as tools for thinking about thinking.

Thus, building on the theoretical foundation of distributed cognition and incorporating ideas from enactive cognitive science and ecological psychology, the material engagement approach aims to highlight the constitutive role of materiality in human cognitive life, arguing for the constitutive intertwining of mind with the material world and against the division of cognition from affect, perception, and action (*cf.* Sutton, 2008; 2010; Hutchins, 2011; 2014).

Keeping that basic theoretical background in mind we return now to explore the implications of the above premises for our understanding of body memory using some specific examples.

5. Remembering at the Other Side of the Engram: Some Case Studies

We discussed above that body memory is very often associated with our bodily skills and habits. But even though it seems intuitively clear to think of our bodily skills as a form of memory, it remains unclear what kind of memory it is. For one thing it does not seem to be a memory of the kind that demands our conscious attention. For another, conventional ideas of storage by means of 'internal representations' seem inadequate, if not simply wrong, as a means to describe how body memories are formed in the past and employed in the present or to specify what, if anything, is really special about them. So what are the memories of our bodies made of?

Trying to answer that question, the remainder of this paper will focus in turn on two simple cases of situated bodies. We start with the familiar example of bicycle riding. Bicycle riding is a simple skill that most people can easily relate to from personal experience. It is also an example often used by philosophers and psychologists to illustrate their accounts. For instance, this is how Michael Polanyi illustrates his famous paradigm case of 'tacit knowledge'. He writes:

1 If I know how to ride a bicycle... this does not mean that I can tell how
2 I manage to keep my balance on a bicycle... I may not have the
3 slightest idea of how I do this, or even an entirely wrong or grossly
4 imperfect idea of it, and yet go on cycling... Nor can it be said that I
5 know how to bicycle... and yet do not know how to coordinate the
6 complex pattern of muscular acts by which I do my cycling... I both
7 know how to carry out these performances as a whole and also know
8 how to carry out the elementary acts which constitute them, though I
9 cannot tell what these acts are. This is due to the fact that I am only
10 subsidiarily aware of these things and our subsidiary awareness of a
11 thing *may not suffice to make it identifiable*. (Polanyi, 1966, p. 4)

12 The basic premise is simple: bicycle riding is an assemblage of knowl-
13 edge or memories about how to perform a complex and demanding set
14 of actions for which we seem to know very little. Not only do we not
15 seem to consciously recall or apply any specific set of predefined rules
16 about how to sit on the saddle, stand the bike on its two wheels, or
17 turn the pedals with the feet; but amazingly we don't need rules to ride
18 a bicycle. Try to consciously remember how to ride a bike; or what it
19 is like to ride a bike. What makes something so simple and common
20 almost impossible to verbalize or to easily phrase in a narrative
21 structure?

22 This is not to say that we cannot remember ourselves riding a
23 bicycle. Memories referring to specific autobiographical events in our
24 personal past seem vivid and easy to describe even when their details
25 may be false. We seem to have no trouble *remembering that* earlier
26 this morning or in other occasions we rode a bicycle to work. We
27 seem pretty capable to write a diary or to tell other people a story
28 involving particular events or episodes of our bike riding activities and
29 whereabouts in the past. It also makes sense to ask if we remember
30 correctly or not the events we describe. But the memory of our bodily
31 skills and embodied habits seems to be of a different kind, one that
32 feels beyond the grasp of conscious or deliberate recollection. That is,
33 we cannot remember the actual skill we call bicycle riding. We can be
34 certain that we know how to ride a bicycle but it seems that our only
35 means to remember is to actually ride a bike. We simply can't
36 verbalize the procedural knowledge involved. In fact, it doesn't feel
37 like memory at all. This leaves us with something of a paradox. The
38 more successful and effortless the actualization of our bodily capacity
39 to ride a bicycle is, the less it resembles an act of memory or
40 recollection.

41 We shall be offering a possible explanation for this paradox below,
42 but first we would like to make a small detour to the work of

1 Lawrence Barsalou, specifically his theory of ‘grounded cognition’
2 and notions of conceptual re-enactment (2008; 2009). Interestingly he
3 also uses the example of the bicycle to illustrate his model of memory
4 based on situated conceptualization, simulation, and prediction. Here
5 for instance is how he describes the storage in long-term memory and
6 subsequent re-enactment of perceptual and motor multimodal states
7 acquired during the visual processing of a bicycle:

8 During visual processing of a bicycle, for example, neurons fire for
9 edges and surfaces, whereas others fire for colour, configural properties
10 and motion. The overall pattern of activation across this hierarchically
11 organized distributed system represents the entity in vision. Analogous
12 patterns of activation in other sensory modalities represent how the
13 bicycle might sound and feel... When retrieving a memory of a bicycle,
14 associative neurons partially reactivate the visual state active during its
15 earlier perception. Similarly, when retrieving an action performed on
16 the bicycle, associative neurons partially reactivate the motor state that
17 produced it. A re-enactment never constitutes a complete reinstatement
18 of an original modal state, and various sources of bias may often distort
19 it. Thus, re-enactments are always partial and potentially inaccurate.
20 (Barsalou, 2009, p. 1281)

21 At the heart of Barsalou’s theory there are two central constructs, i.e.
22 *simulators* and *simulations*. *Simulators* refer to a distributed multi-
23 modal system that develops for any component of experience that
24 attention selects repeatedly. Simulators serve to integrate and store
25 information (for objects, settings, events, actions, introspections,
26 properties, relations, and so forth) in the sense of correlated neural
27 activation patterns across a category’s instances. On the other hand
28 *simulations* refer to specific conceptualizations of previously experi-
29 enced category instances which for that reason are never exact but
30 always partial re-enactments:

31 Across encounters with different instances, visual information about
32 how bicycles look becomes integrated in the simulator, along with
33 auditory information about how they sound, somatosensory information
34 about how they feel, motor sequences for interacting with them,
35 affective responses to experiencing them and so forth. The result is a
36 distributed system throughout the brain’s feature and association areas
37 that accumulates and integrates modal content processed for the
38 category... The bicycle simulator, for example, might simulate a
39 touring bike on one occasion and mountain bike or a cross bike on
40 others. Because all the experienced content for bicycles resides
41 implicitly in the bicycle simulator, diverse subsets can be re-enacted on
42 different occasions, and tailored to specific contexts. (*ibid.*, p. 1282)

1 Two things need to be underlined at this point. First that Barsalou's
2 theory is not about (at least not primarily) body memory. Rather, it is
3 a model focusing on how categories and concepts are formed (by
4 means of a distributed multimodal system) and remembered (through
5 the situated neural re-enactment of the relevant multimodal states). At
6 first glance the model looks that it promotes and supports a thoroughly
7 embodied view of memory and provides a fertile basis for the integra-
8 tion and bodily grounding of the different types of memory. However,
9 there is also a caveat.

10 No doubt the brain is active in a specific and distributed sense when
11 the body performs some action on the bicycle, like it does when the
12 hand is writing or playing a melody on the piano. Neurons fire and
13 distributed networks of neural activation (or deactivation) are formed
14 in correspondence with some aspect (perceptual or other) of our
15 experience of riding a bicycle. However, from a material engagement
16 perspective we have reasons to doubt that the nature of neural activity
17 is of the kind or does the job representational cognitive science
18 (embodied or not) often ascribes to it. For instance, what Barsalou
19 describes as the storage in long-term memory and subsequent re-
20 enactment of perceptual and motor multimodal states associated with
21 the experience of a bicycle (2009, p. 1281) is only part of the process
22 by which humans (brains and bodies) remember their skills.

23 We argue that, as traditionally phrased, the question of body
24 memory is rather misleading. It is misleading because it implies some-
25 how that the human body naturally exists in an isolated, purified, and
26 unmediated state which nonetheless is open to subsequent encultura-
27 tion and enskilment by means of social learning. On this construal, the
28 body essentially remembers by means of the brain, which is the organ
29 capable of representing, storing, and internalizing 'inside the head',
30 through perception and learning, the variety of skills it will sub-
31 sequently re-enact. Thus, the argument goes, it must be on this process
32 of neural inscription and re-enaction of bodily memory that we need
33 to focus in order to understand what matters about body memory. We
34 argue that this neuro-centric view or ontology of memory, although
35 thoroughly *embodied*, is also thoroughly *disembodied*. Never in
36 human history or prehistory did there exist such a thing as an isolated
37 'natural' body. The human body is, and has always been, *more than a*
38 *body*, i.e. a *situated body*. This situated body and the bodily memories
39 that we tend to associate with it cannot be circumscribed using the
40 skin as a boundary. To think of body memory in this sense is to mis-
41 understand completely the meaning of 'situatedness'. A situated body,

1 and the cognitive and affective properties or capacities that such a
2 mode of being affords, is always more, or maybe sometimes less, than
3 a body; it can never be just a body. What we call the ‘natural’, ‘iso-
4 lated’, or ‘naked’ body is an artificial construction of ‘modernism’.
5 This fundamental condition of human *situatedness* should be the start-
6 ing point of our analysis — thus the ontological primacy of material
7 engagement (see also Malafouris, 2015; 2016b; 2018a; Malafouris and
8 Koukouti, 2017). So our initial question about body memory can be
9 rephrased in a more useful way as follows: *how do situated bodies*
10 *remember?*

11 Of course, many proponents of ‘soft’ or ‘representational’ strands of
12 embodied cognition will also recognize that when people construct a
13 simulation to represent a category (e.g. bicycle) they do not do so in a
14 generic amodal and isolated sense, but always represent it in a relevant
15 situation or background setting. For instance, according to Barsalou
16 different ‘situated conceptualizations’ of bicycle will be recruited in
17 different situations (Barsalou, 2009, p. 1283): ‘one situated con-
18 ceptualization for bicycle might support riding a bicycle, whereas
19 others might support locking a bicycle, repairing a bicycle and so
20 forth.’ Typically a situated conceptualization simulates in the respect-
21 ive neural system, and from a particular perspective, basic information
22 about relevant people, objects, actions, introspections, and settings
23 ‘creating the experience of “being there”’ (*ibid.*, p. 1283), that is, in
24 the situation.

25 Let us return now to the paradox of body memory mentioned above.
26 This paradox can be explained as follows. We would like to propose
27 that the reason we find it hard to remember forms of tacit knowledge
28 or skilful bodily action and interaction is because, in those cases,
29 remembering is inseparable from the actual enaction and re-enaction
30 (in real time and space) of the bodily skill in question. In short, we
31 suggest that bike riding is an act of memory in a minimal unmediated
32 form. Our bodily capacity to re-enact in the present, in partnership
33 with our bicycle, our past bicycle riding skills, cancels any need for
34 re-presenting or simulating them. The reason that our bike riding
35 bodies are able to do away with re-presentations is because of the
36 readiness of our bikes to guide and to draw out our skilful movements.
37 This is why we suggest that material engagement is central to under-
38 stand bodily skill as memory.

39 For instance, in the case of bike riding ‘proprioception’ — aware-
40 ness of the position of our own limbs and muscles — is determined by
41 the material form of the bicycle and the ways it affords the positioning

1 of our bodies. Remembering how to ride a bicycle you would need a
2 body as much as you would need a brain. But above all you need a
3 bike. The bike is not just an external cue or prompt that will set the
4 procedural map in motion inside the brain. The memory of the skill
5 we call bicycle riding is not a mere ‘simulation’ or ‘conceptual re-
6 enaction’ as Barsalou would call it (2009), but an active real-time
7 entanglement of neural, bodily, and material affordances. If there is a
8 mapping involved then the bicycle, in its full materiality as well as
9 historical and social ontology, is a central node.

10 Skilful bodily memory should be seen as bicycle-involving. It is
11 constituted primarily of our ability to engage with the materiality of
12 the bike as a material structure and as a cultural artefact. The material
13 structure of the bicycle is stable enough to constrain the set of bodily
14 actions, motions, and intentions that can be realized through our
15 bodily engagement with it. At the same time, it offers some structural
16 flexibility and plasticity which is a necessary component of skilful
17 material engagement — without this flexibility, skilful behaviour and
18 the type of memory that supports it cannot emerge. This also means
19 that every time we ride our bike we are not producing something
20 absolutely new or merely repeating something old. Bicycle riding, like
21 many other human skills, is a form of regulated distributed improvisa-
22 tion (see Hutchins, 2014; Sutton, 2007). There is a kind of organic
23 connectivity founded on tactile-kinaesthetic invariants and embodied
24 alignments made possible by the actual meeting of brains, bodies, and
25 bicycles.

26 We now turn to our second example. It comes from the realm of
27 skilled craftsmanship. Specifically, it is about memory at the potter’s
28 wheel. Many of the points we raised above are implicit in the
29 anthropological study of technique (Leroi-Gourhan, 1964–65/1993).
30 Pottery making is one such well-known and studied example of skilled
31 practice that presents a paradigmatic case for the proposed link
32 between body memory and material form (Malafouris, 2008; 2014;
33 Malafouris and Koukouti, 2017). We want to draw attention to some
34 basic points about the nature of memory in technical skill that often go
35 unnoticed.

36 Think what it means to say of a craftsperson that she or he possesses
37 the knowledge or ability to transform clay into a given material form.
38 We use the term skill to describe this ability or capacity. There are
39 many ways one could think of body memory in this context of skilful
40 action. It relates to the kinematic, to the kinaesthetic, but also to the
41 creative dimensions of the process by which the potter moves his/her

1 hands to produce material form. Notice, however, the deeply
2 entrenched tendency to describe and casually structure the events
3 around agents (usually human) and according to some implicit oppo-
4 sitions/divisions between a controlling mind that is moving a body to
5 shape the clay. According to traditional accounts, if there is memory
6 involved in the process, it must be located in the potter's mind or brain
7 and it must be a memory of a kind that can be used to move or control
8 the hand of the potter in the right way (that is, the way of the skill that
9 produces that memory and which skill this memory trace helps to
10 transmit in time). In that sense pottery making is a form of
11 remembrance; however, it is not the body that actually remembers,
12 rather it is the memory (stored in the potter's mind/brain) that moves
13 the body to produce from. We argue that there is a better way to think
14 about memory in this context, one that sees memory as immanent in
15 the creative process rather than flowing from one abstraction to the
16 other. Again the crucial point is not only to realize the inseparability
17 of the potter's brain and body but importantly of the wider material
18 ecology of action. The material ecology is crucial because without it
19 there can be no engagement, but without material engagement there is
20 very little that the potter's body can remember. As with the example
21 of bicycle riding there are all kinds of memories that come to mind
22 and could be potentially narrated about events that happened around
23 making but very little that can be said or even remembered about the
24 actual process of making.

25 Notice a crucial difference in the structure of the causal events that
26 this new conceptualization brings about: the brain no longer 'uses' the
27 potter's body, rather it is the potter's body that brings the brain in a
28 situation that can be put into use in relation to the action-affordances
29 of the practice or skill we call pottery making. It is not the brain or the
30 body that carries *within it, on the inside*, the special knowledge needed
31 to establish a meaningful and dexterous creative transaction between
32 the potter and the clay; rather, it is the actual engagement with clay, in
33 the throwing, that offers the opportunity of remembrance. The skills
34 remembered and re-enacted with every new opportunity of making are
35 never exactly the same as similar past occasions of creative material
36 engagement. Nonetheless, there is sufficient continuity to warrant the
37 description of this active, skilful, and sensuous material engagement
38 as a form of memory. We argue that to classify this act of
39 remembrance as bodily or material is maybe to misrepresent its
40 distinctive nature as a skilful synergy of mind and matter. The terms
41 body memory and material memory should not be understood as if

1 they describe two different phenomena, rather they should be under-
2 stood as offering alternative descriptions of the same phenomenon.
3 Body memory refers to the ways in which the potter's body
4 remembers its skill of producing the form of a vase through actively
5 engaging with clay. Material memory refers to the ways the afford-
6 ances of clay, on their part, actively engage the potter's body to
7 produce the form of a vase. Seen in that way the form of the vase is
8 not the externalization of the potter's memory in clay, rather memory
9 is immanent in the broader ecology (cognitive and material) of
10 activity.

11 Last but not least, there is a noticeable absence of any need of repre-
12 sentations (in the strict sense of the word). Memory is the active trans-
13 mission and recreation of technique based on the specific ecology of
14 action and the opportunities of material engagement it affords. The
15 observed regularities in the material forms produced by the potter (e.g.
16 vases of a specific type, size, or technique) are not remembered ahead
17 of the action as ideas or images inside the potter's head. The form of a
18 vase does not precede in a 'mental' or even a 'bodily' form its
19 'material' manifestation in clay, nor it could have ever existed without
20 the creative synergy of mind and matter brought about by the potter's
21 actions and movements (Malafouris, 2008c; 2014; Gosden and
22 Malafouris, 2015; Malafouris and Koukouti, 2017). Rather, these
23 regularities of form are the realization of the form-generating potential
24 of specific contexts, material signs, tools, and other scaffolds of the
25 local material environment that in dialogue with the potter's body
26 make possible (through perceptual/haptic guidance and fine-tuning)
27 the re-enactment of the bodily skills involved and thus the recreation
28 (thus memory) of the form of the vase.

29 Obviously the potter's body develops the feeling of clay by training
30 and expertise. In this connection, one could ask how those processes
31 can be linked with the development of expertise: what happens at
32 different levels of expertise? Are there differences in the ways experts
33 and novices remember their skills? Viewing skill as a form of memory
34 implies that developing the skill translates to better memory. But what
35 is it exactly that the potter's body or hand remembers? There are two
36 major ways to think about the links between memory and expertise.
37 The first is to think of the expert as the person that knows better.
38 Better knowledge is better memory. The second is to think of the
39 expert as the person that knows without the need to remember (at least
40 not consciously). MET proposes a third possibility: that the expert is
41 the person that knows how to turn the material world into an active

resource of memory so that, to use the example of pottery making, the form of the vase is remembered by clay as much as it is remembered by the potter's hand or by the potter's brain.

6. Conclusion

We tend to associate memory with the past. Memory is as much, if not primarily, about the present and the future. Although memory is the process by which we remember skills, things, or episodes from the past — usually our personal past — the actual remembering happens in the present and usually for the sake of the future. What we often call a 'recollection' from the past is actually a dynamic construction or re-enactment of the past that takes place in the present in anticipation or response to a future, using different types of memory traces, agents, skills, media, and practices. This has two obvious implications: one implication is that memory (bodily, declarative, or procedural) is situated, mediated, and contextual; the second implication is that anticipation, projection, and prediction are often inseparable from recollection. Bodily memory, in particular, can be easily described as a form of enactive discovery or recognition. The body remembers not so much through a process of passive recollection or the re-enactment of internal memory traces. Rather, the body remembers through the active identification or re-enactment of traces which are both internal and external. The external material environment and forms of material culture that surround us are not just cues or prompts for memory processes that happen inside our bodies or our heads. Instead, they are continuous and co-constitutive agents of recollection. As we saw, the dexterous movement of the hand touching the clay preserves and re-enacts body memory as much as the brain does. None of those elements taken in isolation can explain the phenomenon we are trying to understand. This point is worth stressing because it helps to highlight a common misconception about body memory: although embodied memories have often been described and studied as the products of individual bodies or individual brains, they are in fact the products of our actions, of our interactions, or even more correctly of our transactions with other people and with the material world that surrounds us. In short, the claim we wish to make is that the formation of embodied memory needs *more than a body* (Malafouris and Koukouti, 2017); *it needs a situated body*. All human action is situated action; it takes place in a specific context and is often mediated by

1 some form of materiality. Time and context, that is the cognitive
2 ecology of memory, is of the essence.

3 The skill of throwing a vase on a wheel is not related to bodily
4 memory in some 'internalist' sense where the potter's body
5 remembers 'from within' what the right way is to touch the clay or to
6 manually converse with the wheel. Body memory is the transaction
7 among the constituents of action that enables the active discovery of
8 the relevant situated affordances as they present at hand. Remove the
9 clay or the wheel and memory becomes incomplete; or even a mere
10 potentiality. It is like a pianist trying to perform a piece without the
11 piano. Certainly the body remembers and could recreate the hand's
12 movement. But is it really the same movement? If body memory is
13 only about bodies, why is it then that a pianist's hand cannot recreate
14 the exact movement? Where is the missing memory?

15 The problem here partly emanates from the way we are used to
16 talking about and describing the process of material engagement
17 (creative or not) as separate from memory. On this construal the skill
18 of playing the piano or of pottery making is not a form of active
19 remembering but rather something that can be represented in patterns
20 of muscular activation and generalized motor programmes that can be
21 stored in e.g. long-term memory. We think of memory as a separate
22 process that takes place on the 'inside' and which is what enables the
23 body to remember and perform its skills on the 'outside'. We assume
24 that motor programmes and their assorted neural activation and
25 deactivation patterns somehow represent skill in the form of an
26 'internalized' manual that our bodies can read like we read an
27 'externalized' manual describing how to make a pot or how to play the
28 piano or how to ride a bicycle.

29 In this paper we are gesturing towards a different way of describing
30 that process. The way to describe memory that the perspective of
31 material engagement affords is one that sees skill not as a process to
32 be remembered but as a process of remembering, specifically a pro-
33 cess of remembering through and with. We call this process enactive
34 discovery or *thinging*, namely, *thinking and feeling with, through, and*
35 *about things* (Malafouris, 2011; 2014; 2016a; 2018a), and it is a
36 cognitive process as much as it is an affective and aesthetic one. In
37 this connection, it cannot be emphasized enough that the thing that
38 matters about material memories, from the simplest to the most com-
39 plex techniques of memory, is not that they enhance the storage
40 capacity of the biological brain. Rather, they matter because they
41 change, and in some cases radically transform, the way people

remember or forget. At the same time memory cannot be understood in itself or for itself but only in relation to something else. We should not be thinking of subjects and objects here but of assemblages or entanglements of mind and matter. We can never understand human memory if we don't understand the impact of material culture on human thought and the complex transformations it brings about in the dialectic and forms of remembering and forgetting. Most of the skills, habits, and practices we often think as forms of embodied or body memory refer to processes of material engagement. Thus, building on the work of other researchers adopting a similar transactive, ecological, and distributed approach to the study of memory and bodily skills (esp. John Sutton, Edwin Hutchins, and Tim Ingold) we propose: a) that memory traces exist on the 'inside' in the form of neural activation patterns or bodily habits as much as they exist on the 'outside' in the form of material signs, structures, and artefacts, b) that both kinds of traces are needed for the act of remembrance to take place, c) that, when trying to understand the process of memory, talk of 'inside' and 'outside' can be unhelpful, d) that no neat division of labour between the different disciplines concerned with the study of memory can be maintained, and finally e) that the process of remembering is not merely constructive or reproductive; instead, it is creatively enactive — past events are not stored or reproduced but they are not entirely constructed either.

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