Metaplasticity and the boundaries of social cognition: exploring scalar transformations in social interaction and intersubjectivity

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Abstract

Through the application of Material Engagement Theory (MET) to enactivist analyses of social cognition, this paper seeks to examine the role of material culture in shaping the development of intersubjectivity and long-term scalar transformations in social interaction. The deep history of human sociality reveals a capacity for communities to self-organise at radically emergent scales across a variety of temporal and spatial ranges. This ability to generate and participate in heterogenous, multiscale relationships and identities demonstrates the developmental plasticity of human intersubjectivity. Perhaps human sociality's most unique feature is this intersubjective plasticity, that is, the ability for diverse collectivities of individuals and groups to adopt and transition between numerous social identities and behaviours with profound rapidity and flexibility. However, the most influential models in the study of social cognition, the Social Intelligence Hypothesis and Theory of Mind, promote a view of intersubjectivity that is rooted in methodological individualism and primarily understood as a capacity for observation and prediction. This approach leads to significant issues when confronted with the diversity and plasticity of hominin social organisation, particularly in regards to the computational burdens and information processing bottlenecks such scalar changes imply for cognitivist models. This paper examines the metaphysical assumptions in computational models of the mind that result in representational apriorism and an epiphenomenal treatment of material culture that hinder our understanding of the evolution and development of social cognition. Specifically, this article critiques the logics of computation, information processing, representationalism, and content within Neo-Darwinian frameworks that obscure and distort the interrelationships of evolutionary, developmental, ecological and cultural processes. Through a synthesis of material engagement and enactivist approaches to social cognition, this article argues that it is possible to explain the emergent and multiscale dynamics of hominin sociality in terms of ecologically distributed and developmentally plastic interactions between brains, bodies and material culture.

Keywords Material Engagement Theory · Enactivism · Intersubjectivity · Social Cognition · Niche Construction · Social Intelligence Hypothesis

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1 Introduction

The ability to organise cooperative behaviour at emergent scales has led the evolution of gracile apes to develop into a geological event. These are the insights of the current, if somewhat late dawning, debate on the “Anthropocene” (Smith and Zeder 2013). The recognition that humans are affecting the biosphere at enormous magnitudes plays havoc with conceptions of agency and intentionality within traditional western narratives about humanities relationship to the environment (Chakrabarty 2009). The great predicament of the twenty-first century is that human material-culture is driving non-linear transformations in planetary ecology, permanently altering life on Earth. Human evolution has resulted in a capacity to manipulate and transform the material environment in ways that now threaten the continued existence of the species. Facing the very real threats of systemic collapse and extinction require an understanding of how human socio-technical systems emerge, self-organise and impact ongoing developmental processes. At the core of this wicked problem is a question of how human social interactions, identities, intentions and institutions emerge through and are shaped by the material environment. The profound complexity of the current historical moment has led to a growing academic awareness that material relationships have been radically undertheorized (Latour 2007; Ingold 2007b; Hicks 2012). It is in the context of this growing discourse, that Material Engagement Theory (MET) has been put forth as a means of resituating the ontological foundations of the mind around the cognitive-developmental feedback generated through material culture (Malafouris 2013). Specifically, the thesis of “metaplasticity” argues that feedback between neural, behavioural and material plasticity produces emergent cognitive systems which are made visible through the cultural plasticity of the human record (Malafouris 2008, 2009, 2010a, 2015b, 2016b). This paper puts forward a synthesis of MET with Enactivist approaches to social cognition in order to investigate the diversity and scalar plasticities of human societies made possible through the non-linear material interactions of emergent cognitive systems.

Human sociality exhibits what might be described as intersubjective plasticity, an ability for individuals and groups to adopt and transition between numerous social identities and behaviours at a variety of scales with profound rapidity and flexibility (see De Landa 1997; Gunderson and Holling 2002; Christian 2011; Stirner et al. 2012 for examples of these dynamics).¹ The human record reveals an immense diversity and malleability of human socio-cultural relationships. Developments such as the reorganisation of social, economic and political relationships in a city of millions over the course of months if not days (Aston 2017), feudal societies transforming into nation

¹ One need only consider a contemporary hypothetical family in company seating watching African Americans of their “home team” NFL franchise kneeling during the national anthem. Traditional Theory of Mind accounts would argue that this requires recursive levels of intentionality in which individuals represents the mental contents of the propositional beliefs and intentions of other actors in recursive relationships. Thus, the hypothetical family, whilst presumably singing, is observing content bearing information and assessing it against a set of beliefs about the world in order to formulate new intentions based upon the intentional stances and belief states inferred from tens of thousands of other participants all going through the same process... and to think that the game hasn’t even started yet. This is very much a vision of social cognition as spectatorship with a concomitant lack of actual embodied activity.

states (Anderson 2016), the reconstitution of indigenous identities, communities and polities following European epidemics (Richter 2003) and the emergence of Mediterranean maritime societies (Broodbank 2013) are all powerful examples of the scalar plasticities of human social interaction. Even in the depths of prehistory, it is clear that modern humans were capable of significant “releases from proximity” (Gamble 1998), and their seasonal dynamics of aggregation and dispersal indicate a great deal of social and political creativity (Wengrow and Graeber 2015). However, the general acceptance of cognitivism² in the study of social cognition has resulted in a third person description of intersubjectivity (De Jaegher et al. 2010; Gallagher 2017, p. 65-82) and an epiphenomenal view of material culture (Garofoli and Iliopoulos 2017). Cognitivist frameworks lead to significant issues when confronted with the observed scalar shifts in hominin³ social organisation due to the computational burdens and information processing bottlenecks that such scalar changes imply for computational theories of mind.⁴ Recently, partially in an attempt to grapple with these scalar changes, a number of papers have applied distributed, embodied and enculturated models of cognition to the social intelligence hypothesis that progresses a view of a Palaeolithic mind with internally evolved symbolic content that was increasingly distributed into material culture so as to enable increased social cohesion and extension (e.g. Dunbar et al. 2010a). However, if artefacts are merely an extension of cognitive processes originating from inside the head, this would mean that the cognitive properties of material culture are limited to a set of pre-evolved (representational) semiotic abilities. This vision of neural evolution implies that human cultural diversity results from an underlying homogeneity in the information processing abilities of pre-programmed stone age minds.

This paper argues that the social intelligence hypothesis has traditionally rested upon a number of metaphysical assumptions that severely hamper its description of intersubjectivity and material culture. Primarily, these shortcomings result from an assumption that information transmits content (Hutto and Myin 2013), a ubiquitous developmental teleology that is built upon Theory of Mind (e.g. Stone 2006), an evolutionary teleology that originates from representational apriorism (Garofoli 2017) and the dichotomisation of social and ecological pressures (Sterelny 2007). The cognitivist assumption that the brain evolved to extract information with which to run computations over representational vehicles leads to a neurocentric view focused upon mental content. This framework poses serious difficulties when considering the diversity of human socio-cultural systems and the scalar plasticities of human social organisation such as fission-fusion dynamics, kinship structures, sedentism and urbanisation. From a cognitivist perspective, the stabilisation of brain size presents an informational bottleneck in terms of group size (Dunbar 1992). Similarly, at the developmental scale, the burden of propositional content suggested by Theory of Mind quickly leads to an iteration of the “frame” problem in which the demands of representing the beliefs and intentions of social actors become overwhelming recursive processes in any large and densely connected society (see Gallagher 2017, 86-87). Thus, informational

² Cognitivism is the theoretical synthesis of computationalism, informational processing and representational content in cognitive science and philosophy of mind.

³ This paper follows the contemporary distinction between Hominid as the Taxonomic Family that includes all the Great Apes, and Hominin to refer to the specific lineage of the genus *Homo*.

⁴ For example, Dunbar’s number, which posits a cognitive processing limit that constrains effective and stable social relationships to group sizes with an upper limit of 150 persons (Dunbar 1992).

bottlenecks at the evolutionary scale become an issue of recursive representational burdens at the development scale. This evolutionary teleology that moves from brain to representation to Theory of Mind, compresses the complexity and diversity of human relationships into a standardised suite of cognitive processes adapted to domain-specific evolutionary pressures of which human culture is a result (see Iliopoulos and Garofoli 2016 for a critique of modular cognition). In this view, hand axes, societies and anthropogenic climate change are all just byproducts of the human brains computational abilities.

Instead of defining representational processing as the starting point and Theory of Mind as the expected cognitive outcome of these processes, it is more fruitful to explore how social relationships are formed, sustained and modified as ongoing interactions at various temporal and spatial scales. In these regards, enactivist approaches to social cognition which examine the self-organising dynamics that emerge through embodied interactions provide particularly useful frameworks for understanding the scalar plasticity of social cognition (e.g. De Jaegher and Di Paolo 2007; De Jaegher et al. 2010; Froese and Fuchs 2012). De Jaegher et al. have defined social interaction as “a co-regulated, self-sustaining pattern of joint activity” (2010, p. 443). This perspective leads to questions of how developmentally novel relationships are capable of being conceptualised at the outset. That is, in order to consider social institutions such as nationality, clan or religious community as real existing relationships in which one participates, one must first experience these concepts as substantiated realities (Renfrew 2001). Such a consideration thus requires an examination of the evolution and development of hominin societies in the context of long-term ecological and cultural change. Enactivist accounts have focused primarily on dyadic relationships over the course of fairly limited temporal scales, usually those of childhood, or brief interactions between adults. By emphasising the self-organising properties of social interaction over long periods of cultural change, it is possible to appreciate how material engagement generates non-linear dynamics in the emergence of hominin cognition and sociality.

MET’s focus upon material-culture as constitutive of cognitive processes provides an understanding of how scalar changes in social interaction are generated through epistemic engagement with the material environment. In this way, the unique evolutionary and developmental properties of human social cognition can be explored as a dynamical relationship between the energetic and material flows of the ecosystems in which hominins have emerged. From a Material Engagement perspective, three key issues stand out for the study of social cognition: firstly, the diverse and complex effects of the material histories involved in a specific social context; secondly, the phenomenological dimensions of how social interaction is experienced and preformed through material culture; and finally, the ways in which material culture produces significative meaning in its own right without resorting to apriori propositional content. After a review of the intellectual history of the Social Intelligence Hypothesis and Theory of Mind, this article will consider social intelligence through the perspectives of Niche Construction, the ways in which organism shape evolutionary processes through modification of their environment; Enactivism, the argument that cognition emerges through dynamic interactions in the environment; and Material Engagement Theory. These approaches will be synthesised in order to examine the ways in which contemporary ontogenetic evidence and the early hominin archaeological record imply the

existence of a coevolutionary relationship mediated between eyes, hands and material objects in social contexts. Through the application of metaplasticity to the concept of enactive social cognition, this paper explores how human beings think through the heterogeneity and recursiveness of their social relationships and generate communities at new scales through their material cultures. This enactive, material engagement approach to social cognition seeks to counter the logics of representational apriorism and the epiphenomenal treatment of culture in cognitivist models and their lack of emphasis on developmental processes by considering material culture as constitutive of dynamically embodied and distributed cognitive systems that shape a continuum of evolutionary, ontogenetic and ecological processes.

2 The Matter of Social Cognition

The Social Intelligence Hypothesis (Humphrey 1976; see Emery et al. 2007 for a review) and Theory of Mind (Premack and Woodruff 1978; see Schlinger 2009 for a review) have a shared intellectual history that has dominated theorisation about social cognition at both evolutionary and developmental scales. The concept of social intelligence began to take firm hold when Nicholas Humphrey used a metaphor of chess and social relationships to describe the mechanism that drove the evolution of the human brain as a process of advantage seeking competitive interactions within group living contexts (1976). Two years later, as they sought to test the mental states that chimpanzees could infer in others, Premack and Woodruff established the concept of Theory of Mind as the ability to understand beliefs and intentions from multiple perspectives (1978). The confluence of the two frameworks led to the development of the Machiavellian Intelligence Hypothesis, a theory that the human brain emerged through a co-evolutionary spiral driven by social competition over the ability to infer mental states and manipulate behaviour through benefit maximising calculations (Byrne and Whiten 1988; Whiten and Byrne 1997). Recognising that not all features of human cognition were adequately explained through social pressures, this line of inquiry also led to the articulation of the technical intelligence hypothesis, the argument that brains evolved partially through a selection process that favoured procedural cognition (Byrne 1997). The most widely renowned iteration of the Social Intelligence is undeniably the Social Brain Hypothesis, which postulates that brain size increased to handle dense and complex information (primarily linguistic) flows between conspecific hominins (Dunbar 1998). In more recent years, theorisation around the Social Intelligence Hypothesis has expanded to include enculturation (Moll and Tomasello 2007; Herrmann et al. 2007) Niche Construction (Sterelny 2007) and the contemporary flourishing of 4E approaches to cognition⁵ (Grove and Coward 2008; Coward and Gamble 2008; Dunbar et al. 2010b; Gamble et al. 2011; Gowlett et al. 2012; Coward 2016). Common to the many iterations of the Social Intelligence Hypothesis is a tacit, often explicit assumption that Theory of Mind is the definitive characteristic of mature human intersubjectivity. Both frameworks assume methodological individualism as the

⁵ 4E cognition is comprised of Embodied (bodily structures and processes that shape cognition), Embedded (cognition is environmentally situated), Enactive (cognition is constituted through activity) and Extended (cognition is functionally and structurally distributed into the environment) approaches to the mind.

appropriate level of analysis for social cognition and accept the unobservability of the mind as well as representational content as definitive of cognitive processes. Thus, social cognition has been conceived of as the ability to observe and predict the propositional content of beliefs and intentions hiding inside other brains, thereby promoting a view of social relationships as an aggregate of calculations between individual brains. However, there is good reason to suspect that such Cognitivist frameworks form a type of late twentieth-century “Ptolemaic system” that obscures and distorts the relationship between mind and matter.⁶

Social Intelligence and Theory of Mind are both rooted in the cognitivist view of the mind that emerged through the convergence of information processing theory and computationalism (Piccinini and Scarantino 2011) and reconceptualised the mind in the “image of the digital computer” (Malafouris 2013, 26). Despite the different disciplinary backgrounds, compatibility between information processing, computationalism and representationalism has been largely presumed (Piccinini and Scarantino 2011) and constructed around numerous metaphysical assumptions about the internal, content bearing nature of the mind (Hutto and Myin 2013). The polysemic relationships between representation, information and computation pose serious questions about the semiotic compatibility of information theory and computationalism that are often underexamined. On the one hand, Information theory developed as a way to statistically model communication within engineered systems in regards to the fidelity, transmission, feedback and reproduction of a signal (Shannon 1948).⁷ This theoretical view has led to the dominant scientific tendency to conceptualise information as an independent variable that circulates “unchanged among different material substrates” (Hayles quoted in Knappett 2004, 43). On the other hand, computationalism was conceived of as a way to model cognitive processes using the logical calculus pioneered by Alan Turing and the computability theorists for the formalisation of large data sets (McCulloch and Pitts 1943). Thus, it was assumed that the brain is *the* cognitive system which operates by performing computations, that is, processes that determine outputs based on inputs that are manipulated according to rules defined over the appropriate vehicles (Piccinini 2009). It is completely possible to model mathematically brain activity in this way, the problem comes when these dynamics are conceived of as the processing of representations which act as “information-bearing structures” (Pitt 2017). A metaphysical leap is made by assuming that perceptual inputs from the environment which covary with neural patterns in the brain (measurable as Shannon information) are transformed via computational processes into representations about the world. This is the so called “hard problem of content” which states that covariance between external environmental and internal neural states are not sufficient evidence for the existence of informational content (Hutto and Myin 2013 p. 57-82; Garofoli 2017 p. 8-11). In the context of the contemporary study of social cognition, such cognitivist assumptions posit that distinctly “social” information is transformed by human neural architecture into the propositional content of intentions and beliefs states that the brain was specifically evolved to handle.⁸

⁶ Ptolemy’s system, the dominant heliocentric model of the universe from the second century AD until the Copernican revolution, was mathematically consistent and exhibited a relatively high degree of predictive accuracy as regarded astronomical observations.

⁷ In the technical sense, “Shannon” information is embodied “qua selectable, physically distinguishable structures associated with given probabilities” (Piccinini and Scarantino 2011, p. 240).

⁸ For example, Valerie Stone defines social cognition as “the information-processing architecture that enables us to engage in social behaviour” (2006, p. 103).

In assuming a neurocentric model of the cognitive universe, such approaches to social cognition invariably require an explanation of how the environment comes to be encoded and decoded with propositional content by the brain at both evolutionary and ontogenetic scales. Cognitivism, when framed within the selectionist logics of the Neo-Darwinian synthesis (see Ingold 2007a, c for critiques) leads to the conclusion that the brain, and its cognitive functions are preselected structures. This reasoning implies that specific genetic sequences generate distinct neural components that use representational vehicles to run computations over informational inputs from the environment. In these regards, by articulating Theory of Mind as the high watermark of human social cognition, researchers predefine the expected cognitive-behavioural package, which they then seek at the evolutionary scale. Research thus becomes focused on identifying specific neural correlates and timing of development in order to postulate specific causal mechanisms responsible for this capacity.⁹ It is therefore assumed that evolutionary pressures produced discrete neural components that encephalised under distinctly “social” pressures, resulting in a highly specified mentalising capacity for third person observation. Relationships and interactions between conspecifics are framed as non-ecological pressures whose selective effects can be isolated to specific, modular regions of the brain. Critiquing the social brain hypothesis specifically, Tim Ingold notes that, “on the one hand it reduces the social to the operative, and on the other hand it elevates the brain to the executive, making social life look like the aggregate effect of brains telling their owners what to do” (Ingold 2010). Thus, hominid social behaviour has been conceived of in terms of propositional knowledge, intentional stances and conceptual relationships such as status tracking and bonds (Barrett et al. 2007) and social interactions come to be seen as a cost-benefit calculations by profit maximising individuals interpreting information from a third person stance.

Through the methodological separation of the individual from the social and the social from the ecological, the study of social cognition becomes an issue of measuring content bearing information flows between these conceptually isolated domains. However, a distinction between social and ecological “problems” does not provide any causal explanation for the evolution of hominin sociality; it merely assumes an *a priori* division between the two phenomena as a point of departure for analysis. The assumed relationship between the evolution of social intelligence and theory of mind, when situated within frameworks that presume genetic selection determines (neural) phenotype, thereby producing domain specific cognitive processes, results in an iteration of the ‘behavioural modernity’ problem (Nowell 2010; Shea 2011). Behavioural modernity, the point at which cognitively modern humans are hypothesised to have first emerged, is generally defined as the capacity for abstract thinking, planning depth, innovation, and symbolic thought (McBrearty and Brooks 2000, 492). This concept leads to a great deal of research and speculation as to the specific evolutionary mechanisms, timings and neural components that resulted in cognitively modern humans. The result is a theoretical discourse that is conceptually preoccupied with issues such as genetic markers for language capacities, and the identification of specific pressures and selective events that lead to the capacity for “symbolic processing” (e.g. Dunbar 1992; Klein 2000; Krause et al. 2007). However, the so called “Sapient

⁹ This dynamic is clearly illustrated by a recent study that sought to correlate social network size with encephalization of specific brain areas, particularly those associated with Theory of Mind (Lewis et al. 2011).

Paradox” (Renfrew 1996, 2008), that is, the temporal gap between the stabilisation of the human genome sometime within the last two hundred millennia and the radical behavioural changes that only began to accelerate in the past forty thousand years, complicates this narrative. Even if evidence such as shell beads are used to infer the existence of symbolic cognition up to 100,000 years ago (e.g. d’Errico et al. 2005), this still leaves an explanatory gap as to why the diversity and rate of change in material culture only began to drastically accelerate in the past forty millennia. In terms of social cognition the paradox is particularly thorny when confronting the rapid scalar changes and complexification of human societies over the past ten thousand years. If group size and brain encephalization are positively correlated, it is difficult to explain how social complexity has increased by orders of magnitude, particularly within the past six thousand years as a result of cognitive exaptation from tens if not hundreds of thousands of millennia prior.¹⁰ In these regards, the emergence of states, religions, and Facebook should raise serious questions about the validity of Dunbar’s number as a metric. Either the cultural complexity that begins to appear during the late Pleistocene is a delayed epiphenomenon of apriori genetic selection events,¹¹ or the relationship between hominin cognition and the material world requires a more nuanced investigation than representational and neurocentric models can account for.

Material Engagement Theory proposes that the diverse plasticities of matter and the developmental plasticity of hominin bodies produce significative capacity through the pattern generating capacities of environmentally situated activity (Malafouris 2013, 2015b). This approach recognises that the material properties and qualities of things such as obsidian, marble, clay, and uranium all have distinctive structural patterns with unique influences upon cognitive dynamics. From the perspective of complex systems dynamics (e.g. De Landa 1997; Gunderson and Holling 2002; Johnson 2009) the varieties and combinatorial possibilities of materials found on Earth can be understood to afford countless opportunities for non-linear interactions and emergent behaviour. In these regards, environmental interactions involve “non-trivial causal spread[s]... in processes of mutual and concurrent interaction, and patterns of simultaneous reciprocal causation” between brain, body, and world (Hutto and Myin 2013 p. 6). The material engagement approach poses that, much as our bodies are constituted through the atomic and biomolecular structure of our environment, so too our minds are constituted through the transformative and generative capacity of material interactions on Earth (Malafouris 2016b). Traditional cognitivist perspectives treat material culture as a component process of perceptual-behavioural input/output relationships between environment and brain. In this account, human neural architecture extracts information from the environment and transforms it in to representational processes. Thus, material-

¹⁰ A growing body of data negates the expected results of the social brain hypothesis. For example there is a lack of any clear relationship between grooming behaviours and coalition formation (Barrett et al. 2007, 562). Likewise, some predominantly solitary species have exceptionally large brains (Holekamp 2007, 67), while other socially complex organisms such as corvids reveal no correlation between brain size (Iwaniuk and Arnold 2004). There is no correlation between the frequency of social learning and primate group size, however, there is correlation between brain size, behavioural innovation, social learning and tool use that covaries across primate species (Reader and Laland 2002). This research indicates that the distinct conceptual categories of the social intelligence hypothesis such as social, technical and ecological are far more entangled processes than have been proposed.

¹¹ Such a perspective invariably produces an evolutionary teleology that moves from selective pressure to neural phenotype with internal symbolic processes generating cultural by-products.

culture's role in cognition is little more than a perceptual cue for the real heavy lifting of internal, symbolic processing. Representational apriorism assumes that content bearing mechanisms in the brain precede material forms, and that material-culture functions to transmit information between computational brains (Garofoli 2017). This inverts and externalises the conflation of semantic and technical information discussed above, such that energy and matter flows in the environment come to be viewed as propositional vehicles for semantic content. This conceptualisation of culture as an information-bearing structure that is encoded and decoded by the brain leads to a treatment of material-culture as inferential evidence or "proxies" for representational mechanisms locked inside the head.

In essence, the MET position states that the synthesis of computationalism and information processing at the outset of modern cognitive science leads to linguistic biases and fallacies that cause us to overlook and underestimate the creative potency of the material environment in the emergence of socially cooperative, developmentally plastic hominin bodies. Materials in the environment, artefactual or otherwise, are not merely passive recipients of human activity; things in the world have their own properties and qualities that dynamically constitute the complex systems in which humans are entangled. From the MET perspective, the symbolic systems of computationalism and information theory unique artefacts that emerged through specific historical relationships and technical problems afforded by material culture. The material engagement approach understands complex forms of numerical cognition to emerge through intergenerational communities of practice manipulating material structures which enable quantitative relationships to be conceptualised and reasoned with (see Overmann, 2016, 2017). Though information theory and computationalism are undeniably capable of quantifying and modelling certain observed relationships in the environment, MET understands the mathematical and logical notation systems that they utilise as distinct, culturally derived forms of numerical cognition. In these regards, reducing all cognitive phenomena to these concepts of computation and information processing risks a fallacy of composition which confuses an emergent property of human cognitive systems with a core structure or process. From the standpoint of Material Engagement Theory the treatment of material culture as content bearing, representational epiphenomenon looks much like Ptolemy's epicycles, that is localised complications which conform the phenomenal world to the simplifications of a model that misses the greater complexity of relationships in which it is situated. If the self-organising dynamics of society are not derived from information flows between compartmentalised, third-person social calculators it is necessary to investigate what processes support the emergent complexity of human social interaction and whether those processes are cognitive or not.

3 Distributed Social Brains and Scaffolded Minds

Recently, in keeping with the ongoing theoretical upheavals in philosophy of mind and cognitive science, a growing body of research has been put forward that examines the relationship between material culture and the evolution of social intelligence from more distributed and embodied perspectives (e.g. Dunbar et al. 2010a). These papers emphasise how cooperative cultural interactions shape ontogenesis and consider the

neural, perceptual, emotive and conceptual relationships made possible via material culture. However, despite the novel and important perspectives provided by these theoretical shifts in the discourse on social intelligence, these papers still rest upon metaphysical assumptions that reproduce a teleology of brain to symbol to material medium. Furthermore, though these papers emphasise embodied relationships, they still fundamentally accept Theory of Mind and higher order intentionality as the cognitive end state of socio-cognitive evolution (e.g. Grove and Coward 2008; Coward and Gamble 2008; Dunbar et al. 2010b; Gamble et al. 2011; Gowlett et al. 2012; Coward 2016). Ultimately, while these new Social Intelligence Hypotheses make important contributions, they are still susceptible to the polysemic fallacies of cognitivism, its metaphysical assumptions and the arbitrary conceptual divisions between the individual, social and ecological domains. In accepting the necessity of content and apriori representationalism, these frameworks still submit to a teleology in which pre-evolved cognitive programs are extended into and executed through material culture as memory aids, procedural cues and proxies for emotional bonds, beliefs and intentional stances. In essence, material culture is seen as a container into which the symbolic mind can dump content. This idea of replicating and distributing internal cognitive programs into the material environment is not only epiphenomenal, but implies a kind of cognitive-historical determinism in which literacy, cities and nuclear warfare were exapted from information processing modules which evolved in the human brain sometime during the Middle Stone Age.

Though these novel approaches to social intelligence provide innovative and important discussions about the relationship between material culture and social cognition, they are still bound up with Neo-Darwinian cognitivist logics (see Barona 2018 for an excellent critique). Drawing from distributed, embodied and extended frameworks that recognise artefacts as capable of offloading symbolic storage and manipulation (e.g. Hutchins 1995; Clark 2008) these papers conceptualise material culture as vehicles for propositional content that result from pre-evolved representational capacities. Despite the attention to the affective, attentional, and intentional relationships scaffolded through material culture, artefacts are nonetheless interpreted as “material proxies for symbol-based cognition” (Gamble 2010, 27) which in the context of social cognition, has the “purpose of encoding information to make larger social networks possible” (Gamble et al. 2011, 118). This representational apriorism is largely explained in terms of the lag between the last major encephalisation event (c. 600kya) and the lag in observed technological innovation (Gowlett et al. 2012). It is assumed that material complexity lagged behind social complexity, and that symbols were something that were first developed and exchanged between conspecific brains only to later be transmitted through material forms as symbolic content.¹² Thus, material culture still plays a relatively passive roles as mnemonic devices and other functional extensions that support internal cognitive processes which are to some extent seen as distributed into, or scaffolded from the environment (see Malafouris 2016a for a critique of weakly embodied frameworks). In terms of social cognition, this reasserts the categorical

¹² This is a questionable interpretation based on the varied durability of cultural material alone. Stone tools, for example, have a far slower rate of entropy than cordage or wood. Furthermore, much as the similarity of many modern hand tools to designs from previous centuries are not a sign of general historical inertia, the stability of the Achulean form is insufficient evidence for a lack of change in the socio-technical relationships and cognitive dynamics of the Middle Stone Age.

distinctions between mind and matter, nature and culture that such papers are claiming they wish to move away from. Material culture is understood to be “gradually integrated into social networks” (Coward and Gamble 2008 p. 1969) and social and ecological dynamics are seen to become “fused” over time (Sterelny 2007 p. 728). In these regards, material culture’s primary role in social cognition is to identify “symbolically marked groups” (ibid p. 722) while functioning as “performative cues... that compensate for weak ‘categorical’ knowledge of the people with whom one must interact” (Coward and Gamble 2008 p. 1975). Artefacts fulfil “mnemonic functions, becoming externalised loci of memories which act as ‘prompts’ for and records of the social relationships in which those objects are entangled.” (Coward 2016 p. 80) Thus, material culture is conceptualised as vehicles for emotional and propositional content, such that artefacts are “encoded” into individual brains in ways that extend body schema, empathy and identity from a neurocentric, individualist perspective (Grove and Coward 2008).¹³ Despite their value, these papers continue to reify numerous dichotomies along with an epiphenomenal and evolutionary teleology of material culture that is built upon the unexamined assumptions about representation, information, computation and content.

Still, these frameworks should be acknowledged for giving more serious consideration to the relationships between social cognition and the material environment. The great value of the social intelligence hypothesis is the insight that cognitive and social complexity form co-evolutionary pressures. As Kim Sterelny states, “the feedback loop between individual capacity and social complexity makes the social intelligence hypothesis a niche construction hypothesis” (2007, 720). Niche construction provides an invaluable starting point for reframing hominin social cognition as dynamic relationships that extends across brains, bodies and environment.¹⁴ This perspective reframes the Social Intelligence Hypothesis away from linear interactions between specified neural correlates and behaviour to an examination of the relationships between ontogeny and energy-matter flows in the environment. Cooperative relationships imply that “the evolution of hominin cognition depends on features of the environment that hominins have created themselves” (Sterelny 2007, 720). In this sense, social organisation can be understood as a form of niche construction. The active structuring of relationships within a species group creates unique adaptive landscapes that produce

¹³ The authors follow the weak embodied account of mirror neurons as the foundations for a simulationist account of ToM in which individuals run first person simulations of the experiences of others in order to conceptualise the mental states of others (e.g. Gallese 2007). This maintains a view of social cognition as observation and prediction, but instead of framing this as a third person theoretical stance, “second-person interaction is reduced to first person-internal activity” (Gallagher 2017, 222) through an act of simulation. There is good reason to question why mirror neurons need to be conceptualised as simulations when they can just easily be described as directly embodied experiences of the goal directed actions and emotive states of others (Gallagher 2011, p.75).

¹⁴ Niche construction theory examines the ways in which organisms modify their environments to produce evolutionary feedback between environment and ontogeny (Laland et al. 2016). By considering environmental modifications as a form of ecological inheritance, investigating niche construction allows for an understanding of organisms as participants in their own evolutionary dynamics. Instead of viewing environmental modification solely as the expression of previous genetic adaptations, evolution becomes a reciprocal process in which modification of the environment selects for traits that require niche constructing activities for fitness (Silver and Di Paolo 2006). The logic follows that under highly variable environmental conditions the evolution of developmental and behavioural plasticity will prove a successful adaptive trait. Niche construction theory shows that ontogeny and evolution must be approached as inherently ecological processes.

powerful and often novel forms of evolutionary feedback.¹⁵ However, if niche construction selects for developmental plasticity, under the right conditions, the feedback between evolution, ontogeny and ecosystems should create opportunities for emergent forms of complexity to emerge, such as a radical degree of developmental plasticity. In recognition of this Karola Stotz has argued that humans form “ontogenetic” or “cognitive-developmental” niches as “problem solving resources and scaffolds for individual development and lifetime learning” (2010, 483). Nonetheless, Stotz’s account remains tightly focused on individuals as cognitive processors of “information” and all the conceptual problems this entails. If we wish to understand the evolution of social cognition, then we need to conceptualise matter not as information that is purified into representational computations, but as something that dynamically constitutes socio-cognitive life on its own terms.

Evolution, and that of the human brain particularly, needs to be explored in terms of non-linear, probabilistic and bidirectional processes (Green 1991; Gottlieb 2007). In these regards, the properties of heterogeneous materials have diverse and often subtle impacts upon the dynamics of neural and cognitive processes. MET approaches the ways in which the behaviour of materials influence the cognitive system, not as passive input-output structures that complete a circuit of representational information, but as transformative bodies that alter the feedback dynamics of the cognitive system through “the relational forging of novel combinations, exploratory and transformational connections or synergies” (Malafouris 2015a p. 147). Thinking through obsidian is markedly different from thinking through marble, they afford and constrain certain technical and conceptual realities. In this sense, all material forms provide distinct properties and combinatorial possibilities that fundamentally pattern the dynamics of cognition and the creative diversity of human cultures. Rather than viewing the evolution of social cognition as a distinct process that became fused with material culture over time, it is more constructive to examine how matter in the environment has been constitutively entwined with both the evolution and development of the human neuroarchitecture. The brain is a sensitive organ, responsive to subtly changing patterns in the environment, instead of assuming that symbols are located inside the head, MET asks, “when does a simple mark become an arbitrary sign for people to think with” (Malafouris 2013, 234). Rather than viewing material culture as proxies of pre-evolved symbolic capacities utilised for understanding and formulating intentional states and beliefs, it is possible to investigate ontogenetic relationships principally mediated through eyes, hands, material things and the bodies of others that enable complex social interactions to emerge. From the earliest stages of human life, intersubjectivity develops through attentional focus upon bodies, primarily faces (Gallagher 2011 p. 65–85), a process that moves from imitation to collaboration through gaze sharing, gesticulation and the manipulation of materials in the environment (Moll and Tomasello 2007). In this light, we can begin to reframe the discussion of human social cognition upon embodied interactions and their constitution through material culture.

¹⁵ Sterelny is also critical of the extended mind, preferring the concept of scaffolding, though his critique is targeted more toward the functionalist iterations of the Extended Mind Hypothesis (2010).

4 Embodied Social Intelligence

Humanlike apes began to emerge roughly six million years ago as they began to diverge from our last common ancestor with chimpanzees. The evolution of group living is generally understood to “represent a balance between the centripetal force of predation risk and the centrifugal force of competition” (Barrett et al. 2007, p. 561). The broad trend of hominin species history has been largely defined by a move away from the rigid hierarchies of our primate relatives towards more cooperative social behaviour (Erdal et al. 1994; Boehm 2001). Effective cooperation can help to ensure against the monopolisation of and exclusion from resources while producing scalar effects in production and consumption (Ames 2010; Stirner et al. 2012). Sterelny has argued that hominin foraging altered hominin social environments, producing feedback between cooperative behaviour and resource extraction that fuelled population growth, thereby setting off a co-evolutionary spiral selecting for social complexity (2007). Hominins that shared and reciprocated effectively with each other transformed their environment, thereby altering the dynamics and pressures upon social cognition.

Comparative studies on hominid cognitive development have shown that humans appear to be radically predisposed to engage in cooperative, joint attentional activities at an early age, whereas joint attentional activities with our primate relatives appear to be more driven by competition (Moll and Tomasello 2007). Though Tomasello and his colleagues advocate a representationalist view of the mind, and while it is important not to overstate the evidence gained from animals raised in captivity, it is possible to interpret this behaviour from a non-representational perspective. Barret et al., rejecting cognitivist descriptions of primate social cognition, argue that grooming and proximity maintenance can be understood as the active (and intelligent) structuring of space in order to maintain action-perception loops that sustain mutualistic interactions and alleviate the negative social effects of competition (2007). In this light, social interaction can be viewed as a “niche constructing” dynamic that would logically select for a high degree of perceptual attunement to the bodily affordances of others. Considering niche construction from the perspective of direct perception, “the construction of a niche requires both the perception and utilisation of affordances... if this construction is evolutionarily consequential, then the perception and utilisations of the affordances that led to the niche are not merely a result of an evolutionary process; rather they (partly) determine this process” (Withagen and van Wermeskerken 2010, 503). Thus, sufficient evolutionary conditions favouring group sociality would logically select for the evolution of bodily perception-action systems that support collective living.¹⁶

Human development appears to involve perception action systems uniquely adapted to cooperative behaviours. From the outset, human embodiment is socially embedded and develops, in key respects, through an attentional focus mediated through the bodies of other people. This relationship is nowhere more clear than in the case of facial

¹⁶ From this perspective, the evidence from Moll and Tomasello that suggests chimpanzees can discern the location of hidden food through a grabbing motion, but not through purely cooperative gesturing (2007 p. 643–45) potentially implies an evolutionary divergence between perception-action systems involved in cooperation and competition amongst humans and the great apes.

perception. Foetuses in the third trimester have been shown to turn preferentially toward face like patterns via projected light into the womb (Reid et al. 2017). In addition, new-born infants as young as three hours old are capable of mimicking facial expressions (Meltzoff and Moore 1983). Humans are born with a prenoetic interbodily responsiveness to other humans (Gallagher 2011 p. 133-152). During the earliest phases of life, the human face presents itself as the critical perceptual affordance through which social interactions are scaffolded. Focusing upon eyes developmentally precedes broader facial recognition within infants (Itier and Batty 2009), and around six months infants begin to preferentially focus upon faces, bodies, movement and learn to mirror the emotional expressions of adults (Gallagher 2011, 69-75). Considering this developmental evidence, one can appreciate how forcefully bodies capture attention, drawing gaze and focus in both peripheral and direct observation (Downing et al. 2004). Human perceptual attunement to bodies, faces and hands supports an argument for the co-evolution of human cognition with socially embodied affordances for pragmatic engagements with the world. Studies demonstrate that visual perception of the human form has consistent and distinct neural activation patterns that occur in the extrastriate and fusiform body areas, which are involved in proprioception, body schema, body image, the perception of others and goal directed actions (Astafiev et al. 2004; Peelen and Downing 2007). Furthermore, the fusiform and occipital face areas of the brain, also located in the extrastriate cortex, develop in close proximity to and have functional overlaps with both the extrastriate and fusiform body areas (Haxby et al. 2000; Spiridon et al. 2006). The existence of these neural networks, as well as the interbodily responsiveness to the behaviour of others revealed in “mirror neuron” studies (Bonini and Ferrari 2011) are all evidence for the brains evolutionary-developmental attunement to the bodies of other humans.

Primary intersubjectivity, the fundamental perceptual-motor ability to distinguish self from others within the proprioceptive system (Trevarthen 1979) appears to be present within the first hours of birth. After the first year of life, infants begin to develop secondary intersubjectivity through joint attention upon pragmatic interactions through gaze following and monitoring (Trevarthen and Hubley 1978). As Gallagher and Hutto write, ‘before we are in a position to theorise, simulate, explain or predict mental states in others, we are already in a position to interact with and to understand others in terms of their expressions, gestures, intentions, and emotions, and how they act toward ourselves and others’ (Gallagher and Hutto 2008 p. 5). Critically, it is during the second year of life that humans begin to engage in communicative gesturing and, significantly, pointing behaviours (Tomasello and Rakoczy 2003, p. 125). As with bodies and faces, the hands form the developmental foundations through which social cognition emerges. It is in this sense that the hands co-evolved as an organ of perception and cognition in concert with the pressures that lead to hominin sociality (Gallagher 2017, 164-86). The hands are the human niche constructors’ primary affordance and interface for pragmatic engagements with the world and this is where the central co-evolutionary role of material culture starts to become truly apparent. Supported by the developmental properties of primary and secondary intersubjectivity, humans engage with and manipulate things in the world as a process of social learning that substantiates identities, meaningful relationships and enculturated behaviours. This evidence reveals how fully material culture is entangled with the perception-action systems of human embodiment, providing essential affordances through which social cognition develops.

5 Social Things

Modern human neural development emerged through hominin bodies collectively negotiating their environments and each other for millions of years. The earliest tool making skills developed in the context of social learning and cooperative group living at least 3.3 million year ago with stone choppers used by pre-hominin species (Harmand et al. 2015). Hand axe's and even rudimentary choppers are incredibly potent affordances for ecological modification, particularly in regards to nutrient-rich packages such as bone marrow. Early tools can be understood to have provided a means for accessing previously unavailable niches, enabling hominins to support expanding populations through the novel modification of energetic and material flows in the environment. The success of these behaviours would have led to increasing local competition and population dispersal, adding to the complexity of the environment. Tool use in conjunction with conditions favouring group living would have exerted powerful co-evolutionary pressures between social dynamics, material culture and population growth. Tools, by affording access to new ecological niches, provided the energetic feedback necessary to support the further expansion of socially cooperative tool use. Furthermore, increasing food availability also affords, in principle, an increased ability to share. Simply put, the opening up of abundant new food sources in group living contexts provides new opportunities to invite others to partake in harvesting as well as physical acts of offering food, for example, during collective acts of butchering. The fact that human cognitive development is grounded in the perception-action loops afforded by faces, hands and objects in the environment (particularly in cooperative contexts during the second year of life) all attests to the evolutionary depth of these relationships. In this light, the perception-action loops afforded by the human body, their ontogenetic expression in modern humans, and the evidence from the archaeological record support a perspective of cognitive-developmental niche construction in which social intelligence evolved and developed through material engagement.

Conventional wisdom has it that the evolution of mind reading mechanisms and theory of mind fundamentally underpins the emergence of language, complex tool making, and group cohesion (Mithen 2000; Dunbar 1992, 1993). For example, it has been suggested that stone tool manufacture minimally requires second order intentionality¹⁷ (Gowlett et al. 2012, p. 698) and that the elegant bifacial symmetry of Achulean technology entails a control of numerous “variables that require a level of processing... similar to that required in high levels of socially-orientated intentionality” (Gamble et al. 2011 p. 123). These arguments render tool production as a kind of syntactic procedure that generates forms based upon propositional knowledge and intentions inside the head. However, this framework overlooks the bidirectional influences that the material environment has upon skilled behaviours, such as a recent experimental study that suggests fracture dynamics play a more significant role than language in guiding stone tool design (Moore and Perston 2016). The exploratory and indeterminant aspects of tool manufacture and use (Chakrabarty 2018) indicates a far more fluid and dynamic process in which intentional states are distributed through and emerge from skilled engagement with the material environment (Malafouris 2013 p.

¹⁷ Second order intentionality is the basic ability to attribute mental states to others, e.g. I know that you know X.

153-177). Furthermore, the ways in which material culture can mediate joint attention and activity (Gallagher and Ransom 2016) suggests that a metaplastic entanglement of stone tool production and early hominin communities constituted an enactive intentionality which was, “intersubjective from the start... generated in our interaction” (Gallagher 2017 p. 81). In these regards, it is possible to explore how basic acts of mark making through material engagement can begin to generate significant meaning (Iliopoulos 2016a, b) that shapes identity formation, intersubjective awareness and social extension without an appeal to beliefs and intentional stances.

The emergence of novel tool using behaviours in group living contexts provides a coherent account of the co-evolutionary pressures suggested by early childhood intersubjective development. Significantly, our primate relatives are capable of displaying all the joint attentional abilities of humans in terms of initiating, regulating and responding to joint attentional activities (Leavens and Racine 2009). This evidence implies that the foundations of socially embedded attentional focus and activity was present before the divergences from our last common ancestors. In these regards, the evolution and development of sustained attentional focus and the ways in which it makes acts of emulation and imitation in social learning possible is of key importance. The capacity to attend to and replicate successful behaviours, to use the traditional terminology, should confer a strong selective advantage that contributes to overall fitness of a group. Interestingly, emulation of goal directed behaviour is more frequent in our primate relatives, whereas the phenomenon of “over-imitation” in children has led Froese and Leavens to argue that this is a developmental response to the conventional and arbitrary relationships of their cultural environments (Froese and Leavens 2014). Importantly, the over-imitating of children requires a high degree of attentional focus and attunement to the actions of others so as to model and perform actions within one’s own body-schema. This evidence fits well with Daniel Hutto’s Mimetic Ability Hypothesis in which the early evolution of the brain was potentially spurred on through the establishment of a “mimetic culture” in which the “flexibility conferred by mimetic skills in conjunction with recreative imaginative abilities for practice and rehearsal would have vastly increased the developmental possibilities for social expression and engagement” (2008 p. 215). Such abilities can be conceptualised in psychological terms such as working memory and executive functions (Wynn and Coolidge 2011). However, this language suggests a highly internalist model of cognition that obscures the distributed and extended dimensions of material culture. The abilities involved in tool use, and the imitation of these behaviours, would have generated numerous layers of feedback capable of ecologically reinforcing attention, memory and identity between different socially embedded and embodied action-perception systems.

In humans, the fine motor skills involved in crafting are supported by neural structures primarily located in the cerebellum. These activation patterns in the cerebellum connect through the pons into the neural networks of the temporal lobe involved in proprioception and identity (Wynn and Coolidge 2014). The crafting process thus activates bodily awareness in ways that involve the ability to distinguish self and other from the environment. What’s more, the proprioceptive system neurophysically incorporates tool use into the body schema, extending the perception-motor system to encompass tools in an act of “cognitive prosthesis” (Malafouris 2012). Such extended embodiment through artefacts reveals an integration of identity and material form at the fundamental level of the “brain-artefact interface” (Malafouris 2010b). In these regards,

the retaining and reuse of tools by hominins beginning around two million years before present (Overmann and Wynn 2018 p. 8) suggests the emergence of a more continual and persistent identification with tools. Another way to frame this dynamic is that tools began to occupy a greater degree of attentional focus in daily life, borne out by evidence for the intentional selection of durable but easy to flake materials, the harvesting, manufacturing and use of stone flakes in separate locations and the transport of materials over distances occasionally greater than ten kilometres (Wynn et al. 2011; Toth and Schick 2018). It is in consideration of this that Manjari Chakrabarty has argued that the “Oldowan knappers’ awareness of raw material quality, or their forethought in multiple aspects of the tool manufacture and use” can be interpreted as the early signs of an emerging, distinctly hominin cognition (2018 p. 8). Preferential selection of materials, transport, manufacture and use of tools all imply processes of material signification (Malafouris 2013 p. 89–118) involved in identity, value, and sociality that do not rest upon propositional content.

Just as any animal tracks signify their cause, resource, debitage and butchery sites would have produced numerous indexical signs contiguous with hominin activity in the environment (see Knappett 2005 85–106; Iliopoulos 2016a p. 250–259 for discussion). Such sites potentially played roles in orientation and navigation, identifying the presence of known or unknown group and the establishment of territorial ranges. Furthermore, the tools themselves, when considered in terms of brain artefact interfaces, suggests a degree of facotrality, or part/whole relationships (see Knappett, 2005 p. 85–106), between tools, hominin identities and intentional action. Cognitive prosthesis and its factorial dimensions also suggests that tool sharing makes possible a physically partible and exchangeable form of embodied intersubjectivity. What’s more, preferential selection of materials can be understood as enactive signs of value, not as belief states held about materials, but through attention to, interaction with and recognition of distinct properties and causal relationships that motivated early hominins to travel significant distances to acquire specific objects. Thus, the very presence of the environmental marks created by knapping would have created a “rich landscape of affordances” (Rietveld and Kiverstein 2014) capable of generating new forms of recursive interaction and awareness.

The production of even the earliest flaked cores would have been a cognitively sophisticated process, requiring the ability to initiate, perceive and respond to transformations in stones so as to produce one tool with another. Affordances such as weight, density, mineral composition and formation would have shaped the processes and possibilities of interaction. Haptic and visual feedback would have guided individual engagement with particular types of rock such as quartzite or chert that had proven useful through experimentation. Knapping sends reverberations through the nervous system; when a stone is struck in the correct way it produces a distinct awareness of the energy transfer between tool and material. A misplaced hit, if it doesn’t deflect, will transfer more energy back into the body and produce a dull sound as opposed to the distinct ring of a well-placed strike. Such material qualities shaped perceptual attunement to the behaviour of the stone.¹⁸ One can intuit the impact stone tools would have had upon the perceptual environments of hominin communities. It is not hard, for

¹⁸ In these regards, the development of an enactive account of material engagement and fascination would be of great value, that is, an investigation of interactive fixation upon objects in perceptual cognitive dynamics.

example, to imagine the potentially syncopated rhythms produced by early Hominin groups knapping in unison and the ways this would have shaped attention, work rhythms, interbodily resonances, and possibly the emergence of hominin musicality. Preferred stone sources, flake scatter, continued tool use, all such things would have altered the perceptual intricacy and interactive possibilities of the environment, thereby plausibly shaping sustained attention, social memory, and identity as well as interactions at novel scales in the landscape. Thus, not only would early hominin have been transforming flows of energy in their ecosystems, but also generating increasingly more complex environmental dynamics as the success of these behaviours began to take root. These considerations imply processes of ecological and evolutionary change that were inherently social and artefactual from the outset.

The mediation of attention and interaction through tool, hand and body within early hominid communities can be understood to have generated novel opportunities for “world-directed” intentions that were “target focused but not content involving” (Hutto 2017 p. 837) In contrast to the hypothesised evolution of a “mind reading” neuroarchitecture for attributing mental states (see Fenici and Garofoli 2017 for a critique) the concept of “mind minding”, in which individuals develop context sensitivity to the intentional attitudes of others through attending to their behaviour (Hutto 2017) provides a much more parsimonious account for the development of intersubjectivity amongst early hominins. Rather than viewing the evolution of social cognition as a progressive expansion of intentional orders, one can examine how social interaction and intersubjective awareness have coevolved with material culture as an emergent, as opposed to teleological, process. Rejecting an evolutionarily specified mind reading module requires that propositional knowledge be examined as an emergent property of cultural and linguistic constructions (Fenici and Garofoli 2017 p. 106). In these regards, the sophisticated cognitive abilities referred to by ToM and Folk Psychology are potentially better accommodated within a framework of narrative proficiency (Hutto 2008; Gallagher and Hutto 2008). The evolutionary roots of the ability to communicate a sequence of events is more likely to be found in behaviours such as gesticulation and pantomime than an appeal to pre-evolved capacities for meta-representation (Hutto 2008 p. 217–227). This would fit well with evidence that the neural networks involved in tool making and language partially overlap, suggesting that they share their “foundations in more general human capacities for goal-directed action and are likely to have evolved in mutually reinforcing ways” (Malafouris 2010b p. 267). The evidence for training induced morphological changes in the neural circuitry of monkeys (see Malafouris 2013 p. 165–167) strongly suggests that the expansion of stone tool use effected metaplastic reorganisations within cognitive systems of early hominin communities. Furthermore, the enskilment of complex tool using behaviours, particularly with composite technologies, implies intergenerational communities of practice that generated intersubjective intentionality through training (Walls 2018). It is plausible that changes effected by tool use, by reorganising not only hominin ecological niches, but their experiences of embodiment and social identity, began to generate both the energetic resources necessary for evolutionary change, but also the cognitive-developmental pressures that selected for encephalisation. Instead of a linear teleology of propositional intentionality inscribed into the neuro-architecture of the brain, we see a patchwork or “mosaic” of intersubjective relationships in which novel ways of conceptualising self and other were generated through material-cultural interactions.

6 Conclusions

What defines MET's perspective on human cognitive evolution is that it does not look for preformed structures, intentions or symbols located within the skull, but explores how materiality shapes thought as an enactive process. The metaplastic view of the mind is one of an 'incomplete and unfinished process, in some sense 'blind,' and thus, potentially, in a permanent state of ongoing evolution' (Malafouris 2015b: 358). Thus, behavioural modernity does not have to be conceptualised as a point of departure from a finalised cognitive package in a completed evolutionary process. Rather, hominins, by cooperatively modifying their environments, can be seen to have generated a highly flexible and creative social intelligence that is materially enacted. By not making the metaphysical assumption of content, nor committing a linguistic fallacy that conflates information and representation, MET allows for a treatment of material culture that readily overcomes the explanatory gaps created by computational approaches to social cognition. The embodied properties of matter generate novel ecological feedback and connections within and between humans in their environments. Material things allow for the accumulation and conservation of cognitive changes by acting as "mediational, temporal and plastic" structures through which the brain develops (Malafouris 2013, 245). From this perspective, neural plasticity is the critical evolutionary feature of the brain that supports the emergence of social complexity through continuous feedback between the developmental affordances of the environment and human ontogeny. In these regards, the application of MET and enactivist approaches to social cognition within a niche construction framework supports a hypothesis of embodied social intelligence.

Material culture, as a form of ecosystem engineering, transforms the flow of energy and matter in the environment. By not abstracting the relationship between mind, culture and environment to the informational processing of representations it is possible to take a dynamic systems approach, in which material culture is understood to integrate cognitive development into the energetic and material flows of ecosystems at multiple scales. Conceptualising material culture as intrinsically cognitive and social helps to reframe the concept of intersubjectivity and subverts categorical distinctions between the ecological, the individual and the social. The self-reinforcing teleologies of evolutionarily apriori representations and Theory of Mind development produces a narrative of human social cognition that is stadial and homogenous. It is a description of the mind that does great injustice to the diversity of human societies and their historical processes. Their social relationships do not operate upon an interchangeable logic of recursive intentionality. Rather, human societies are spatially and temporally self-organising. Daily activities, rituals, and historical events are not passively observed, inferred and predicted, they are dynamically engaged, navigated and transformed. Human social organisation is incredibly fluid, capable of patterns of aggregation, dispersal, and heterogenous interactions at numerous scales, from the fission fusion dynamics of hunter gatherers over the course of a single year, to processes of centralised aggregation and dispersal over the course of generations. What's more, all of these reconfigurations in social dynamics imply extended reorganisations in the burdens and demands of social interaction, implying functional and structural changes in cognitive systems over historical periods. Any model of social cognition that wishes to contend with both evolutionary and developmental scales must be able to accommodate the non-linear,

self-organising and emergent dynamics of human social relationships, or submit to a historical determinism based on the evolution of a metarepresentational mechanism in the brain. The alternative is to see an evolutionary process in which brains, hands and the bodies of others generated cognitive developmental change through environmental modification thereby transforming ecological inheritance, signification and the possibilities for social interaction. In this light, one can explore the heterogeneity and scalar plasticities of human social relationships as processes of metaplastic niche construction which have emerged through the co-evolutionary entanglement of brains, bodies and materials since the origins of the species.

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Compliance with ethical standards

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