Do no harm: the extended mind model and the problem of delayed damage [Draft of September 2015]

Introduction: the problem of harm

Ann Murphy has raised the question of philosophy's shame in the proliferation of images of violence in philosophical writing and in the necessity of appealing to such images (Murphy 2012, 37). In this essay, through a critique of arguments for the extended mind, I want to show how explicit non-violence can be also be troublesome for philosophy, not only in terms of images but more so in terms of philosophical models.

I will argue that there can be harm due to philosophy that is not directly expressed in violent imagery or violent models. The harm is instead a concealed and delayed detrimental effect of an assumption of non-violence in a working model, defined as a picture of a field of enquiry and the methods required to approach it. In theses for the extended mind, harm follows from models that assume and seek smooth and transparent interactions. These conceal conflict in the situations they seek to describe and explain. This omission leads to harm, defined as a diminishing of our capacities to flourish in a given environment.

There are two analogies for the problem I want to draw attention to. The first comes from education. If we assume that one of the aims of education is to prepare a child for later challenges and to help it to avoid harm, it can be detrimental to inculcate peaceful models of the world, when later situations are going to be conflictual. The phrase 'an innocent abroad' and the adjective 'gullible' capture the difficulty.

Though there is an understandable desire to protect a child from images of violence and strife, we do it no favours in yielding to this desire, since later situations will reveal our kindness to be misguided and harmful. For example, we might shy away from the nightmares caused by the violent tale of Little Red Riding Hood. But in teaching a child to beware of false appearances, even in those it is closest to, the story inculcates an important life lesson (Orenstein 2002, 4).[1]

Running counter to the lessons of Little Red Riding Hood, the charm but also danger of the film Forrest Gump is the successful innocent at its centre. He is ill-prepared for a violent world, yet he prospers nonetheless. Gump rewrites historical violence as both survivable by innocents and senseless, rather than as caused by specific political actions that require wariness and suspicion (Kahn 2013). The film harms its audience by preparing it badly for reflection on violent conflicts.[2]

[1] For a helpful introduction to its role as lesson and a full collection of versions of Little Red Riding Hood, see Zipes (1993).

[22] Paul W. Kahn traces a contemporary incapacity to represent and react to state violence to Gump's innocent presence around violent historical events. His blameless presence makes it harder for us to comprehend the causes of the violence. The false innocence of Gump as ever-present 'popular sovereign' renders violence more dangerous: 'If Gump expresses the wholeness of sovereign presence, all those around him are experiencing the failure of representation. For them the violence of the state is without meaning.' (Kahn 2013, 112-13).

The second analogy is about design. Assuming that one of the aims of engineering is to construct an effective machine for a given task, we can hinder it in this aim, if we give in too much to another aim of engineering and design: to construct something harmonious. There are simple examples of this failing; for instance, the flashily designed corkscrew that always splits the cork.

There are also more complex examples, such as the harmonious building that fails to direct flows of people around it adequately.[3] In the dysfunctional building, a model focused on aesthetics breaks down because it does not take sufficient account of its practical task. Hence the demand, inherited from classical architecture and Vitruvius, to combine strength, use and beauty rather than privilege any one of them.[4]

I want to draw attention to the hold of an engineering and design model on the extended mind thesis. I am aware that there are many distinctions within this broad movement; for instance, in differences between embodied, embedded, enacted and extended mind (Rowlands 2003, 3). However, for my purposes, these distinctions are less important. What matters is that a particular kind of model dominates across them. In order to take account of the genesis of the model, I will focus my critical remarks on the influential work of Andy Clark (Clark 2008, Clark and Chalmers 2010).

My argument is that Clark's work depends on a model that misrepresents the nature of interactions in the world. I will raise the possibility that harm can follow from his engineering and design influenced model and from its desire for a smooth and easy engagement with our environment. Clark views philosophical problems of mind and world as engineering problems based upon practical difficulties and technical solutions that successfully ease them.

According to my analysis, he gives us a harmful model for philosophy and for those who seek to learn from it, because the ideas of ease and engineered solutions misrepresent the ever-changing and more threatening nature of our interactions with the world. In the final section of the essay, I suggest a different and more conflictual model, but one that I claim involves less consequent harm.

Models for the extended mind: Brunel or Machiavelli?

The problem I want to draw attention to is raised in one of the critical discussions from Clark's Supersizing the Mind where he addresses a counterargument made by Kim Sterelny (Sterelny 2004). Clark addresses Sterelny's argument in the context of the question of whether the mind is extended

[3] See Lance Knobel's critical study of the design of the Barbican Arts Centre, London, resulting from its monolithic design: 'The Barbican would never be built today because people are aware that what makes a city enjoyable and lively is diversity, change, and small interventions and not a single vision, conformity, and gigantism' (Knobel 1981, 242).

[4] 'When executing the works of architecture, writes Vitruvius in the most frequently cited phrase of his entire treatise, you must take three things into account: firmitas (strength), utilitas (use) and venustas [beauty]' (McEwen 2003, 199).

into the world beyond the brain or its 'skin-bag'. Sterelny's critical remarks draw attention to a deeper flaw in the model Clark uses to tackle the extension of mind, notwithstanding Sterelny's broad sympathy for Clark's approach.

Clark uses the term 'skin-bag' early on in his book to show that his arguments about extension do not only apply to mind or brain, but also to its physical location in bones and skin. I am more interested, though, in the wider language used in the passage:

> It matters that we recognize the very large extent to which individual human thought and reason are not activities that occur solely in the brain or even solely within organismic skin-bag. This matters because it drives home the degree to which environmental engineering is also self-engineering. In building our physical and social worlds, we build (or rather we massively reconfigure) our minds and our capacities for thought and reason (Clark 2008, xxviii).

My concern is with the use of the concepts of 'environmental engineering', 'self-engineering' and 'building' which will be repeated throughout Clark's book. The conceptual frame for the problem of the extension of mind is engineering and building. It is about the successful construction of ways to interact smoothly with the world: 'problem solving resources will yield an acceptable result with minimum effort' (Clark 2008, 13). This leads to an engineering model that combines a picture of the world as something that can be engineered through methods seeking to build in it and that achieve a smooth and transparent relation to it as efficiently as possible.

A little later in his book, Clark adds two important concepts to this engineering model. The first is the idea of 'tools', taken loosely from Heidegger. The mind is extended through tools that allow us to build our world and to devise successful solutions to engineering problems. These tools work as transparent equipment: 'At such moments, the body has become "transparent equipment": equipment (the classic example is the hammer in the hands of the skilled carpenter) that is not the focus of attention in use' (Clark 2008, 13). We'll see later that the metaphor of transparency is important not only for the argument with Sterelny, but also more broadly in the engineering model. The aim of engineering is to achieve the kind of transparency and ease sought by ergonomics: 'The part of design that ensures equipment and devices are optimized with regard to human well-being' (Atkins and Escudier, 2013).

The second concept is function, where a function is defined as the playing of a particular causal role: 'The use of the term functional in distributed functional decomposition is meant to remind us that even in these larger systems, it is the roles played by various elements, and not the specific ways those elements are realized, that do the explanatory work' (Clark 2008, 14). Thus it is not a content, manner or behaviour that matters for a function but rather whether a particular task or role is accomplished satisfactorily. Again, the engineering motif is reinforced by the idea of function since what matters are causal relations and systemic inputs and outputs of the kind we can attribute to robots (Wheeler 2010). We should think of the mind and of its extension in terms of functions such as successfully sorting, navigating and transforming.

This idea of function lends itself, not only to an engineering model, but also to the modern idea of tasks that resolve practical and technical problems, thereby surmounting them and ushering in a new age freed from the difficulties of the old. This is the spirit of the great engineer, such as Brunel, in his construction of the *Great Britain*, a ship that is said to have changed shipping forever.[5] Again, the metaphors of ease and smoothness are important. What was once difficult and unreliable in terms of travel became easy and commonplace thanks to Brunel's railway network, his bridges and his ships (Brindle 2006).

Sterelny's challenge to Clark lends itself to an inflationary and a deflationary reading. His critical point can be taken as applying strictly to a particular argument for the extended mind, in the deflationary version, but it can also be taken as the basis for a much wider critical argument about Clark's underlying assumptions about interactions in the world and the picture that supports it. Sterelny is less interested in the extension of the individual mind than how social practices, as developed over long periods, are inherited and help to scaffold our interactions with the world.[6]

A flavour of the wider aims of Sterelny's work and their social and political significance can be garnered from the argument of his book The Evolved Apprentice: How evolution Made Humans Unique. He argues that a framework constructed from an apprentice learning model and interplay between informational, ecological, and reproductive cooperation 'explains the evolution of and relative stability of behavioural human cultures' (Sterelny 2012, 197). Human evolution is exceptional because of the role of apprentice learning and cooperation in human interactions. This is important for the deflationary argument because the nature of this learning and cooperation clashes with criteria of smoothness and inherent transparency in extended interactions.

According to Sterelny, apprenticeship for reproductive cooperation must not assume smoothness and transparency. It is quite the contrary. Instead of a model that sees interaction as becoming easier, more transparent and more compliant, thanks to tools and other extensions, Sterelny understands human evolution, apprenticeship and cooperation as dependent on resilient forms of difficulty proper to human cooperation, such as dishonesty and deception.

In cooperation we also seek individual benefit. Therefore, to learn how to cooperate well we must be taught that cooperation is not always with truthful and helpful fellow humans, but rather with beings with an interest in deceiving and fooling us. Our scaffolding to get round this problem is highly sophisticated and the political and social dimension of Sterelny's works comes out in his arguments for the essential role of social norms: '… children came to learn not just the tools of their ecological trade and the characteristics of their local world. They had to acquire the distinctive language, mores, customs, attitudes, beliefs, and public symbols of their groups.' (Sterelny 2012, 152)

[5] 'With her unprecedented size, the highly innovative design of her hull, the largest engines that had ever been built, and her superbly efficient screw propeller, she was by far the most technically advanced book that had ever been built. She is arguably the single most important vessel, in terms of ship design, in history' (Brindle 2006, 131-2).

[6] Scaffold is a term that Clark and Sterelny use frequently. It betrays a shared engineering and solution based approach. However, with Sterelny, the image clashes with his work on apprenticeship, where the description of education and learning as scaffolding is less appropriate, given the synthesis of education process, teacher and student. He would be better served by a new take on traditional terms such as *Bildung*. (Løvlie 2003)

In learning to live by these norms, it would be both false and harmful to suppose that the interactions regulated by them were inherently smooth and transparent. Instead, we need a Machiavellian social intelligence based on competitive bargaining, exchange and honesty assessment, if we are to gather the benefits of shared tasks and cooperation in foraging for food:

> Ordinary human decision making, then, takes place in a translucent social world. Often relevant information is available, information that would guide adaptive decision making were an agent aware of it and able to assess its relevance and reliability. But cues are often not perceptually salient. Their relevance is often not obvious, and their reliability is difficult to assess. Our social world is translucent because it is the result of a Machiavellian evolutionary dynamic.' (Sterelny 2012, 9)

The translucent quality of human interaction and the constant need to reassess relevance and reliability is the *result of* the Machiavellian dynamic of cooperating with others whose interest is not only to cooperate but also to gain individual benefit at the expense of others.[7]

Sterelny insists upon the difficult and conflictual nature of Machiavellian cooperation: 'However, perception operates in an environment of active sabotage by other agents. So despite the superb design of some of our sensory systems, perception of the external environment often delivers signals that are noisy, somewhat unreliable, and functionally ambiguous [...]' (Sterelny 2004, 246) If this is right, then Clark's model is harmful because it prepares us for a smooth interaction with a transparent world, when in fact we should be preparing for the opposite: a world full of novel traps and difficulties we need to be trained for.

Clark only responds to the deflationary version of Sterelny's argument. He does so by conceding the point but restricting its scope. Though some interactions are vulnerable to malicious manipulation, Clark does 'not think, however, that we treat all our perceptual inputs in this highly cautious way. Moreover, *as soon as we do not do so*, the issue about extended cognition seems to open up.' (Clark 2008, 103) This is to miss the inflationary side of Sterelny's argument, since for him it is not whether we treat *some* perceptual inputs cautiously, but rather that we should be prepared to treat *all* inputs in a social environment cautiously, and that we should be taught to think of them in this way because of the Machiavellian evolutionary dynamic and its effect on our social world. Translucency is hard earned in a conflictual environment.

David Spurrett and Stephen Cowley take the debate between Clark and Sterelny further by addressing the deflationary and inflationary versions of his critical point (Spurrett and Cowley 2010). Against the deflationary argument they point out that the non-extended mind can be as conflicted as the extended one, so that Sterelny's attempt to distinguish extended and non-extended functions

[7] Dependent on cooperation *and* suspicion, this communal learning has been a theme from early on in Sterelny's work, notably on the importance of niche construction 'in a hostile world': 'The fidelity of transmission depends both on individual psychological adaptations (imitation learning, deliberate teaching) and scaffolding developmental environments. But once social learning has been converted into a genuine inheritance mechanism, it allows rapid evolutionary change.' (Sterelny 2003, 240)

fails. They give the example of inner conflict about trying to abandon smoking as an example to support this point.

However, this response is only satisfactory for the logical deduction of extension on the basis of parity principles such that 'if a process in the world works in a way that we should count as a cognitive process if it were done in the head, then we should count it as a cognitive process all the same' (Chalmers 2008, x). It misses the deeper inflationary criticism that Clark has a mistaken general view of extended interactions.

To address this latter point, Spurrett and Cowley fall back on the engineering model and make two claims. First, though competition can be a source of instability, it can also be a source of better constructions where we 'enhance stability' (Spurrett and Cowley 2010, 314). Second, that joint action in spaces of conflict can be more effective than acting alone. This second point is irrelevant because it is exactly Sterelny's argument. What matters is *how* it is more effective. Is it by assuming that conflict is always a possibility, or by assuming that it can be engineered out? So when Spurrett and Cowley claim that we are often right to trust extensions, they make the same mistake as Clark. It is not whether we are right to trust extensions such as our mobile phones, but whether we should maintain awareness of the possibility of deception, why we should do so, and how we should do so.

So now we can understand the profound difference between Sterelny and Clark. It is not about extension of the mind, but about the nature of our successful interaction with a wider world. Is the right model for interaction a tool based engineering one, where Brunel shows us the way to cut through earth and water as a smooth and automatic achievement? Or is the model to come from Machiavelli, when he reminds us that all our social interactions carry the risk of new setbacks due to the recurrent deceptiveness, unreliability and inventiveness of other social actors?

The origins of the happy-harmful model

In order to trace the origins of Clark's smooth and transparent model, that I will now refer to as the 'happy' model for interaction with the world, as opposed to a 'conflict' model that I will set out in the next section, I will now return to one of the most influential texts for the extended mind thesis: 'The Extended Mind' by Clark and David Chalmers, first published in 1998.

In the following passage, they give features of their notebook 'Otto' case of extension that lead to criteria for deciding on whether there is extension of the mind:

> First, the notebook is a constant in Otto's life - in cases where the information in the notebook would be relevant, he will rarely take action without consulting it. Second, the information in the notebook is directly available without difficulty. Third, upon retrieving information from the notebook he automatically endorses it. Fourth, the information in the notebook has been consciously endorsed at some point in the past, and indeed is there as a consequence of this endorsement. (Clark and Chalmers 2010, 38)

I want to draw attention to five aspects of these features that determine its happy character: constancy, direct availability, lack of difficulty, automatic endorsement and prior conscious endorsement. The happiness of the model follows from five familiar though not uncontroversial virtues. In commenting on each one, I will give alternative 'unhappy' or vicious cases.

First, extension should be a constant, like a constant companion. It reliably accompanies a given action with a given function: memory can be bolstered by a constant function of external data recall. If a given extension for a function is irregular in its use, then it is not truly an extension. For instance, we have an unhappy case when an external hard drive drive malfunctions once in a while such that we use it warily.

We can see the strength of Sterelny's critical point, here, since there are many kinds of extension through devices and games which become unreliable because of a context of deceit and competition. Something supposedly as constant as a mobile phone (an oft used example for extension, for instance, by Chalmers in his 'Foreword' to Clark's Supersizing the Mind) can become inconstant and an object of warranted suspicion.

Many found this out to their cost in recent phone hacking scandals, where their mobile phone companies were tricked into resetting their PIN codes to factory settings, thereby allowing their voicemail to be eavesdropped (Davies, 2014). After the hacking and other government sponsored eavesdropping scandals, the confidence of proponents of reliable extension seems rather quaint and foolhardy: 'One of us has a mobile telephone that rings with a unique melody when the call is from his wife's mobile phone. Is has *never* played that melody for calls from any other number, not even (as humans embarrassingly can) confusing it with, say, the number of a previous partner.' (Spurrett and Cowley 2010, 314) It is not your wife; it is a journalist from the News of the World.

Second, extension should be directly available. This virtue is like direct prose, or like direct access to information, implying intimacy and openness. There has to be a lack of mediation in accessing a given function for it to be directly available. We must not depend on intermediaries that might interrupt it. We would have an unhappy case of availability where a function had to be accessed through a third party whose motives we did not trust; for instance, were we to access information through a truculent operator or a clunky interface.

There are cases where standard examples of extension - for instance, when accessing and storing information through the web - where this directness has become a matter of doubt. The directness turns out to have been illusory. We thought we had direct access, but in fact we were being observed and monitored by hidden intermediaries exploiting 'dual-use' technologies (Clarke 2014, 129). In order to remedy this we have to pass through greater mediation, such as proxy servers.

Third, there should be a lack of difficulty in extension. Here, difficulty does not mean complexity. An extension might well involve many steps and considerable knowledge. It might be complex, but it should not involve undue effort and trials. It should not be difficult.

There is a virtue of ease here that plays well with the link between virtues and happiness, though I will shortly begin to question this. Difficulty implies a hard relation to the extension. There is an unhappy relation due to the difficulty of the work involved. It is awkward. The vicious case of lack of

difficulty would be a function that required effort going beyond comfort and certainty, for instance, when we had to use a mechanism with a poorly written instruction manual.

I want to note at this point how the idea of lack of difficulty is tricky in relation to rare but catastrophic failures. When everything is running smoothly, a system such as a plane's fly-by-wire system can seem to lack difficulty, in the sense of struggle. However, recent crashes have shown that such a system can rapidly and catastrophically fall into deeply difficult states; for instance, in the disastrous confusion experienced by pilots in the AF447 Crash.[8] There is a parallel here with my wider point about bad models and subsequent harm. Being in a state of ease and confidence with a system can be exactly what leads to disaster when the system fails in a complicated way.

Fourth, extension should be automatically endorsed. This is a virtue of implicit trust and reliability. We do not question the extension. It is used with confidence in relation to the correct accomplishment of its function. An unhappy counter-example would be of a piece of technology that made us pause in doubt when using it; for instance, a useful piece of software that can sometimes be exploited to our detriment. We can see how automatic endorsement is deeply problematic when we add a profit motive to the extension. A conflictual model is more accurate in describing our ongoing privacy struggles with email providers who are also data gatherers and resellers (Gorman 2012).

Fifth, the extension should also have benefitted from a prior conscious endorsement. At some point we must have consciously endorsed the extension as reliable with respect to its cognitive function. The unhappy case for this feature involves kinds of misguided confidence where we give endorsement but for the wrong reasons or for incomplete reasons; for instance, where we have limited understanding of all the processes involved, or do not have a full purview of the future tasks to be accomplished. The virtue here is rational examination and the vice is lack of understanding at the point of endorsement.

This endorsement should avoid the problem I have raised with respect to catastrophic failures, because the failing system will have been understood at the point of endorsement. However, that assumes that it is possible for pilots to give conscious endorsement of a system as complex as the avionics of a modern plane. Even the engineers involved in designing the plane cannot do that. It took the National Transportation Safety Board 23 months to arrive at final recommendations after Lithium-ion fires on Boeing 787s. The faults found were traced to design and manufacturing shortcomings that could not have been the subject of conscious investigation, let alone endorsement, by the pilots. (NTSB 2014)

This list of virtuous features and opposing vices allows for a better sense of what I mean by a happy picture of how the mind is extended. Here, happiness does not refer to a state of mind. Instead, happy means that the extension is virtuous in the way it works with us: it functions smoothly and transparently with good outcomes. The extension is reliable, direct, easy, trustworthy, and the result

[8] The BEA final report draws attention to the pilots' 'total loss of cognitive control of the situation' and recommends measures designed to improve the 'ergonomics of information supplied' (Flottau 2012). The problem is that for the plane and training to be certified there must have been an assumption of lack of difficulty, but this did not stand the test of the rare situation encountered by the pilots. So when can we say that there is a genuine lack of difficulty and would it not be more sensible to assume - and train for - such difficulty?

of a conscious decision to award trust. Like the common image of a good emotional relationship, the extension is something we are comfortable and at ease with. This goodness should allow us to flourish. It is like a faithful working dog; but one that does not age, die or turn on us.

Before I outline my alternative model, I want to draw attention to three properties of happy extension that connect to my point about models. First, as presented by Clark and Chalmers it amounts to a *virtuous picture*. This does not mean that there is no precise model for extension. There obviously is, though its exact form has been in dispute ever since their original paper. It means that as virtuous it works as a picture. It is perceived as a whole and works through our imagination.

We see the happiness of the model in the resemblances and overlapping features of the virtues described by Clark and Chalmers. The model works on our imagination; for example, in the way it has generated many imaginative searches for different kinds of happy extension and strong debate about which ones truly accord with the model. Why do we care about labelling functions as 'extended'? Partly, it has to do with accession to a virtuous picture of existence with technologies and social functions, art forms and even natural phenomena.

Second, happy extension takes place against a background of *moral anxiety*. We can deduce this property from the vicious examples I have suggested above. Since the extension is happy and virtuous it helps us avoid many different types of breakdown and perceived threats: unreliability, indirectness or lack of clarity, difficulty, untrustworthiness, lack of forethought and irrationality.

We are anxious to avoid such breakdowns and happy extensions are taken as a good way of staying away from them. Why characterise this anxiety as moral, though? It is partly because avoidance is made more certain if we follow the virtues. But, more profoundly, it is because disaster is seen as a moral consequence of not following them. The decisions leading to disaster are taken as blameworthy, for instance were we to adopt an unreliable technology when a trustworthy extension was available.

Some dispositions and judgements associated with modern travel are a powerful example of the operation of this moral anxiety. We expect the flight and train crew to be in a virtuous extension with their instruments. We disapprove of and dread instances where this turns out not to be the case, for instance, when protocols are unclear, instruments unreliable, or more and more frequently, when there is not a full prior intellectual endorsement of the instruments and computers by those operating the train or the plane.

Finally, the happy extended model has the property of imparting an *outward arrow* to extension. This means that extension works from some kind of reliable core and then functions in an outward direction, confirmed by Clark's parity principle, and extending the boundaries of that function thanks to essentially benign functional collaborations. In this sense, the extension is not two-way. It is not as if the world extends into the core, which might be a reason for unhappiness according to the moral anxiety of my second point, since the invasion could be a threat.

When taken together, these characteristics allow me to draw the features of a different model, where our extension into the world is *perverse* as opposed to virtuous, where extension should be thought of as carrying a *constant threat of unhappy outcomes*, and where extension should not be thought according to an outward arrow, but rather as a *two-way conflictual and wary development*.

Crisis, what crisis?

The phrase 'Crisis, what crisis?' was mistakenly - perhaps even maliciously - attributed to the British Prime Minister, James Callaghan, during the 1978-1979 'Winter of Discontent'; a period of social unrest and breakdown coinciding with particularly bad winter weather. It captures a perceived insouciance to crisis that was, in part, to lead to the downfall of the Callaghan government (Shepherd, 2013). My aim has been to make a correct attribution of the phrase to a dominant model and world picture as set out by Andy Clark in his work on the extended mind. There is insouciance as to the struggle and conflict in extended relations in the model. So despite its smooth and transparent features, the model harbours future harm due to a false picture.

The harm follows from a series of deeply ingrained features of the extended mind model: commitment to engineered solutions; the values attributed to inherently smooth and transparent interactions in the world; the dominance of ideas of tools and functions for the analysis of problems and for the evaluation of success; criteria of constancy, direct availability, lack of difficulty, automatic and conscious endorsement that contribute to what I have called a happy model.

Sterelny's critique of Clark, based on a Machiavellian conflict based model rather than a happy one, points to a different way of approaching relations in a world that proves to be both translucent and deceptive. By way of conclusion, I will therefore sketch an alternative 'conflict' model to the happy, but ultimately harmful, model that dominates arguments for the extended mind.

According to the conflict model, we should replace the ideas of individual tools and functions, brought together in larger systems, by the idea of a multiplicity of conflicting processes that work together but also against one another. This combination of collaboration and conflict leads to a dynamic situation where transparency and smoothness should only ever be seen as temporary states that conceal underlying changes that will come to disrupt a clarity and ease that prove to have been merely apparent.

We can turn to evolutionary biology, for instance, to recent work in process biology, to support this multiplicity based conflict and collaboration model (Dupré 2012, Bapteste and Dupré 2013, Williams 2016), but in future work I want to examine the way the arts and literature offer a counter model to the damaging tool-function-engineering dominance of our contemporary ways of understanding our relation to the world and of how we should create critically *with* its multiple processes.

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