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## *Historical Cognitive Science: Analysis and Examples*

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## INTRODUCTION

Central in this thesis is the project of ‘historical cognitive science,’ as described and pursued by John Sutton. Throughout his work, Sutton has provided both exemplars of this project and made remarks about its aims and the rationale behind it.

In this thesis I provide my own contribution to this project. I do this by first discussing the nature and aims of ‘historical cognitive science’ as envisioned by Sutton and afterwards providing two studies which were envisioned as exercises in historical cognitive science.

In the first chapter I outline and discuss Sutton’s own descriptions of what the project of ‘historical cognitive science’ amounts to. This provides the background for the two following chapters.

In chapter two I discuss Robert Hooke’s “universal cure of the mind,” in which books are invoked as an aid to the memory. I will argue that there is a strong structural similarity between the way Hooke conceptualises the role of these aids and Clark & Chalmers’s theory of the “extended mind”.

Chapter three focuses on the notion of brain plasticity. I discuss two historical figures in which (brain) plasticity is invoked in a context of self-reformation, namely René Descartes and Denis Diderot. In both cases, the combination of plasticity with the notion of self-reformation or self-discipline will lead to a conceptual separation of the self from the plastic material being reformed.

In the last chapter I provide a further analysis of the cases discussed in chapter 2 and 3. More specifically, I look at the implications of the structural similarities between Hooke and Clark & Chalmers. With regards to Descartes, I use Foucault’s genealogical work to point out the entanglement of psychological practice and theory in the works of Descartes discussed in chapter 3, an entanglement which is also referred to by Sutton.

# 1. WHAT IS ‘HISTORICAL COGNITIVE SCIENCE’?

## 1.1. Introduction

In this chapter, I trace out the nature and scope of John Sutton’s notion of a *historical cognitive science*. Sutton’s *historical cognitive science* is a complex (though not incoherent) project incorporating insights from a variety of sources and encompassing different goals. Throughout his work, Sutton has provided both descriptions and exemplars of this *historical cognitive science*. I will give an overview of Sutton’s own descriptions of the project and discuss his pursuit of it. This chapter must provide the background for the two following chapters, in which I present my own research as a contribution to this project of a *historical cognitive science*.

## 1.2. Thinking beyond dichotomies

### 1.2.1. Past and Present

In his *Philosophy and Memory Traces*, John Sutton discusses a variety of models of memory, placing them on “a spectrum between *local* or archival models of memory as unchanging items in storage spaces, and *distributed* or reconstructive models of memory as blending patterns in shifting mixture.”<sup>1</sup> At the latter side of the spectrum we can find both Descartes’ model with its animal spirits and contemporary connectionist network models of memory. Putting these models side by side along with the reactions they invoked allows Sutton to show how concerns about the self and psychological control were involved in this criticism, both then and now: “Rhetoric against confusion and mixture drives critics of distributed models of associative memory from the Cambridge Platonists to Jerry Fodor.”<sup>2</sup>

Although it is *historical*, Sutton’s project also aims at the present. History “affords the requisite pretence of distance”<sup>3</sup> and makes it easier to point at the role of cultural and moral issues in the conceptualisation of the mind. The point is thus not to show how the early moderns got it wrong or where they anticipated certain discoveries made by a contemporary cognitive science which has finally reached its maturity and disentangled itself from the constraints of culture. What history allows us to do is to bring to light the entanglement of

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<sup>1</sup> John Sutton, *Philosophy and Memory Traces: Descartes to Connectionism* (Cambridge: Cambridge University Press, 1998), 5.

<sup>2</sup> Sutton, *Philosophy and Memory Traces*, 10, 2.

<sup>3</sup> *Ibid.*, 2.

cognitive science with issues of control, personhood and morality, which is still at play in contemporary cognitive science.<sup>4</sup>

This kind of project is a tricky one, and Sutton admits that he “must flirt throughout with the twin dangers of nostalgia and present-centeredness.”<sup>5</sup> Sutton’s reading of Descartes’ model as “a distributed model of memory employing superpositional storage” can surely be called anachronistic, but considering the aims of *historical cognitive science* just mentioned it is a fertile and defensible anachronism.<sup>6</sup> The use of these anachronisms should not be equated with the writing of a Whiggish history of cognitive science. As just mentioned, the aim is not to show where people in the past “got it wrong” or “were on the right track” and assess older theories with contemporary norms. The point is to go beyond an easy dichotomy between the past and the present and to let both interact in a way that is mutually illuminating.<sup>7</sup>

### 1.2.2. *Nature and culture, humanism and scientism*

This approach to the historical material is also motivated by the attempt to avoid another dichotomy, namely that between nature and culture, avoiding “either humanist resistance to reduction or blind scientific hostility to culture.”<sup>8</sup>

The rejection of this dichotomy is itself motivated by a certain view on the nature of human cognition. In *Philosophy and Memory Traces*, a certain view on cognition is argued for and taken as a motivation for taking the historical seriously. This argument has an interesting architecture. Central in the book is the already mentioned distinction between *local* and *distributed* or *superpositional* memory models and the discussion between proponents of these different kinds of models. Sutton himself is no innocent bystander in this discussion, but sides with the proponents of distributed models, undertaking “both the description and the defence of [these] related theories of memory[.]”<sup>9</sup> These models of memory, moreover, hint at “an understanding of how complex self-organising physical systems like us can be so psychologically plastic, attuned to the configurations of culture in which cognition and

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<sup>4</sup> See John Sutton, “Body, Mind, and Order: Local Memory and the Control of Mental Representations in Medieval and Renaissance Sciences of Self,” in *1543 and All That*, edited by G. Freeland and A. Coronas, 117–50 (London: Kluwer Academic Publishers, 2000), 120-121 for a clear and concise treatment of this point.

<sup>5</sup> Sutton, *Philosophy and Memory Traces*, 15.

<sup>6</sup> *Ibid.*, 23.

<sup>7</sup> On this “mutual illumination,” cf. John Sutton, “Spongy Brains and Material Memories,” in *Embodiment and Environment in Early Modern England*, edited by Mary Floyd-Wilson and Garrett Sullivan, 14–34 (Basingstoke: Palgrave Macmillan, 2007), 16.

<sup>8</sup> Sutton, *Philosophy and memory traces*, 12.

<sup>9</sup> *Ibid.*, 2.

remembering are situated.”<sup>10</sup> Sutton actively engages history in his defence of distributed models of memory, and these models in turn provide him with good reasons to take seriously the historical embeddedness of human cognition.

A further motivation originating from contemporary cognitive science for taking the historical into account is provided by the theory of *extended cognition*. I will not fully lay out the theory of extended cognition here, as it will be treated in the second chapter of this thesis.<sup>11</sup> Very generally (but precise enough for the purpose of the present discussion), Sutton describes the *extended mind hypothesis* as follows:

“[m]any of our cognitive states and processes are hybrids, unevenly distributed across biological and nonbiological realms [...]. In certain circumstances, things – artifacts, media, or technologies – can have a cognitive life, with histories often as idiosyncratic as those of the embodied brains with which they couple [...]. The realm of the mental can spread across the physical, social, and cultural environments as well as bodies and brains.”<sup>12</sup>

In “Exograms and Interdisciplinarity,” Sutton does not engage in the conceptual and metaphysical debates on the notion of *extended cognition*.<sup>13</sup> Rather, he points out the methodological implications of the *extended cognition* theory, which have also been hinted at by Clark himself. The notion of *extended cognition* provides a further motivation for Sutton’s project of a *historical cognitive science*. It is not just that cognition is a product of cultured brains, embedded in history. Cognition itself should not be seen as merely a product of brains, but as spread across hybrid systems of brains coupled with artefacts and technologies. These systems themselves vary across history, inviting historical investigation. The hybridity of

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<sup>10</sup> Sutton, *Philosophy and Memory Traces*, 2.

<sup>11</sup> In that chapter I will only discuss the theory of *extended cognition* as provided by Clark and Chalmers, as it is that version that has most structural similarity with Hooke’s thinking. Sutton’s version however differs from Clark (and Chalmers)’s and provides his own take on *extended cognition*, which he dubs “second-wave extended cognition”. Unlike Clark and Chalmers’s approach, which is based on the so-called *parity principle* (cf. chapter 2 of this thesis), the second wave of thinking about extended cognition is based on a *complementarity principle*. A comparison and discussion of both versions of the *extended cognition* theory would take us too far and would only unnecessarily complicate matters here. Sutton himself provides a comparison of both varieties of thinking about *extended cognition*: John Sutton, “Exograms and Interdisciplinarity: History, the Extended Mind, and the Civilizing Process,” in *The Extended Mind*, edited by R. Menary, 189–225 (Cambridge, Massachusetts: MIT Press, 2010).

<sup>12</sup> Sutton, “Exograms and Interdisciplinarity,” 189.

<sup>13</sup> *Ibid.*, 190. A good overview of the issues at play is provided by the other essays taken up in *The Extended Mind* volume, edited by Richard Menary (Menary, R., ed. *The Extended Mind* (Cambridge, Massachusetts: MIT Press, 2010)) A more elaborated motivation for the non-metaphysical stance is given in John Sutton, Celia B. Harris, Paul G. Keil, and Amanda J. Barnier. “The Psychology of Memory, Extended Cognition, and Socially Distributed Remembering,” *Phenomenology and the Cognitive Sciences* (2010). doi:10.1007/s11097-010-9182-y.

these systems moreover provides an incentive for making this investigation an *interdisciplinary* investigation.<sup>14</sup>

### *1.2.3. Naturalised pasts and cultured presents*

So far I have treated two dichotomies: past/present and culture/nature (or humanism/scientism). In each case, Sutton tries to go beyond the dichotomy by showing the complex entwinement of components that had been first presented as being mutually exclusive. These two attempts at going beyond these existing dichotomies are in turn themselves entwined. This is expressed best in Sutton's own words as "[t]he active use of history in bringing culture into science and in undermining easy present-centredness."<sup>15</sup> The point of *historical cognitive science* is "to demonstrate that it is possible to attend to contexts and to brains at once."<sup>16</sup> Moreover, based on the view on human cognition discussed above, attending to both is not merely a possibility, but a necessity. Contexts without brains are empty, brains without contexts are blind. Human cognition is situated and embedded in a historical context, this context also providing the artefacts and technologies with which brains can couple to form hybrid cognitive systems. The study of cognition is therefore not the study of the unchangeable brain, but the study of a hybrid phenomenon changing and shifting through history. The attention to the role of external factors in cognition does not however amount to downplaying the role of the brain. As these hybrid systems are composed of artefacts *and* brains, understanding these systems demands attention to the brain. Therefore, "any realistic proposal for active interdisciplinarity in the cognitive sciences is still likely to set mainstream experimental psychology and neuropsychology at the heart of the sciences of the mind."<sup>17</sup> Historical research into early modern memory practices is as relevant to our contemporary understanding of cognition as present-day brain scans can be for our study of historical forms of cognition.

*Historical cognitive science* is both a historical investigation into earlier forms of cognition and ways of thinking about human cognition, *and* a study of human cognition which takes the cultured and historical embedded character of cognition seriously. Once one acknowledges that human cognition is historically variable, this variability itself becomes an important object of study for a science of human cognition. On the other hand, it also means that our present cognitive abilities and our meta-reflections about our own cognition are themselves a

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<sup>14</sup> Sutton, "Exograms and Interdisciplinarity," 190-193.

<sup>15</sup> *Philosophy and Memory Traces*, 2.

<sup>16</sup> *Ibid.*, 1.

<sup>17</sup> Sutton, "Exograms and Interdisciplinarity," 191.

product of history.<sup>18</sup> Historical investigation can thus help contemporary cognitive science, on the one hand by providing insights into the history of our own cognition, on the other by providing the potential for critical reflection on contemporary cognitive science itself.<sup>19</sup>

### 1.3. The extended mind and the plastic brain

The following two chapters consist of studies in the vein of Sutton's *historical cognitive science*. In chapter 2 I discuss Hooke's "universal cure of the mind" and show the affinity between the way he conceptualises the role of external artefacts and Clark and Chalmers's views on *extended cognition*. As should be clear from the foregoing discussion, I do not mean to make Hooke into a proponent of extended cognition *avant la lettre* (just as Sutton's intention was not to make Descartes into a connectionist). A further interpretation of the implications of the structural affinity between Hooke and Clark & Chalmers will be provided in the concluding chapter.

In chapter 3 I discuss the conceptualisation of brain plasticity and its relation to notions of the self. I point at the way the combination of brain plasticity with the notion of self-reformation makes the positing of a self separate from the plastic brain material a compelling move, even in the case of self-declared monists as Diderot or contemporary figures such as Jeffrey Schwartz. This is not to be read as a defence of dualism or a call for a return to Cartesianism, but rather as an attempt to understand why it is so difficult to conceptualise self-reform without separating the self from the material being reformed.

In "Controlling the passions," Sutton warns against an easy self-congratulatory attitude where we applaud ourselves for having gone beyond a Cartesian dualism and having found our place in the world again, after the work of thinkers such as Wittgenstein, Merleau-Ponty, and Gibson.<sup>20</sup> He points at the fact that "all the difficult issues remain." Even if we now know that

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<sup>18</sup> In "Body, Mind, and Order," Sutton describes *historical cognitive science* as "work[ing] between two projects[:] [...] the analysis of other and older theories of mind [...] [and] the task of working out how such views about mind and self reflect or partly cause different historical forms of mental activity." (Sutton, "Body, Mind, and Order," 117.)

<sup>19</sup> Sutton points at the use of history for providing a certain distance which facilitates critical reflection on contemporary cognitive science (John Sutton, "Controlling the Passions: Passion, Memory, and the Moral Physiology of Self in Seventeenth-Century Neurophilosophy," in *The Soft Underbelly of Reason: The Passions in the 17th Century*, edited by S. Gaukroger, 115–46 (London: Routledge, 1998), 138; *Philosophy and Memory Traces*, 2 (cf. supra)) In "Body, Mind, and Order", there are two extra ways mentioned in which *historical cognitive science* can enrich contemporary cognitive science: by bringing to light "forgotten or neglected explananda" and providing "self-consciously present-centred inquiry" with "extra breadth, context-sensitivity, and attention to discontinuity which historical work requires," to be employed polemically. (John Sutton, "Body, Mind, and Order," 117.)

<sup>20</sup> Sutton, "Controlling the Passions," 121.

we are our bodies, “the bodies which we are are neither simple nor unified.”<sup>21</sup> We still need to address “[t]he dislocations and fragmentations between the parts of a somatopsychic ‘unity’.”<sup>22</sup> The same can be said about the notion of the self. After (pick your favourites) the post-structuralist death of the subject or Dennett’s reduction of the self to being no more than a narrative centre of gravity, the difficult issue of conceptualising self-reform without a centralised self still remains.

The chapter on self and brain plasticity should be seen as a preliminary contribution to a project of providing a “revised notion of self” and “new decentred conceptions of subjectivity.”<sup>23</sup> Like Foucault’s notion of critique, the point is not to search the boundaries of what is thinkable and guard them, but to actively search and test those boundaries with the aim of transgressing them.<sup>24</sup>

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<sup>21</sup> Ibid., 121.

<sup>22</sup> Ibid., 122.

<sup>23</sup> Sutton, *Philosophy and Memory Traces*, 17.

<sup>24</sup> Cf. Michel Foucault, “What is Enlightenment?” in *The Foucault Reader*, edited by P. Rabinow, 32-50 (New York: Pantheon Books, 1984). A more recent and related project is that of *Critical Neuroscience*, which partly draws on Foucault’s notion of critique (cf. Jan Slaby, “Steps towards a Critical Neuroscience.” *Phenomenology and the Cognitive Sciences*, no. 9 (2010): 397–416). The similarities and potential interactions between *critical neuroscience* and *historical cognitive science* deserve to be worked out, but lie beyond the scope of this thesis.

## 2. HOOKE'S UNIVERSAL CURE OF THE MIND AND EXTENDED COGNITION

### 2.1. Introduction

In this chapter, I discuss Hooke's "universal cure of the mind" and show its affinities with the contemporary notion of *extended cognition*. My aim is not to portray Hooke as a proponent of *extended cognition avant la lettre*, but to highlight certain structural similarities between his views on the working of memory and his proposals for aiding memory with writings and the hypothesis of *extended cognition*. In order to situate Hooke's views in its proper historical and cultural context, I will start this paper with a short summary of the work of Sorana Corneanu on the *cultura/medicina animi* tradition, in which we should situate Hooke's "cure of the mind." I will also refer to the work of Peter Harrison on the importance of the notion of the Fall for our understanding of early modern epistemological projects. After that I will discuss the notion of *extended cognition*, focussing on the version given by Clark and Chalmers in their seminal 1998 paper. I will then discuss Hooke's views on cognition and the nature of extended memory, highlighting the structural similarities between Clark & Chalmers notion of *extended cognition* and Hooke's extended memory. I will conclude with a short discussion of Richard Yeo's views on Hooke and memory, arguing against his interpretation that there is a strong difference between internal and external memory for Hooke.

### 2.2. A cure of the mind

Sorana Corneanu has argued that the epistemological and methodological projects of the Royal Society virtuosi should be placed within a broader tradition in early modern culture, a tradition concerned with the "cure" or "cultivation" of the mind.<sup>1</sup> This *cultura/medicina animi* tradition had brought forth an elaborate literature traversing different disciplines and genres.<sup>2</sup> These works offered a diagnosis of the frailties of the human mind and proposed several regimens devised to cure these frailties. The *cultura animi* project thus combined self-knowledge and self-reformation.<sup>3</sup> The anthropology behind the *cultura animi* tradition is strongly linked to the notion of the Fall. Peter Harrison has shown how "the myth of the Fall informed discussions about the foundations of knowledge and influenced methodological

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<sup>1</sup> Sorana Corneanu, *Regimens of the Mind* (Chicago: University of Chicago Press, 2011), 2.

<sup>2</sup> *Ibid.*, 4.

<sup>3</sup> *Ibid.*, 46, 71-73.

developments in the nascent natural sciences.”<sup>4</sup> Different views on the nature of Adamic knowledge before the Fall and the precise consequences of his sin on his faculties led to different proposals of ways to remedy these consequences. All agreed however that “those seeking to determine the rightful course for the advancement of knowledge needed to reckon with Adam and what befell him as a consequence of his sin.”<sup>5</sup>

In the Preface to *Micrographia* Hooke presents his “universal cure of the Mind.”<sup>6</sup> In Hooke’s own words, this cure consists in

“[t]he addition of such artificial instruments and methods [by which] there may be, in some manner, a reparation made for the mischiefs, and imperfection, mankind has drawn upon it self [...] whereby every man, both from a deriv’d corruption, innate and born with him, and from his breeding and converse with men, is very subject to slip into all sorts of errors.”<sup>7</sup>

Hooke here on the one hand echoes the Baconian doctrine of the idols, and on the other hand the notion that the corruption of man’s faculties is a result of the Fall.<sup>8</sup> The use of artificial instruments and methods gives us a way to remedy these corruptions and promises “to recover some degree of those former perfections.”<sup>9</sup>

Hooke’s cure aims more specifically at “rectifying the operations of the sense, the memory, and reason.”<sup>10</sup> According to Hooke “the errors of the understanding are answerable to the two other.”<sup>11</sup> This means that it is the senses and memory that need to be cured.<sup>12</sup> The senses can be rectified by the use of instruments or “the adding of artificial organs to the natural.”<sup>13</sup> The microscope, which of course takes centre stage in *Micrographia*, serves as a perfect example. As a book, *Micrographia* also provides an example of another kind of artificial aid. Where instruments can help the senses, books and writing can help memory by constituting an external memory. In what follows I will show the affinity between Hooke’s views and the notion of *extended cognition* in contemporary cognitive science and philosophy of mind. I

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<sup>4</sup> Peter Harrison, *The Fall of Man and the Foundations of Science* (Cambridge: Cambridge University Press, 2009), 4.

<sup>5</sup> *Ibid.*, 2.

<sup>6</sup> Robert Hooke, *Micrographia: Or, Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses. With Observations and Inquiries Thereupon* (London: Printed for James Allestry, 1665), vi.

<sup>7</sup> Hooke, *Micrographia*, i.

<sup>8</sup> The notion of the Fall also plays an important role in Bacon’s own views, so the Baconian element and the theme of the Fall are interrelated. Cf. Corneanu, *Regimens of the Mind*, 31-32.

<sup>9</sup> Hooke, *Micrographia*, i.

<sup>10</sup> *Ibid.*, i.

<sup>11</sup> *Ibid.*, ii.

<sup>12</sup> However, in the “General Scheme” (cf. *infra*) Hooke also hints at a methodology that can serve as an external aid to the Understanding.

<sup>13</sup> *Ibid.*, iii.

will first give a very general overview of the notion of extended cognition and afterwards discuss Hooke's "cure of the mind" in more detail. Special attention will be paid to his views on external memory.

### 2.3. Extended Cognition

In their 1998 paper, "The Extended Mind," Andy Clark and David Chalmers argue that human cognition is not bound by the body and the skull but can 'extend' into the environment.<sup>14</sup> In the case of doing complex calculations with the help of pen and paper for example, the manipulation of these external media should be seen as part of the cognitive process of calculating. The brain still plays a role, but some cognitive operations are "delegated to manipulations of external media."<sup>15</sup> When does something external to the brain and body count as part of a cognitive process? Clark and Chalmers give the following criterion, which has become known as the *parity principle*:

"If, as we confront some task, a part of the world functions as a process which, *were it done in the head*, we would have no hesitation in recognizing as part of the cognitive process, then that part of the world *is* (so we claim) part of the cognitive process."<sup>16</sup>

Further in the paper, Clark and Chalmers ask us to imagine the case of Otto, an Alzheimer's patient who carries a notebook around in which he writes down all new information he gains and from which he looks up old information he needs.<sup>17</sup> The notebook functions as an external memory for Otto. Inga, on the other hand, does not suffer from Alzheimer's and can rely on her internal memory. When Otto hears about an exhibition in the Museum of Modern Art and decides to go there, he looks up the address in his notebook and heads for the museum. When Inga hears about the exhibition, she accesses the address stored in her memory and goes to MoMa. The information stored in Otto's notebook functions in the same way as the information in Inga's brain in constituting the belief that MoMa is located at that specific address.<sup>18</sup> One could of course point at several differences between Otto's notebook and Inga's brain-bound memory, but according to Clark & Chalmers

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<sup>14</sup> Andy Clark and David J. Chalmers, "The Extended Mind," *Analysis* 58, no. 1 (1998): 7-8.

<sup>15</sup> *Ibid.*, 8.

<sup>16</sup> *Ibid.*

<sup>17</sup> *Ibid.*, 12.

<sup>18</sup> *Ibid.*, 12-16.

"[t]hese various small differences between Otto's and Inga's cases are all *shallow* differences. To focus on them would be to miss the way in which for Otto, notebook entries play just the sort of role that beliefs play in guiding most people's lives."<sup>19</sup>

The information in Otto's notebook *functions* in the same way as the information stored in Inga's brain. It is this functional isomorphism that is central in the *parity principle*. What I now want to show is how Hooke's views on external memory invoke the same kind of functional isomorphism between the working of internal and external memory as the one invoked in the *parity principle*.

### 2.3. Hooke's extended memory

In Hooke's view of cognition there are three faculties to be considered: Reason (Hooke also uses the terms Understanding or Judgment), Memory, and the Senses. Lotte Mulligan aptly calls this the *epistemological triad*.<sup>20</sup> These three stand in a certain relation to each other and the correct functioning of the *epistemological triad* depends on a very specific dynamic between the faculties. Both Memory and the Senses are subordinate to Reason. Hooke however emphasises that the understanding is to order those faculties "only as a lawful master, and not as a tyrant."<sup>21</sup> With regards to the Senses, Reason "must watch their irregularities."<sup>22</sup> With regards to the Memory faculty, Reason has to perform a kind of quality check on the information stored there and order it:

"It must examine, range, and dispose of the bank which is laid up in the Memory: but it must be sure to make distinction between the sober and well collected heap, and the extravagant Idea's, and mistaken Images, which there it may sometimes light upon."<sup>23</sup>

Both regulatory functions are interrelated. New information from the senses helps in the assessment and organisation of memory, old information stored in memory can help in watching the irregularities of the senses. Hooke therefore speaks of "a continual passage":

"So many are the links, upon which the true philosophy depends, of which, if any one be loose, or weak, the whole chain is in danger of being dissolv'd; it is to begin with the hands and eyes, and to proceed on through the memory, to be continued by the reason; nor is it to

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<sup>19</sup> Clark & Chalmers, "The Extended Mind," 16.

<sup>20</sup> Lotte Mulligan, "Robert Hooke's 'Memoranda': Memory and Natural History," *Annals of Science* 49 (1992): 48.

<sup>21</sup> Hooke, *Micrographia*, vii.

<sup>22</sup> *Ibid.*

<sup>23</sup> *Ibid.*

stop there, but to come about to the hands and eyes again, and so, by a continual passage round from one faculty to another, it is to be maintained in life and strength[.]”<sup>24</sup>

As we have seen, Hooke’s ‘cure of the mind’ is not only aimed at the right ordering of the faculties, but also at providing external aids for them. Instruments such as the telescope and the microscope have provided external aids for the senses. The memory faculty is however not without its own external aids:

“[...] we may be sufficiently instructed from the written histories of civil actions, what great assistance may be afforded the memory, in committing to writing things observable in natural operations. If a physician be therefore accounted the more able in his faculty, because he has had long experience and practice, the remembrance of which, though very imperfect, does regulate all his after actions: What ought to be thought of that man, that has not only a perfect register of his own experience, but is grown old with the experience of many hundreds of years, and many thousands of men.”<sup>25</sup>

There is no essential difference between the physician who has a lot of experience at his disposal in the form of internal memories or the one who has books in which the experience of thousands of physicians is written down. The latter is as it were “grown old with the experience of many hundreds of years.” Both have memories (be they external or internal) at their disposal which “regulate all [their] after actions.” Hooke puts emphasis on the fact that memories are things that are *used* by the rational faculty:

“What may not be expected from the rational or deductive faculty that is furnisht with such materials, and *those so readily adapted, and rang’d for use*, that in a moment, as ‘twere, thousands of instances, serving for the illustration, determination, or invention, of almost any inquiry, may be represented even to the sight?”<sup>26</sup>

Hooke’s later methodological work provides us with a more clear picture of what it means for materials to be “readily adapted, and rang’d for use”. In *The Posthumous Works of Robert Hooke* (1705) we find a treatise with the long title “A General Scheme, or Idea of the Present State of Natural Philosophy and How its Defects may be Remedied by a Methodical Proceeding in the Making Experiments and Collecting Observations whereby To Compile a Natural History, as the Solid Basis for the Superstructure of True Philosophy” (henceforth “General Scheme”).

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<sup>24</sup> Hooke, *Micrographia*, vii.

<sup>25</sup> *Ibid.*, xiii.

<sup>26</sup> *Ibid.* (Emphasis added)

The intellect in its workings uses the materials stored in memory. In the same way, the external memory in the form of philosophical histories provides material for “the work of raising new axiomes or theories.”<sup>27</sup> Hooke emphasises that those philosophical histories are not just a mere collection of facts, but are a *repository of materials* that are to be used. It is therefore of the utmost importance to organise the materials in the repository, to make them “rang’d for use”:

“The method of distributing the matter of philosophical history [...] need not be very nice or curious, they being laid up only in heaps as it were, as in a granary or store house; from thence afterwards to be transcribed, fitted, ordered and rang’d, and tabled, as I shall afterward explain to be made fit for use; for (as I instanced before) a sufficient store of sound and good materials, ought to be collected before the work of superstructure can be begun.”<sup>28</sup>

Hooke’s description of the external materials aiding memory echoes the passage on internal memory quoted above. There he also talks about heaps of information being stored and waiting to be assessed and ordered by the Understanding. External and internal memory are therefore treated in the same way by the reasoning faculty: as a storage of information waiting to be organised and as a store of materials to be used in raising theoretical superstructures. There is thus a very strong functional isomorphism between external and internal memories.

Hooke’s external memory fulfils the criterion of functional isomorphism invoked in the *parity principle* in a very strong way: its working is designed by Hooke to parallel the working of internal memory. The working of memory is twofold: “a faithful preservation of the things committed to it, and a ready recollecting them when necessary.”<sup>29</sup> External memory mimics and already improves internal memory by preserving the things committed to it in a more reliable way. In the “General Scheme,” Hooke therefore pays most attention to making sure that the external memory is organised in a way that promotes “ready recollecting them when necessary.”

Hooke gives a more general comment on the use of external aids in his method, a comment that illustrates the claims I have made and deserves to be quoted at length:

“By this method also, the imperfections of history will be amended. And tho’ indeed this process of reasoning and inquiry may seem nothing else but what every man would do, and does indeed continually practise in all kinds of inquiry: yet has this vast advantage above the

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<sup>27</sup> Hooke, *Micrographia*, xiii.

<sup>28</sup> Robert Hooke, *The Posthumous Works of Dr. Robert Hooke*. Ed. Richard Waller (London: Printed by Sam. Smith and Benj. Walford, 1705), 21.

<sup>29</sup> Hooke, *The Posthumous Works of Dr. Robert Hooke*, 18.

common way, where the bare powers of the senses, memory and understanding are relied upon, that it perfects these faculties to the highest pitch they are capable of, and that is indeed as much as can be hoped for from art; for whereas in the common ways of ratiocination, examination and inquiry, all things are trusted to the immediate power of the faculties of the soul, *vis.* the bare senses, memory and reason; in this they are none of them left, without their armour, engines, and assistants, the senses are helped by instruments, experiments, and comparative collections, the memory by writing and entering all things, ranged in the best and most natural order; so as not only to make them material and sensible, but impossible to be lost, forgot, or omitted, the Ratiocination is helped first, by being left alone and undisturbed to it self, having all the intention of the mind bent wholly to its work, without being any other ways at the same time employed in the drudgery and slavery of the memory,[...] for first all things are set down in their order [...] [N]or will the mind be much troubled to run over all the particular instances and heads of inquiry, they are all presented at once to the view: their order, congruity, disagreement, similitude, &c. are all manifest to the eye, quickly to be examined, recollected, reviewed, otherwise placed, blotted out, or the like, according to occasion[.]”<sup>30</sup>

Several points can be made about this passage. First, Hooke admits that the kind of reasoning he proposes “may seem nothing else but what every man would do, and does indeed continually practise in all kinds of inquiry.” However, the use of artificial aids “perfects [our] faculties to the highest pitch they are capable of.” There is thus no qualitative difference between the working of “the bare senses, memory, and reason” and the way they work when helped by “their armour, engines, and assistants.” Secondly, the use of artificial aids helps the Ratiocination by leaving it “alone and undisturbed to it self”. By having externalised forms of memory at its disposal, where relevant information is already ordered and clearly presented, the reasoning faculty no longer needs to actively order and search memories, and can thus fully concentrate on building “superstructures” with this information.<sup>31</sup> As thinking for Hooke is “partly memory, and partly an operation of the soul in forming new ideas,”<sup>32</sup> the Understanding can now fully concentrate on the forming of new ideas, the work on and with memory already being fulfilled and committed to paper.

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<sup>30</sup> Hooke, *The Posthumous Works of Dr. Robert Hooke*, 34.

<sup>31</sup> For a discussion of 17th century views on the relationship between memory and reason, see: Richard Yeo, “Between Memory and Paperbooks: Baconianism and Natural History in Seventeenth-Century England,” *History of Science* 45 (2007): 5-6; 24.

<sup>32</sup> Hooke, *The Posthumous Works of Dr. Robert Hooke*, 146.

In one of the other texts in the *Posthumous Works*, Hooke presents a model of memory and its workings.<sup>33</sup> I will not go into the details of Hooke's model, but highlight the aspects that are relevant for the current discussion.<sup>34</sup>

Hooke starts his discussion by emphasising that memory is *material* or "Organical," as he puts it.<sup>35</sup> It is "as much an organ, as the eye, ear or nose."<sup>36</sup> Richard Waller, the editor of Hooke's posthumous works wherein the lecture on memory was published, felt obliged to add the following disclaimer:

"[...] though possibly some persons may imagine that the foregoing explication of these abstruse actings of the soul is too mechanical, and tends to the making the soul a material being, yet I hope the candid reader, perusing it without prejudice, will not find the least cause for such an imputation[.]"<sup>37</sup>

This however was just the concern that was voiced by some members in the audience after Hooke's lecture was given.<sup>38</sup> According to Oldroyd it might be even so that Boyle was reacting to Hooke's model of memory when in his *Christian virtuoso* he "expressed amazement at the thought that such a multitude of ideas might be accommodated in such a restricted space."<sup>39</sup>

Hooke does not fully materialise the mind, however. The Intellect itself, the Soul, is an incorporeal being.<sup>40</sup> However, "tho' it be an incorporeal being, yet in performing its actions, makes use of corporeal organs, and without them cannot effect what it wills."<sup>41</sup> Bearing in mind Hooke's views on the use of *artificial* organs, we could add that the Soul in its acting can use both natural and artificial organs, the working of both (as we saw in the case of memory) being isomorphic. This we can compare to Clark's *Hypothesis of Cognitive Impartiality*, which he later added as a natural accompaniment to the *parity principle*:

"Our problem-solving performances take shape according to some cost function or functions that, in the typical course of events, accord no special status or privilege to specific types of

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<sup>33</sup> Hooke, *The Posthumous Works of Dr. Robert Hooke*, 139-148.

<sup>34</sup> A discussion (and visual representation) of this model can be found in D.R. Oldroyd, "Some 'Philosophicall Scribbles' Attributed to Robert Hooke," *Notes and Records of the Royal Society of London* 35, no. 1 (1980): 17–32.

<sup>35</sup> Hooke, *The Posthumous Works of Dr. Robert Hooke*, 140.

<sup>36</sup> *Ibid.*, 139.

<sup>37</sup> *Ibid.*, 148.

<sup>38</sup> Singer refers to the record of the lecture in which this reaction from the audience is mentioned. Cf. Singer, B.R. "Robert Hooke on Memory, Association and Time Perception (1)" 31 (1976): 117.

<sup>39</sup> D.R. Oldroyd, "Some 'Philosophicall Scribbles' Attributed to Robert Hooke," 25.

<sup>40</sup> Hooke, *The Posthumous Works of Dr. Robert Hooke*, 140.

<sup>41</sup> *Ibid.*, 140.

operations (motoric, perceptual, introspective) or modes of encoding (in the head or in the world.”<sup>42</sup>

Applied to Hooke’s view on the workings of the Understanding: the immaterial Soul accords no privilege to internal or external memories, but in the context of natural philosophy, there are a lot of benefits to be gained by using external memories. According to Clark, the *Hypothesis of Cognitive Impartiality* poses a (solvable) puzzle to the proponent of extended cognition:

“For it threatens, unless delicately handled, to undermine the image of cognitive extension in quite a novel fashion. Thus, suppose we now ask: Just *what is it* that is so potently impartial concerning its sources of order and information? The answer looks to be “the biological brain.” So haven’t we (rather deliciously) ended up firmly privileging the biological brain in the very act of affirming its own impartiality?”<sup>43</sup>

To solve this puzzle, Clark makes a distinction between two different explanatory targets. On the one hand we have the recruitment of the extended organization itself and on the other “the flow of information and processing in the newly soft-assembled extended device.”<sup>44</sup> This leads Clark to the dictum: “Individual cognizing, then is *organism centered even if it is not organism bound*.”<sup>45</sup> In the process of assembly, the brain plays a very special and central role. However, once the extended system, comprising both organism and external media, is in place, “it is the flow and transformation of information in (what is often) an extended, distributed system that provide the machinery of ongoing thought and reason.”<sup>46</sup>

This discussion by Clark can help alleviate the worry that Hooke’s immaterial Soul, safely tucked in its seat in the brain, sits uneasily with the notion of cognition being extended. In Hooke’s case, cognition is centered around the soul, but the flow and transformation of information takes place in an extended, distributed system comprising immaterial soul and material memory, both internal and external.

Hooke’s discussion of the working of memory shows other parallels between the workings of internal memory and his proposals for the use of external memory. Recall the already quoted passage from *Micrographia* in which Hooke talks about materials being “rang’d for use” by the rational faculty. One of the characteristics of these materials “rang’d for use” is “that in a

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<sup>42</sup> Andy Clark, *Supersizing the Mind: Embodiment, Action, and Cognitive Extension* (Oxford: Oxford University Press, 2011), 121.

<sup>43</sup> *Ibid.*, 122.

<sup>44</sup> *Idem.*

<sup>45</sup> *Ibid.*, 123.

<sup>46</sup> *Ibid.*, 122.

moment, as ‘twere, thousands of instances [...] may be represented even to the sight[.]’<sup>47</sup> Hooke puts a lot of emphasis on ordering the information in such a way as to produce discrete and manageable units, presenting the user with a lot of information synthesised in one image. In the “General Scheme,” Hooke asserts confidently

“that the whole mass of natural history, may be contain’d in much fewer words than the writings of divers single authors: and the method of using them will be much more easy, and the labour of interpreting or understanding them, if done aright, will be almost as easy as to unravel a bottom when you begin at the right end.”<sup>48</sup>

At the end of the “General Scheme,” Hooke describes “the manner and order of entring what things are to be registred, and in what manner[.]”<sup>49</sup> A first thing that becomes clear is that the external memory envisioned by Hooke is *dynamic* and its contents and organisation change during the course of experimentation and investigation.<sup>50</sup> Hooke advises collecting different *histories* in a book, functioning as an active external memory and enabling the intellect to think on paper as it were, by re-arranging, adding or removing the information in the book:

“Now these histories being writ in brief, in a small piece of very fine paper, ‘twill be very convenient to have a large book bound after the manner of those that are very usual for keeping prints, pictures, drawings, &c. in [...] On the sides of which [...] it would be convenient to stick on with mouth glew, or some such substance [...]; the several small schedules containing the abbreviated and complicated histories of observations or experiments, as they are last written in fine paper, for by the contrivance of this is book, which for brevity’s sake I will call a Repository, not only all the histories belonging to any one Inquiry may be placed so as to appear all at one view [...] but they may at any time, upon occasion, be presently remov’d or alter’d in their position or order[.]”<sup>51</sup>

The information already written down also serves as material for re-reading and further synthesising, the result of which is again put down on paper, preferably in short-hand or abbreviation, “whereby the whole history may be contracted into as little space as is possible[.]”<sup>52</sup> The same synthetic activity is applied by the Understanding on the ideas stored in the internal memory, producing new ideas which are a synthesis of all subordinate ideas:

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<sup>47</sup> Hooke, *Micrographia*, xiii.

<sup>48</sup> Hooke, *The Posthumous Works of Dr. Robert Hooke*, 21.

<sup>49</sup> *Ibid.*, 61.

<sup>50</sup> *Ibid.*, 62, 64.

<sup>51</sup> *Ibid.*, 64.

<sup>52</sup> *Idem.*

“Another and more compleat action of the Soul, is the forming new Ideas from the comparing the re-actions from several ideas placed here and there in the repository, and its being sensible of the harmony or discord of them one with another, which does produce an idea wherein all those various respects are in some means united and impressed upon one and the same idea. This is an idea of greater perfection [...] and this I conceive to be that action of the soul which is commonly called reasoning[.]”<sup>53</sup>

The work done on external memory parallels the work the intellect does on internal memories and is indeed a form of extended reasoning.

Richard Yeo has mentioned the notion of *extended cognition* in his discussion of Vannevar Bush’s “memex” and Hooke and Locke’s views on external archives.<sup>54</sup> He does not link the notion of *extended cognition* to Hooke however, comparing it only to the workings of Bush’s memex and contrasting the latter with Hooke’s external archive. Yeo contrasts the memex as an individualised external memory with the depersonalised and institutionalised external archive envisioned by Locke and Hooke. The latter two “envisaged an institutional archive rather than one controlled by the interests and mental associations of an individual.”<sup>55</sup> The evaluation of Yeo’s claims about Locke I leave to others, but I do want to make several comments on Yeo’s discussion of Hooke’s views on (external) memory.

Although Yeo is right in calling attention to the institutional aspects of Hooke’s views on external memory and its potential for being used and shared as a *collective* external memory, he is mistaken in portraying Hooke’s external memory as thoroughly de-personalised. According to Yeo,

“in his “General Scheme” (c.1666), Hooke concluded that the external storage of information has to be governed by collective, rather than individual, interests and that these might include shared categories and principles of classification.”<sup>56</sup>

In Yeo’s interpretation, Hooke is motivated by a strong distrust of “the temporal and associative character of individual memory,” and accordingly holds the view that “external storage and retrieval processes must break with such patterns.”<sup>57</sup> Yeo sees Hooke positing a strong distinction between the workings of individual memory, which should be distrusted, and the workings of the collective external memory, which works in a different way as

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<sup>53</sup> Hooke, *The Posthumous Works of Dr. Robert Hooke*, 146.

<sup>54</sup> Richard Yeo, “Before Memex: Robert Hooke, John Locke, and Vannevar Bush on External Memory,” *Science in Context* 20 (2007): 24.

<sup>55</sup> Yeo, “Before Memex,” 21.

<sup>56</sup> *Ibid.*, 32.

<sup>57</sup> *Ibid.*, 35.

internal memory and can therefore avoid the dangers linked to it. I have however shown that in Hooke's views the working of external memory *parallels* the working of internal memory. Moreover, although Hooke indeed puts a lot, if not most, emphasis on the fact that external memory can be used as a *collective* memory, he does not exclude the possibility of a *personalised* external memory. Yeo is mistaken in asserting that "in his "General Scheme" (c.1666), Hooke concluded that the external storage of information has to be governed by collective, rather than individual, interests." On the contrary, Hooke asserts that the individual natural philosopher should organise his external archive so as to best suit his *personal, individual* work:

"On these large sides he may place them either according to the method of the queries, which he has at first propounded to himself, or according, to their first appearing plainness, or difficulty, or after any other method of inquiry, or proceeding, *which every one will be best able to adapt for himself, according to the subject whereon he makes his inquiry, or according to his particular aim and scope in examining it, or according to the knowledge he has already acquir'd in it.*"<sup>58</sup>

The Repository Hooke is talking about in this passage is thus an external, but still personal memory, containing information "ranged for use" by the reasoning faculty of the individual natural philosopher in a way that is appropriate to the specific query the individual is working on.

## **2.4. Conclusion**

In this chapter I have discussed Hooke's "universal cure of the mind" and have argued that his conceptualisation of the role of external media in this cure displays an affinity with the notion of *extended cognition*. Again, it should be emphasised that it was not my aim to put Hooke forward as an early modern proponent of Clark & Chalmers-style *extended cognition*. I have tried to put Hooke's statements in its proper historical context by showing how they are embedded in the tradition of *cultura animi*, based on an anthropology which sees human nature as fallen and incomplete. What can be gained from pointing out the structural similarities between Hooke's views and the notion of *extended cognition* will be discussed in chapter 5. In this chapter however it already allowed me to argue against Yeo's positing a strong distinction between the workings of external and internal memory in Hooke's thinking.

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<sup>58</sup> Hooke, *The Posthumous Works of Robert Hooke*, 64. (Emphasis added)

### 3. SELF AND BRAIN PLASTICITY

#### 3.1. Introduction

In the previous chapter I started from the contemporary notion of *extended* cognition. This chapter is meant as an “essay towards” a history of ‘brain plasticity’, a concept which can provisionally be defined as the notion that the structure of the brain is open to re-organisation. In an article discussing the history of the notion of neuronal plasticity, Berlucchi and Buchtel credit William James with first coining the term ‘plasticity’.<sup>1</sup> In this chapter I would like to show that Descartes, although he does not use the term itself, deserves to be added to the history of ‘brain plasticity’. Another aim of this chapter is to show the entanglement between the concept of brain plasticity, practices of self-reform, and the notion of a centralised self.

I start by discussing the plasticity of the brain in Descartes’ thinking. Brain plasticity will be seen to provide the conditions of possibility for self-reform. At the same time, the combination of the notion of plastic and modifiable brain matter with the idea of self-reform will provide extra reasons to posit the existence of a self which is separate from the material being reformed.

After discussing Descartes, I will treat Diderot. Diderot being a self-declared materialist and monist will do his best to give a materialist conceptualisation of consciousness and cognition without invoking a non-material entity such as an incorporeal soul. I will however show that Diderot’s thinking shows some structural similarity with Descartes when it comes to the subject under discussion, namely the self and brain plasticity. In passages discussing self-reform we find the same plasticity providing the conditions of possibility for this self-reform. At the same time, Diderot will in these passages be seen to posit a self and contrast it against the plastic material to be reformed. The contrast with other passages where individuality and subjectivity are deflated makes plausible that it is the conceptualisation of self-reform that makes the positing of a central self, put against a plastic nervous system, a compelling move.

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<sup>1</sup> G. Berlucchi and H.A. Buchtel, “Neuronal Plasticity: Historical Roots and Evolution of Meaning,” *Exp Brain Res*, 192 (2009): 307.

### 3.2. Towards a history of brain plasticity

As noted by Berlucchi and Buchtel in an article trying to map out the roots and development of the meaning of the notion of neuronal plasticity, “the concept of neural plasticity has been complicated by attributing considerably different meanings to it.”<sup>2</sup> A more general definition, provided by Berlucchi and Buchtel should suffice for the purpose of this chapter:

“The term plasticity has been in use in brain science for well over a century to refer to the suspected changes in neural organization which may account for various forms of behavioral modifiability, either short-lasting or enduring, including maturation, adaptation to a mutable environment, specific and unspecific kinds of learning, and compensatory adjustments in response to functional losses from aging or brain damage.”<sup>3</sup>

In more popularising works on neuroplasticity, it is sometimes invoked as providing the key for self-reform. Norman Doidge’s book on the subject, aptly called “The Brain That Changes Itself” bears as a subtitle “Stories of Personal Triumph from the Frontiers of Brain Science.”<sup>4</sup> Jeffrey Schwartz sees the possibility of self-reform, based on neuroplasticity, as a proof for the existence of a non-material mind distinct from the brain.<sup>5</sup> Although I will not work out the comparison with contemporary material, it will become clear that the historical investigations pursued in this paper are, just like Sutton’s work on distributed memory models, made with an implicit reference to this contemporary material.

In a short historical overview, Descartes is pointed out by Doidge as the main culprit for our overly rigid understanding of the structure of the brain. According to Doidge, “Descartes’s idea of the brain as a complex machine culminated in our current idea of the brain as a computer and in localizationism.”<sup>6</sup> Descartes’ vision of the brain will however be shown to be anything but a vision of a machine with cogs and parts ready in place and destined to stay there. Just as Doidge, Descartes will point at the brain’s plasticity as a source of hope, providing us with the possibility of self-reform.

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<sup>2</sup> G. Berlucchi and H.A. Buchtel, “Neuronal Plasticity,” 307.

<sup>3</sup> Idem.

<sup>4</sup> Norman Doidge, *The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science* (London: Penguin Books, 2007). A more scholarly view on the present state of the art of research on neuroplasticity can be found in Catherine Belzung and Peter Wigmore, eds. *Neurogenesis and Neural Plasticity*. (Berlin: Springer, 2013).

<sup>5</sup> Jeffrey M. Schwartz and Sharon Begley, *The Mind & The Brain: Neuroplasticity and the Power of Mental Force* (New York: HarperCollins Books, 2003)

<sup>6</sup> Doidge, *The Brain That Changes Itself*, 13.

Berlucchi and Buchtel start their historical overview of the development of the notion of neuronal plasticity with William James, who is credited for first adopting the term plasticity.<sup>7</sup> Although Descartes does not use the term itself, I think the following discussion will show that he deserves to be added to the ranks of thinkers trying to conceptualise brain plasticity. Throughout the chapter I will in footnotes refer to passages in James' work that resonate with Descartes' thinking, to illustrate the (sometimes striking) parallels between their formulations. The main focus of this chapter will be the conceptualisation of the relationship between brain plasticity, self-reform and the self. Just as in Schwartz' book, brain plasticity will be seen to be invoked as providing the possibility for self-reform, which in turn makes the conceptualisation of a separate self shaping the plastic material of the brain an appealing move.

Although one could state that Descartes is pre-committed to the existence of a soul or self separate from the material body for metaphysical reasons, a discussion of Diderot will show how someone who at times wilfully deflates the concept of a self and individuality, will start emphasising a contrast between an active self and the plastic material being reformed by that self, when the notion of self-reform is at play.<sup>8</sup>

The work I do on Descartes here comes close to Sutton's own work on Descartes' model of memory. The interpretation of Descartes' work I pursue here is not to be seen as providing an alternative or competing interpretation to that of Sutton, but rather as providing one that is complementary to his. My choice of a different contemporary notion (i.e. neuroplasticity) as a starting point leads to a different take on the historical material. On the other hand, the subject of brain plasticity itself again brings my undertaking dangerously close to the work Sutton has done in *Philosophy and Memory Traces*. Was it not the plasticity of the traces left behind by the roaming animal spirits that caused so much concern among the critics of Descartes' model? It was however not so much the plasticity itself they were concerned about, but the dangers of confusion and mixing of memories. In this paper I will focus on the way brain plasticity was and is conceptualised as something positive and necessary for (self-directed) change. It is in this way that my take on the material should be seen as complementary to that of Sutton. Moreover, Sutton himself refers to this "further, positive picture of self-mastery" in

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<sup>7</sup> Berlucchi and Buchtel, "Neuronal Plasticity," 307.

<sup>8</sup> It must be emphasised that I do not mean to make Diderot into a crypto-dualist. Diderot consistently avoids metaphysical dualism and the self he posits is still fully material. Still, in passages treating self-reform, this self will be seen to be contrasted strongly to the rest of the body.

Descartes' thinking in which "the plasticity of corporeal memory" is "the soul's only hope".<sup>9</sup> Sutton adds that "[t]hough I cannot expand on this suggestion here, it is worth pointing out that the much maligned Cartesian gap between self and body starts to look better motivated from this perspective."<sup>10</sup> So rather than a challenge, my thesis is more a working out of his own suggestions.

### 3.3. Descartes's plastic brain

#### 3.3.1. Descartes' views on the brain

At the beginning of his *Traité de l'Homme*, Descartes states that he will first describe the body on its own, then the soul on its own and finally treat their union.<sup>11</sup> The body is described as a complex machine. These human machines, as described by Descartes, are capable of complex behaviour and interaction with their environment, even before they are joined with a soul. Central in the motion and behaviour of these machines are the so-called *animal spirits*. These *animal spirits* are material substances, namely the smallest particles of the blood which are separated from the more coarse blood-particles in the brain.<sup>12</sup> These *animal spirits* come together in the pineal gland and from there course through the brain and the nerves through which they end up inflating the muscles and thereby moving the body.<sup>13</sup> Descartes likens the workings of these animal spirits in the production of movement to the function of the water running through the pipes of moving statues.<sup>14</sup> As just mentioned, these human machines are not only capable of mere movement, but also of reacting to their environment:

“Les objets extérieurs, qui par leur seule présence agissent contre les organes de ses sens, & qui par ce moyen la déterminent à se mouvoir en plusieurs diverses façons, selon que les parties de son cerveau sont disposées, sont comme des étrangers, qui, entrans dans quelques-unes des grottes de ces fontaines, causent eux-mêmes sans y penser les mouvemens qui s’y font en leur présence[.]”<sup>15</sup>

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<sup>9</sup> Sutton, *Philosophy and Memory Traces*, 102.

<sup>10</sup> Ibid., 102-103. In “The Body and the Brain,” Sutton treats the relationship between Descartes' neurophysiology and his ideas on self-reform more in detail, cf. John Sutton, “The Body and the Brain,” in *Descartes' Natural Philosophy*, edited by S. Gaukroger, J. Schuster, and J. Sutton, 697–722 (London and New York: Routledge, 2000).

<sup>11</sup> René Descartes, *Oeuvres de Descartes*. Edited by Charles Adam and Paul Tannery. Vol 11 (Paris: Vrin, 1996), 119-120. (Henceforth referred to as AT)

<sup>12</sup> AT Vol 11, 130.

<sup>13</sup> AT Vol 11, 130.

<sup>14</sup> AT Vol 11, 130-131.

<sup>15</sup> AT Vol 11, 131 (Original spelling is retained, with the exception of the u being replaced by v where necessary)

Descartes goes on to explain the precise way in which animal spirits make the muscles move, the working of the sense organs and the way the arrangement of the parts of the brain come to be. I will focus on Descartes' account of the brain and its organisation here.

For Descartes, the brain is nothing more than “un tissu composé d'une certaine façon particuliere[.]”<sup>16</sup> In the quote above we saw that the arrangement of the parts of the brain influences the reaction of the human machine to an external object. Explaining the constitution of the brain is therefore crucial for Descartes' account of the behaviour of the human machine. Descartes begins by saying that there are pores in the brain (i.e. spaces between the fibres of the brain-tissue) through which the animal spirits travel.<sup>17</sup> The chief characteristic of these fibres is their plasticity:

“[L]es principales qualitez de ces petits filets sont de pouvoir assez facielement estre pliez en toutes sortes de façons, par la seule force des esprits qui les touchent, &, quasi comme s'ils estoient faits de plomb ou de cire, de retenir tousiours les dernies plis qu'ils ont receus, iusqu'à ce qu'on leur en imprime de contraires.”<sup>18</sup>

I already mentioned that the animal spirits travelled through the pores in the brain. These pores themselves are however actually the result of the force being exercised by the roaming spirits.<sup>19</sup> The animal spirits themselves are always in motion: “Jamais ils ne s'arrestent un seul moment en une place[.]”<sup>20</sup> Once they get out of the pineal gland they move “vers [les endroits] où la disposition qui est pour lors dans le cerveau, les fait tendre.”<sup>21</sup> How this specific disposition of the brain comes to be becomes clear from Descartes' account of memory, which invokes the plasticity of the brain fibres just mentioned. If the animal spirits move through the fibres of the brain, the force of this motion leaves a certain trace. Depending on the force of this movement or its repetition, the trace can become more permanent:

“[N]on pas toutesfois si aisement ny si parfaitement du premier coup, que sur la glande H, mais peu à peu de mieux en mieux, selon que leur action est plus forte, & qu'elle dure plus long-temps, ou qu'elle est plus de fois reïterée. Ce qui est cause que ces figures ne s'effacent pas non plus si aisement, mais qu'elles s'y conseruent en telle sorte, que par leur moyen les

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<sup>16</sup> AT Vol 11, 170.

<sup>17</sup> AT Vol 11, 170.

<sup>18</sup> AT Vol 11, 171. Compare with William James on plasticity: “Plasticity, then, in the wide sense of the word, means the possession of a structure weak enough to yield to an influence, but strong enough not to yield all at once.” William James, *Habit* (New York: Henry Holt and Company, 1914), 5-6.

<sup>19</sup> AT Vol 11, 171.

<sup>20</sup> AT Vol 11, 171-72.

<sup>21</sup> AT Vol 11, 173.

idées qui ont esté autrefois sur cette glande, s’y peuvent former derechef long-temps apres, sans que la presence des objets ausquels elles se rapportent y soit requise. Et c’est en quoy consiste la *memoire*.”<sup>22</sup>

This allows Descartes to explain learning and habituation. Repeated motion of animal spirits through the same trace makes the passage wider and therefore more permanent, explaining why repetition makes memories more lasting or why repeated actions become habits. The latter is also explained by the already mentioned property of the animal spirits moving “vers [les endroits] où la disposition qui est pour lors dans le cerveau, les fait tendre.” The force of habit is a result of the animal spirits following the path of least resistance: they tend to go through the pores which have been widened the most by repeated passing of earlier animal spirits.<sup>23</sup> Descartes can also explain the process of association, in a way reminiscent of Hebb’s rule that “neurons that fire together, wire together”:

“Et mesme il faut remarquer que, si on en rouvroit seulement quelques-uns, comme *a & b*, cela seul pourroit estre cause que les autres, comme *c & d*, se rouvroient aussi en mesme temps; principalement s’ils avoient esté ouverts plusieurs fois tous ensemble, & n’eussent pas coustume de l’estre les uns sans les autres. Ce qui monstre comment la souvenance d’une chose peut estre excitée par celle d’une autre, qui a esté autrefois imprimée en mesme tems qu’elle en la Memoire.”<sup>24</sup>

As John Sutton has noted, “[i]n a sense Cartesian brains do consist entirely of memory.”<sup>25</sup> Memory should here not be merely seen as the possibility to recollect, but more generally the ability to gain experience and acquire certain dispositions. It is memory that enables the man-machines of Descartes to exhibit the same kind of behavioural complexity as we humans with a soul:

“Mais l’effet de la Memoire qui me semble icy le plus digne d’estre consideré, consiste en ce que, sans qu’il y ait aucune ame dans cette machine, elle peut naturellement estre disposée à

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<sup>22</sup> AT Vol 11, 178.

<sup>23</sup> Compare Leon Dumont, as quoted approvingly by William James: “Water, in flowing, hollows out for itself a channel, which grows broader and deeper; and, after having ceased to flow, it resumes, when it flows again, the path traced by itself before. Just so, the impressions of outer objects fashion for themselves in the nervous system more and more appropriate paths, and these vital phenomena recur under similar excitements from without, when they have been interrupted a certain time.” (James, *Habit*, 8) James goes on to explain habituation by “currents” leaving “traces” in the brain, in a way very reminiscent of Descartes’ use of animal spirits: “The currents, once in, must find a way out. In getting out they leave their traces in the paths which they take. The only thing they can do, in short, is to deepen old paths or to make new ones; and the whole plasticity of the brain sums itself up in two words when we call it an organ in which currents pouring in from the sense-organs make with extreme facility paths which do not easily disappear.” (James, *Habit*, 12).

<sup>24</sup> AT Vol 11, 179.

<sup>25</sup> Sutton, *Philosophy and Memory Traces*, 91.

imiter tous les mouvemens que de vrais hommes, ou bien d'autres semblables machines, seront en sa presence."<sup>26</sup>

Why then does Descartes introduce an incorporeal soul into the picture? I will start from the notion of habituation. Descartes' pre-occupation with self-reform is linked with a strong belief in the ability to impose new habits upon oneself. This ability is made possible by the plasticity of the brain just discussed. Plasticity is here not seen as a threat, but as a possibility. But the notion of self-reform and the way it is construed by Descartes almost naturally leads to the positing of a self (incorporeal soul) distinct from the material which is reformed.

### 3.3.2. *Self-reform and habituation*

Descartes begins *Les Passions de l'Ame* with a rant on the Ancients. Nothing proves the deficiency of the teachings of the Ancients better than what they have written on the subject at hand: the passions.<sup>27</sup> Therefore it is necessary to start again from the basics. Descartes starts by clarifying that something that happens is called "une passion au regard su sujet auquel il arrive, & une action au regard de celuy qui fait qu'il arrive."<sup>28</sup> Although agent and patient are often different things, it is important to keep in mind that the notions *action* and *passion* are just two different ways of looking at the same thing happening.

Descartes then goes on to discuss the body which, being the thing the soul is joined to, is the primary cause of the passions of the soul. From the viewpoint of the body however, they are, as we have just seen, to be called actions. Descartes emphasises the importance of distinguishing body from soul and gives an account of the working of the body-machine, along the lines of the account given in the *Traité de L'Homme*.<sup>29</sup> As in the latter treatise, Descartes emphasises that the body-machine is able, even in absence of the soul, to exhibit complex behaviour. Senses, muscles, nerves, animal spirits and the organisation of brain pores are enough to make an organism move and interact with its environment.<sup>30</sup>

So far for the actions of the body. The actions of the soul, then, are "toutes nos volonte, à cause que nous experimentons qu'elles vienent directement de nostre ame, & semblent ne dependre que d'elle."<sup>31</sup> A general definition of the passions of the soul, given by Descartes, is: "Des perceptions, ou des sentimens, ou des émotions de l'ame, qu'on raporte particulièrement

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<sup>26</sup> AT Vol 11, 185.

<sup>27</sup> AT Vol 11, 327.

<sup>28</sup> AT Vol 11, 328.

<sup>29</sup> AT Vol 11, 328-48.

<sup>30</sup> AT Vol 11, 341-42.

<sup>31</sup> AT Vol 11, 342.

à elle, & qui sont causées, entretenues & fortifiées par quelque mouvements des esprits.”<sup>32</sup>  
The passions of the soul are thus attributable to motions of the animal spirits. In the explication of the definition, Descartes further emphasises that he includes this reference to the animal spirits as cause of the passions “affin de les distinguer de nos volontez, qu’on peut nommer des émotions de l’ame qui se raportent à elle, mais qui sont causées par elle mesme[.]”<sup>33</sup> Everything said before on the nature and working of the animal spirits, including the plasticity of the brain fibre, is therefore relevant in the context of the passions. This becomes clear when Descartes gives an example of how the passions are excited in the soul. In the previous article he had described how after seeing a creature, the soul receives an image of its figure. Fear of this creature can be explained thus:

“[S]i cette figure est fort estrange & fort effroyable, c’est à dire, si elle a beaucoup de raport avec les choses qui ont esté auparavant nuisibles au corps, cela excite en l’ame la passion de la crainte, & en suite celle de la hardiesse, ou bien celle de la peur & de l’espouvante, selon le divers temperament du corps, ou la force de l’ame, & selon qu’on s’est auparavant garanti, par la defense ou par la fuite, contre les choses nuisibles ausquelles l’impression presente a du raport. Car cela rend le cerveau tellement disposé en quelques hommes, que les esprits reflexis de l’image ainsi formée sur la glande, vont de là se rendre, partie dans les nerfs qui servent à tourner le dos & remuer les jambes pour s’en fuir, & partie en ceux qui eslargissent ou estreissent tellement les orifices du coeur, ou bien qui agitent tellement les autres parties d’où le sang luy est envoyé, que, ce sang y estant rarefié d’autre façon que de coustume, il envoie des esprits au cerveau qui sont propres à entretenir & fortifier la passion de la peur, c’est à dire qui sont propres à tenir ouverts, ou bien à ouvrir derechef, les pores du cerveau qui les conduisent dans les mesmes nerfs. Car de cela seul que ces esprits entrent en ces pores, ils excitent un mouvement particulier en cette glande, lequel est institué de la nature, pour faire sentir à l’ame cette passion.”<sup>34</sup>

Specific reactions to stimuli are a result of habituation. Previous reactions to similar stimuli have carved out pathways in the brain which are now followed by the animal spirits in all similar situations (recall Descartes’ discussion of association discussed above). The reaction being dependent on the disposition in the brain, which in its turn depends on the previous reactions of the individual, leads individuals to react differently to the same stimulus.

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<sup>32</sup> AT Vol 11, 349.

<sup>33</sup> AT Vol 11, 350.

<sup>34</sup> AT Vol 11, 356-57.

The prime effect of the passions, according to Descartes, is that they “incitent & disposent leur ame à vouloir les choses ausquelles elles preparent leur corps[.]”<sup>35</sup> As the will is free, the passions can do no more than dispose the will.<sup>36</sup> The will in its turn can effectively make the body-machine (including the brain) do what it wants: remembering, imagining and moving the body.<sup>37</sup> Actions of the body-machine caused by the will are produced by the same mechanisms as those not caused by the will, i.e. by the animal spirits roaming through the pores of the brain, the nerves and the muscles. The Soul therefore has to produce willed actions through the mediation of the pineal gland:

“Et toute l’action de l’ame consiste en ce que, par cela seul qu’elle veut quelque chose, elle fait que la petite glande, à qui elle est estroitement jointe, se meut en la façon qui est requise pour produire l’effect qui se raporte à cette volonté.”<sup>38</sup>

Although the Will is free to will whatever it wants, it is not the case that she has complete sovereign control over the body-machine and can merely by willing a thing make the corresponding action be done by the body. As just mentioned, to produce willed actions, the Soul has to act through the mediation of the pineal gland, by making the latter issue forth animal spirits in the necessary direction. Besides their movement being caused by the Soul through the pineal gland, the animal spirits caused to move by the Soul are no different in nature and function from all the other animal spirits roaming the body-machine. Therefore, they behave in the same way: moving easier through the pores in the brain most often frequented before and weary to take the road less travelled. Therefore: “Nos pasions ne peuvent pas aussi directement estre excitées ny ostées par l’action de nostre volonté, mais elles peuvent l’estre indirectement[.]”<sup>39</sup> This can be done cunningly, by using the knowledge about the nature of the movements of animal spirits through the brain pores and processes of association discussed above<sup>40</sup>:

“par la représentation des choses qui ont coustume d’estre jointes avec les passions que nous voulons avoir, & qui sont contraires à celles que nous voulons rejeter. Ainsi, pour exciter en

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<sup>35</sup> AT Vol 11, 359.

<sup>36</sup> AT Vol 11, 359-60.

<sup>37</sup> AT Vol 11, 360-61.

<sup>38</sup> AT Vol 11, 360.

<sup>39</sup> AT Vol 11, 362.

<sup>40</sup> Here we find a concrete instance of Sutton’s remark that “The civilising process of learning to tame one’s own body was not just a matter of maintaining appropriate habits at table: it required also intense attention to psychophysiology.” Sutton, *Philosophy and Memory Traces*, p48n22. For a more detailed discussion of the importance of knowledge of one’s own body and its psychophysiology in the context of self-reform, see: John Sutton, “The Body and the Brain;” in *Descartes’ Natural Philosophy*, edited by S. Gaukroger, J. Schuster, and J. Sutton, 697–722 (London and New York: Routledge, 2000)

soy la hardiesse & oster la peur, il ne suffit pas d'en avoir la volonté, mais il faut s'appliquer à considerer les raisons, les objets, ou les exemples, qui persuadent que le peril n'est pas grand; qu'il y a tousjours plus de feureté en la defense qu'en la fuite; [...]"<sup>41</sup>

The latter may sound as an example of a very cerebral reasoning process: the intellectual part trying by pure reason to subdue the emotional part. The consideration of "reasons, objects, and examples" is however not meant as a way of reasoning oneself out of a certain passion, but a way of using the principle of association by letting the animal spirits move through the pores which have been linked to the passion one wants to excite. The Soul has a power over the body-machine, but it still has to play by the latter's rules.

This explains why the facts about the physiology of the passions are "utiles à sçavoir, pour donner le courage à un chacun d'estudier à regler les passions."<sup>42</sup> Descartes makes this comment near the end of the last article of the first part of *Les Passions*, having just summed up and repeated the most important points on the brain's plasticity and habituation. He also introduces an example meant to induce hope in the malleability of the brain. A hunting dog can, after training, be made to run only after the partridge after hearing the gunshot, even though by nature he would have been inclined to run after partridges as soon as he saw one. Therefore,

"puisqu'on peut, avec un peu d'industrie, changer les mouvements du cerveau dans les animaux depourvus de raison, il est evident qu'on le peut encore mieux dans les hommes; & que ceux mesme qui ont les plus foibles ames, pourroient acquerir un empire tres-absolu sur toutes leurs passions, si on employoit assez d'industrie à les dresser, & à les conduire."<sup>43</sup>

### 3.3.3. *Metaphors & points of entry for a homuncular soul/self*

In his discussion of metaphors used for memory, Sutton points out that

"These metaphors provide metaphysical points of entry for a homuncular soul, separate from the distinct imprints, pictures, or writings which it can somehow interpret, decode, or read. Such a central executive is a moral as well as a psychological necessity, since the idea of order in memory is linked with the requirement that discipline be imposed on one's memories."<sup>44</sup>

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<sup>41</sup> AT Vol 11, 362-63.

<sup>42</sup> AT Vol 11, 370.

<sup>43</sup> AT Vol 11, 370.

<sup>44</sup> Sutton, "Body, Mind, and Order," 124.

The metaphors he is referring to here are metaphors used in localist memory models. In *Philosophy and Memory Traces*, Sutton writes: “Only if memories are local items waiting to be scanned and dealt with is there need for a strong conception of an active, evaluating, transcendent self.”<sup>45</sup> One of the central points of this chapter is however to show that it is not only localist memory models that demand “a strong conception of an active, evaluating, transcendent self,” but that this same demand occurs in models of self-reform that base the possibility of self-reform on the plasticity of the brain.

This is illustrated by the metaphors invoked by Descartes in his discussion of the organisation of the pores in the brain. In both cases, the metaphors actually involve humans as the source of organisation. In the case of the moving statues in the grottoes, invoked in *Traité de l’Homme*, the rational soul is likened to the fountaineer “qui doit estre dans les regards où se vont rendre tous les tuyaux de ces machines, quand il veut exciter, ou empescher, ou changer en quelque façon leurs mouvemens.”<sup>46</sup> The example of the trained dog can be read as a metaphor, too: just as dog brains do not train themselves, but are trained by rational humans, likewise human brains cannot train themselves, but are to be trained by a rational soul distinct from it.

The reflexive causality of self-reform in the sense of the same thing doing the reforming and being reformed seems to be difficult to conceive, leading to a separation of a reforming self from the reformed plastic matter. Moreover, in the metaphors discussed above, the reforming activity is done by *humans*. When applied to the self and the reformation of brain plasticity, these metaphors likewise “provide metaphysical points of entry for a homuncular soul.”

In the following section of this chapter I discuss Diderot, being invoked by Charles Wolfe as somebody who “provides not just a materialist outlook but one which acknowledges the self-organising dimensions of brains.”<sup>47</sup> It is interesting to compare Diderot’s conceptualisation of self-reform and plasticity with that of Descartes. Diderot emphasises that there is “only one substance in the universe, in man and in the animal”<sup>48</sup> and that it “should be adopted as an essential hypothesis” that “nature has chosen to use the same mechanism in an infinite

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<sup>45</sup> Sutton, *Philosophy and Memory Traces*, 17-18.

<sup>46</sup> AT Vol 11, 130.

<sup>47</sup> Charles Wolfe, “‘The Brain Is a Book Which Reads Itself’. Cultured Brains and Reductive Materialism from Diderot to J.J.C. Smart,” in *Mindful Aesthetics: Literature and the Science of Mind*, edited by Helen Groth and Chris Danta, 73–89 (London: Continuum, 2013), 83.

<sup>48</sup> Denis Diderot, “D’Alembert’s Dream,” in *Rameau’s Nephew and Other Works*, Translated by J. Barzun and R.H. Bowen (Indianapolis: Hackett Pub., 2001), 104.

number of different ways.”<sup>49</sup> In the dialogue, Diderot playfully deflates the notion of individuality and reduces living beings (including humans) to a “sum of a certain number of tendencies.”<sup>50</sup> Although both self and body are material in Diderot’s scheme of things, he will be seen to increase the contrast between the two in contexts where self-reform and self-habitation are involved. Again, the plasticity of the reformed matter, combined with the notion of self-reform, will invite the conceptualisation of the reforming self as something different in nature from the material being reformed.

### 3.4. Diderot’s centre and network

According to Diderot there is a unique “position to suit any given organic molecule”, which the molecule will “search” for.<sup>51</sup> This “searching” can be understood in terms of attraction and resistance (cf. §XXXVI.2.). If two molecules attract each other, they are both “searching” the position which suits them. An *elastic body* will “[resist] a force which would tend to disrupt the co-ordination between [its molecules],” i.e. it “wants” to stay in the position that suits it.<sup>52</sup> When the disruptive force persists, the system will change, making it “search” for the new position which suits her new organisation.<sup>53</sup>

In *D’Alembert’s dream* Diderot will show how this same self-organisation is at work in the coming into being and working of consciousness. A “system capable of nothing but sensation” has “[a] pure and simple sensibility, [a] sense of touch.”<sup>54</sup> It is important to note that Diderot describes this pure sensibility in terms of touching, which enables us to see sensibility in terms of contact, which in turn brings us back to the contact and co-ordination between molecules described above. The different senses are all different forms of touching, and their development can be described in the same way as the aforementioned co-ordination of molecules. When it comes to the working of consciousness, it is no more than a certain *elastic body* searching its suited position, as a system of molecules:

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<sup>49</sup> Denis Diderot, *Thoughts on the Interpretation of Nature and Other Philosophical Works* (Manchester: Clinamen Press, 1999), §XII, 40-41.

<sup>50</sup> Diderot, “D’Alembert’s Dream,” 125.

<sup>51</sup> Diderot, *Thoughts on the Interpretation of Nature and Other Philosophical Works*, 68.

<sup>52</sup> *Ibidem.*, 53.

<sup>53</sup> “[...] to co-ordinate their actions in relation both to the laws governing their attraction, configuration, etc. and to the action of the disruptive force.” (Idem.) For a more elaborate treatment and contextualisation of Diderot’s matter theory, see: Charles T. Wolfe, “Endowed Molecules and Emergent Organization: The Maupertuis-Diderot Debate,” *Early Science and Medicine* 15, no. 1–2 (2010): 38–65. doi:10.1163/138374210X12589831573063.

<sup>54</sup> Diderot, “D’Alembert’s Dream,” 130.

“What is a living creature? ... The sum of a certain number of tendencies. ... Can it be that I myself am anything more than a tendency? ... No, I am tending toward a limit. [...] And life itself? ... Life is a series of actions and reactions. ...”<sup>55</sup>

When Diderot concludes that “there is not an entity in all the natural world that does not know suffering and enjoyment,”<sup>56</sup> he is not saying that molecules feel pain and pleasure like we do. What he does say is that humans act like molecules in being attracted by or resisting other systems of matter. For Diderot, there is no gap between the workings of matter and the workings of consciousness to be explained.

In one passage of *D’Alembert’s dream*, the character of Diderot uses an analogy with vibrating strings to explain how we can think about absent objects. A string “vibrates and makes a sound for a long time after it has been plucked,”<sup>57</sup> explaining how a materialist can account for us thinking about an object when no material object affects our senses. The analogy further allows Diderot to give a materialist account of the thinking process itself by invoking the notion of resonance.<sup>58</sup> Here the character of d’Alembert objects that Diderot is contradicting his own attempt “to eliminate the distinction between mind and matter,” by making “the philosopher’s mind [...] an entity distinct from the stringed instrument, a sort of musician that listens to the vibrating strings and draws conclusions about their harmony or dissonance.”<sup>59</sup> We saw how the metaphors used by Descartes invited the same dualism. Diderot retorts however:

“The philosopher-instrument has sensations, so he is simultaneously the performer and the instrument. Because he is conscious, he has a momentary awareness of the sound he produces; because he is an animal, he remembers the sound. [...] Imagine a clavichord endowed with sensation and memory, and then tell me whether it will not learn and be able to repeat by itself the tunes you play on its keyboard.”<sup>60</sup>

So a human being is both the instrument and the musician of its own thought-music. To pursue the metaphor further, unlike Descartes, Diderot does not want to introduce a metaphysical distinction between the musician with the ability to change the tune played on

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<sup>55</sup> Diderot, “D’Alembert’s dream,” 125.

<sup>56</sup> *Idem*.

<sup>57</sup> *Ibid.*, 100.

<sup>58</sup> “But vibrating strings have yet another property, that of making other strings vibrate; and that is how the first idea recalls a second, the two of them a third, these three a fourth and so on, so that there is no limit to the ideas awakened and interconnected in the mind of the philosopher, as he meditates and hearkens to himself amid silence and darkness.” *Ibid.*, 100.

<sup>59</sup> *Ibid.*, 100.

<sup>60</sup> *Ibid.*, 101.

the harpsichord (Descartes' fountaineer-soul) and the instrument being manipulated (Descartes' body-fountain-statue).

Later in the dialogue the issue of unity pops up. If a conscious living being is a mere aggregate of molecules which are each themselves "sensitive," how to account for the existence of "[a] system or self that is aware of forming a unity?"<sup>61</sup> The answer is that the contact between the molecules is not a case of *contiguity*, but of *continuity* so that "[the] sensitivity, then, exists throughout the whole mass."<sup>62</sup> An analogy is made to a bee swarm that acts as one individual. Later on the source of a sense of identity is explained by memory and a likeness is made to both the cluster of bees and a monastery:

"MLLE. DE L'ESPINASSE. I mean simply that the monastic spirit persists only because the monastery replaces its members a few at a time, so that whenever a new monk enters the community he finds himself surrounded by a hundred old ones who influence him to think and feel as they do. If one bee leaves the swarm, the bee that takes his place very quickly gets into the swing of things.

D'ALEMBERT. Come, now - you're being silly with all this talk about monks, bees, hives and monasteries.

BORDEU. Not so silly as you might think. While there is only one center of consciousness in an animal, there are many, many different impulses. Every organ has impulses peculiar to itself."<sup>63</sup>

Several points should be made about this passage. First of all, a distinction is made between the consciousness of the parts and their wills (impulses). The parts "lose their consciousness" to the whole, but retain their will. Another thing is that Diderot is still doing a fine job of avoiding anything akin to dualism. The analogy with the monastery even allows him to refer to the maintenance of unity without referring to a centralised controller imposing that unity on something other. There is no mention of an abbot, it are "a hundred old ones who influence [the new monk] to think and feel as they do."

Earlier in the dialogue, another analogy had been used however, and it is this analogy, when being further invoked in the discussion of the unity of consciousness and especially in the discussion of habituation and self-reform that in the end leads Diderot to conceptualise a self which differs from the material which it reforms.

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<sup>61</sup> Diderot, "D'Alembert's Dream," 110.

<sup>62</sup> Idem.

<sup>63</sup> Ibid., 42.

The character of Mademoiselle de L'Espinasse at a certain point introduces the following analogy:

“Imagine a spider at the centre of its web. Shake a strand. You’ll see the animal rush up on the alert. All right then. What if the strands which the insect pulls from its intestines and pulls back when it wishes were a sensible part of itself?”<sup>64</sup>

The character of Dr. Bordeu responds and gives an anatomical gloss on the analogy:

“I follow your thought. You mean to suggest that inside your own body, in some region of your brain - perhaps in the part known as the meninges - there may be one or more points to which are conveyed all the sensations that are produced anywhere along the threads.

[...]

The threads run everywhere. There is scarcely a point on the surface of your body that is not connected to the end of one of those threads. And the spider has her nest in that part of your brain that I just mentioned - the meninges - and if you were so much as to tap lightly on that part of the brain, you would induce unconsciousness in the whole organism.”<sup>65</sup>

The analogy on its own and its gloss do not provide a cause for concern. The web of the spider should be seen as if “a sensible part of itself,” not something distinct from the spider. Dr. Bordeu refers to a very bodily and material entity to gloss the spider in the analogy, namely the meninges, not quite a centralised location like Descartes’ pineal gland. However, later in the dialogue the concept of a network of sensitive fibres and a “centre” emerges and is linked to the analogy of the spider and its web. The “centre” is seen as the locus of memory and reasoning.<sup>66</sup> Moreover, this centre:

“is all that matters, and at the center there is no specific or particular kind of sensitivity - the center does not see nor hear; nor does it feel pain. It is generated and then nourished; it grows out of a soft, inert, insensitive material, on which it rests just as if it were on a cushion - there it sits, listens, makes judgments and promulgates its decisions.”<sup>67</sup>

When questioned by Mademoiselle de L'Espinasse, Dr. Bordeu affirms that it suffers no pain,<sup>68</sup> which is strange, considering the assertion quoted earlier that “there is not an entity in all the natural world that does not know suffering and enjoyment.” I have also quoted a passage in which it was mentioned that the parts lose their consciousness to the whole, but

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<sup>64</sup> Diderot, “D’Alembert’s Dream,” 125-26.

<sup>65</sup> Ibid., 126-27.

<sup>66</sup> Ibid., 136-37.

<sup>67</sup> Ibid., 137.

<sup>68</sup> Idem.

that their wills remain. In further discussions of the properties of the “centre” and the network, both are played out against each other, each trying to impose their will upon the other. The “centre” is moreover invoked as being the real seat of being of the animal, its real self: “[a creature's] entire being seems to be concentrated there, sometimes dominating the rest of the network of threads and sometimes dominated in turn by them.”<sup>69</sup> It is the centre of consciousness, memory and will, located in a place that is totally different from the rest of the body, “a soft, insensitive, inert substance”, where it sits as a judge.<sup>70</sup>

It is striking that the passages in which the contrast between the self (“the centre”) and the body-other is emphasised the most precede examples of self-disciplining, self-habituating and self-reform. Dr. Bordeu refers to a woman who was able, by pure willpower, to cure herself from “a most alarming attack of the vapors”<sup>71</sup> By doing this “[t]he organ of her will power at the centre of her network got stronger,”<sup>72</sup> being more able to subdue the *other* wills of her body. Bordeu goes on to mention ascetics walking on burning coals and a priest being operated without sedation, being able to withstand the pain through intense concentration. “[A] firm disposition in the center of the network” is “a result of education, habit or organization[.]”<sup>73</sup> This allows for the possibility of self-reform, akin to the process of becoming one’s own tamer, as in the metaphor invoked by Descartes, where the rational part subdues the body-machine. When discussing ‘great men’, Bordeu contrasts them with ‘mediocre people,’ who are characterised by ‘sensibility’.<sup>74</sup>

“BORDEU: [...]”But what exactly is a person who is said to have sensibility? He is a creature who is moved in all things by the behavior of his diaphragm. Just let a well-chosen word catch his ear, just let his eye light upon an odd situation, and -lo and behold- all of a sudden his insides are in a commotion, every fiber in his nervous system is agitated, he begins to tremble from head to foot, [...] in short, the center of the bundle of fibers doesn't know what's going to become of it. It would be better to have a little more *sang-froid*, a little more reason, more judgment, more instinct, more self-reliance.

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<sup>69</sup> Diderot, “D’Alembert’s Dream,” 147.

<sup>70</sup> Having discussed some examples of the power of the centre over the body, Mmlle. De L’Espinasse asks: “Why, indeed, is it impossible that I should think with my whole body?” Bordeu answers: “You can be sure that there is only one center of consciousness. [...] It is physically impossible that it can be in more than one place, namely, at the center to which all sensations are transmitted, where the memory functions, where comparisons are made. [...] The center can receive all kinds of sensations, can register them, can remember them - that is, retain a continuous impression.” (Ibid., 153)

<sup>71</sup> Ibid., 148.

<sup>72</sup> Ibid., 149. Cf. James: “As a final practical maxim, relative to these habits of the will, we may, then, offer something like this: *Keep the faculty of effort alive in you by a little gratuitous exercise every day.*” (James, *Habit*, 65).

<sup>73</sup> Diderot, “D’Alembert’s Dream,” 149-150.

<sup>74</sup> Ibid., 155.

[...]

In the event that a great man has unfortunately inherited that type of disposition, he must work incessantly to overcome it, to dominate his sensibility, to make himself the master of his impulses and to safeguard the center of the bundle in all its rights. If successful, he will be wholly self-possessed in the midst of the gravest dangers; his judgment will be calm and sound.”<sup>75</sup>

Throughout the dialogue, Diderot had been both trying to account for individuality and subjectivity in materialist terms<sup>76</sup> and at the same time playfully breaking those notions down.<sup>77</sup> The passages in which Diderot, with visible joy, tries to deconstruct the sense of individuality and subjectivity - the “I” being nothing more than a “sum of tendencies” – stand in contrast with the passages on self-reform where a more unified and active self is put against the network to be subdued. Although Diderot does not end up with a substance dualism, the “centre” still being a material and bodily thing, we do find some structural similarities with Descartes: the plasticity of the brain (and more generally the nervous system/body in Diderot) opens the possibility of self-reform, but this self-reform is conceptualised by separating the reformed plastic material from the reformer, the self. **3.5. Concluding remarks: back to the present, and directions for further research**

In this chapter I have discussed two historical examples of thinkers conceptualising the plasticity of the brain and invoking it in the context of self-reform. The plasticity of the brain allowed for the possibility of reform, but is also linked with to the positing of a separate self doing the reforming action.

This brings us to the project of providing “revised notions of self” and “new decentred conceptions of subjectivity,” already referred to at the end of the first chapter. As Sutton in his book, I have not pursued these questions in this chapter, but the history of brain plasticity does deserve to be complemented by a philosophy of brain plasticity, tracing out the philosophical challenges posed by thinking out the concept of brain plasticity and the political and individual potential it offers. Catherine Malabou has recently pursued these questions in

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<sup>75</sup> Diderot, “D’Alembert’s Dream,” 154-155.

<sup>76</sup> “Each sensitive molecule had its own identity before the contact occurred. So how did it lose that identity, and how did the consciousness of the whole come into existence as the result of all these losses of identity?” (Ibid., 121)

<sup>77</sup> “And you still speak of individuals, you poor philosophers! Stop worrying about your supposed individuals and answer me this question: Is there in all nature one single atom that is absolutely like another atom? ... No. ... Then will you not agree that in nature everything is bound up with everything else, and that it is impossible that there should be any gap in the chain of beings? What, then, do you mean when you talk about individuals? There isn't any such thing; no, there isn't any such thing. ... There is only a single great individual - the whole universe.” (Ibid., 124.)

here *What Should We Do With Our Brain?*.<sup>78</sup> In her discussion of the relationship between self and brain plasticity in the third chapter of the book (“You are Your Synapses”), Malabou engages with writers such as Damasio and LeDoux to give an account of the emergence of a self, and to discuss its nature.<sup>79</sup> In her treatment, however, Malabou makes the move Charles Wolfe has argued against in his “De-ontologizing the Brain,” namely to “reinvest the brain with the mysterious character that the self has lost[.]”<sup>80</sup> Malabou gives her own account of the move from the neuronal to the mental. Her account however is still completely brainbound and individualistic. Wolfe on the other hand points at the link between the plasticity of human brains and the human ability to make use of and interact with the environment (including the social environment) in cognition.<sup>81</sup> This of course brings us back to the concept of *extended cognition*, the other concept at the heart of this thesis. *Extended cognition* thus prompts us to put the brain’s plasticity in a broader picture: brain plasticity is what allows the human brain to link itself to and exploit social and environmental structures, leading to the behavioural complexity that we humans display. When it comes to the question of the self, then, we should take care not to get trapped in a myopic focus on the brain, but also take into account the embedded and distributed character of human cognition.<sup>82</sup>

On the historical level, I have also left a lot of work undone. To begin with, I have devoted less attention than I should have to actual practices of self-discipline and the wider cultural context in which they should be situated.<sup>83</sup> The link between brain plasticity and the embeddedness (and extendedness) of human cognition makes this kind of historical research even more pressing.

Moreover, the points made by Sutton on the entanglement of the practical and the theoretical in the context of memory, are also relevant here. In footnotes questioning Ian Hacking’s assertion that there were no sciences of memory before the late nineteenth century, Sutton counters that “practical methods for imposing rigidity on the mind [...] were intimately entwined with theoretical quests for facts about memory,”<sup>84</sup> a complex interaction taking

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<sup>78</sup> Catherine Malabou, *What Should We Do with Our Brain?* (New York: Fordham University Press, 2008).

<sup>79</sup> Malabou, *What Should We Do with Our Brain?*, 55-77.

<sup>80</sup> Charles T. Wolfe, “De-Ontologizing the Brain: From the Fictional Self to the Social Brain,” *CTheory* 30, no. 1 (2005). <http://www.ctheory.net/articles.aspx?id=572>, accessed 25/12/2014.

<sup>81</sup> Wolfe, *Ibid.*

<sup>82</sup> For a further discussion of this point, see Wolfe, *Ibid.*

<sup>83</sup> In his intellectual biography of Descartes, Stephen Gaukroger for example devotes a lot of attention to the internalization of religion and the growing importance of the virtue of ‘self-discipline’ or ‘self-control’ in Descartes’ time. Cf. Stephen Gaukroger, *Descartes: An Intellectual Biography* (New York: Oxford University Press, 2002), 24-32.

<sup>84</sup> Sutton, *Philosophy and Memory Traces*, p48n22.

place between knowledge-that and knowledge-how.<sup>85</sup> It is strange that of all people Hacking should miss this point, since

“the Foucauldian models for examining historical technologies of the self on which Hacking builds include abundant analysis of the close interplay between theoretical-knowledge claims and mundane bodily and psychological practice.”<sup>86</sup>

The account given in this chapter has been very theory-centered, focussing on the *conceptualisation* of brain plasticity, self, and self-reform in the *theories* of Descartes and Diderot. This will have to be complemented with an analysis of the role of these concepts and theories in *practices* of self-reform. What function does the concept of a *self*, separate from plastic brain material, have in these practices? Does dividing one’s internal experience into reforming self and malleable non-self provide practical benefits in the context of self-reform? I will refer back to this issue of the entanglement of theory and practice in the following chapter.

In this chapter, I have also only focused on two figures. Further research on the history of brain plasticity of course has to go beyond Descartes and Diderot. A first author that deserves attention is Malebranche, who (among other things) further develops Descartes’ account of the brain and animal spirits. In footnotes I have quoted passages from William James’ work which show a remarkable similarity with Descartes. This of course leads to another historical question: how to account for those similarities?

Also, I have not treated figures for whom the organisation of the brain is more rigid and less amendable to change. Taking such conceptions of the brain into account will make a comparative analysis possible, providing more depth.

All of this (and more) will have to be done in that “yet-unwritten history of brain plasticity.”<sup>87</sup> I hope however to have shown that such a history is worthy of pursuit.

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<sup>85</sup> Sutton, “Controlling the Passions,” 139-140n16.

<sup>86</sup> Sutton, *Ibid.*, 140n16.

<sup>87</sup> Wolfe, “The Brain is a Book Which Reads Itself,” 75.

## 4. ANALYSIS

### 4.1. Introduction

In this chapter I will provide a short analysis and a further discussion of the cases discussed in the previous chapters, focussing on the entanglement of theory and practice. In the case of Hooke, this will enable me to show that making the analogy with *extended cognition* can amount to more than just pointing out interesting structural similarities. In the case of Descartes and brain plasticity, a more explicit reference will be made to Foucault's thinking about knowledge and power and a link will be made to Sutton's own remarks on the analysis of the interplay between theory and practice.

### 4.2. Early Modern Extended Minds

In my discussion of Robert Hooke's 'universal cure of the mind' and Clark & Chalmers's 'extended mind', I have emphasised that I did not have the intention of making Hooke into a proponent of extended cognition *avant la lettre*, but rather to point out some interesting structural similarities with regards to the conceptualisation of external memory. One could ask the question, then: what is the use of making the comparison and what implications does the presence of these structural similarities have?

The easiest and least controversial answer would be that the comparison has a heuristic function. I had worked on Hooke's 'universal cure of the mind' before encountering the 'extended mind' hypothesis. Once I got acquainted with it, I noticed a certain affinity between both. In really working out the comparison, the 'extended mind' hypothesis can be seen as a heuristic tool: it guides the discussion of Hooke's 'universal cure of the mind', making certain connections and aspects of Hooke's thinking visible which would perhaps not have been noticed without the use of the analogy with the 'extended mind' hypothesis.

We could however dare to be a bit more ambitious. In a critical discussion of Clark's *Supersizing the Mind*, Robert Rupert goes over the arguments provided in favour of the 'extended mind' hypothesis in order to refute them. I will not deal with Rupert's criticism here, but start from his observation that part Clark provides different kinds of arguments for

his view, one of them being phenomenological.<sup>1</sup> Indeed, Clark uses a variety of Merleau-Ponty's discussion of the blind man's cane to argue that

“human minds and bodies are essentially open to episodes of deep and transformative restructuring in which new equipment (both physical and “mental”) can become quite literally incorporated into the thinking and acting systems that we identify as our minds and bodies[.]”<sup>2</sup>

In fluent use of equipment, be it physical or “mental”, new “agent-world circuits” come into being.<sup>3</sup> Phenomenologically, fluent use of equipment is described by Don Ihde as an *embodiment relation*, our relationship with the equipment being one in which

“the machine displays some kind of partial transparency in that it itself does not become objectified or thematic, but is taken into my experiencing of what is other in the World.”<sup>4</sup>

From this point of view, we could view the structural similarities between Hooke's thinking and the ‘extended mind’ hypothesis as a conceptualisation on Hooke's part of the phenomenological experience of his books and notebooks having become part of his cognitive functioning, not being experienced as something external, but taken up in his “experiencing of what is other in the World.”

### **4.3. Power and knowledge: Descartes and brain plasticity**

Here I want provide a link with the Foucault's genealogical work as exemplified in *Discipline and Punish*, and his ideas on the entanglement of knowledge and power expressed there.<sup>5</sup> *Discipline and Punish* is more than “just” the history of “The Birth of The Prison”. It not only talks about disciplinary and punitive practices, but also aims at telling something about the human sciences and our knowledge about man.<sup>6</sup> Foucault discusses the emergence of discipline as a new modality of control in the early modern period and analyses the manifolds of micro-level disciplinary techniques at work in different contexts: e.g. “arts of distribution”

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<sup>1</sup> Robert D. Rupert, “Cognitive Systems and the Supersized Mind,” *Philosophical Studies* 152, no. 3 (2011): 428.

<sup>2</sup> Clark, *Supersizing the Mind*, 31.

<sup>3</sup> Idem.

<sup>4</sup> Don Ihde, *Technics and Praxis* (Dordrecht: D. Reidel Publishing Company, 1979), 8.

<sup>5</sup> Attention for the entanglements of knowledge and power is of course still present in Foucault's work on *technologies of the self*.

<sup>6</sup> One of the general methodological rules Foucault puts down for himself at the beginning of the book is not “treating the history of penal law and the history of the human sciences as two separate series,” but instead “see whether there is not some common matrix or whether they do not both derive from a single process of ‘epistemologico-juridical’ formation; in short, make the technology of power the very principle both of the humanization of the penal system and of the knowledge of man.” Michel Foucault, *Discipline and Punish: The Birth of the Prison* (New York: Vintage Books, 1975), 23.

or techniques of distribution of individuals in space<sup>7</sup>, “hierarchical observation,”<sup>8</sup> “normalizing judgement,”<sup>9</sup> etc. An important point Foucault wants to make about power is that it should not be seen as merely repressive, but that it should be seen more as something productive. Power is productive, the disciplinary practices Foucault discusses produce individuals, “the man of modern humanism,”<sup>10</sup> and provide the condition of possibility for the emergence of the human sciences: “that moment when the sciences of man became possible is the moment when a new technology of power and a new political anatomy of the body were implemented.”<sup>11</sup>

These disciplinary practices, including the power of normalization and the imposition of homogeneity, paradoxically produce individuality and make knowledge about these individuals possible by measuring deviation from the norm.<sup>12</sup> Foucault also refers to the way disciplinary power produces knowledge about “natural” bodies. The body *resists* the power imposed on it and in this way knowledge about the *natural*, the *organic* body becomes possible:

“the disciplinary controls of activity belonged to a whole series of researches, theoretical or practical, into the natural machinery of bodies; but they began to discover in them specific processes; behaviour and its organized requirements gradually replaced the simple physics of movement. The body, required to be docile in its minutest operations, opposes and shows the conditions of functioning proper to an organism. Disciplinary power has as its correlative an individuality that is not only analytical and ‘cellular’, but also natural and ‘organic’.”<sup>13</sup>

Here we find a clear discussion of what Sutton referred to as “the close interplay between theoretical-knowledge claims and mundane bodily and psychological practice.”

Foucault’s analysis can be used to show the same interplay at work in Descartes’ conceptualisation of brain plasticity discussed in the previous chapter. Descartes, being engaged in practices of self-discipline and self-reformation tries to impose new cognitive and emotive habits upon himself. The acquisition of these new habits is however not a simple matter of mere willing, the body (brain) resists the discipline imposed on it. Although not

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<sup>7</sup> Foucault, *Discipline and Punish*, 141.

<sup>8</sup> *Ibid.*, 170-171.

<sup>9</sup> *Ibid.*, 177.

<sup>10</sup> *Ibid.*, 141.

<sup>11</sup> *Ibid.*, 193.

<sup>12</sup> *Ibid.*, 184.

<sup>13</sup> *Ibid.*, 156.

referring to the bodily processes related to habituation, Descartes already in the *Regulae* refers to the painstaking efforts required for self-reformation:

“But those who desire a perfect mastery of the latter part of my method [...] should be advised that a long period of study and practice is needed in order to acquire this technique.”<sup>14</sup>

In the *Passions* and *The Treatise on Man* Descartes provides a theoretical framework that enables one to understand the recalcitrance of the brain, resisting re-organisation: the animal spirits follow the path of least resistance, preferring to go through the pores that have been widened the most by previous passages. At the same time the plasticity of the brain allows for the possibility of change: the passages in the brain are not fixed. With effort, the animal spirits can be forced to move in new ways. After repeated effort and practice, these new passages have become widened and more easily travelled by the animal spirits. New habits will have been imposed by the self.

In the discussion of Descartes’ conceptualisation of brain plasticity we saw how this theoretical knowledge was evoked in a practical context, the physiology of the passions being something “profitable to be known,” knowledge of the workings of the brain and the animal spirits helping the self in moulding the plastic brain material which, though malleable and changeable by effort, has its own nature, its own normativity.<sup>15</sup> The practices of imposing one’s will on the brain material make this nature visible. Knowledge of this nature in turn helps in these practices of self-discipline, by allowing the self to use the rules of the game in its own advantage.

#### **4.4. Conclusion**

In this chapter, I have provided a short analysis and discussion of the previous two chapters, showing (in a very general way) the entwinement of practice and theory in the cases discussed. In Hooke’s case, the structural similarity between his thinking and the *extended cognition* theory could be explained by an attempt on Hooke’s part of conceptualising the phenomenological experience of mental equipment having become “transparent” by fluent use. In my discussion of Descartes, I have built upon Foucault’s discussion of power and knowledge and the knowledge produced by the resistance offered by the body in an analysis of Descartes’ theorisation of the recalcitrance and plasticity of the brain. This theory itself was

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<sup>14</sup> René Descartes, *The Philosophical Writings of Descartes*. Translated by J. Cottingham, R. Stoothoff, and D. Murdoch. Vol I. (Cambridge: Cambridge University Press, 1985), 51.

<sup>15</sup> Cf. Sutton, “The Body and the Brain”.

again taken up in practice, providing knowledge which enables a more efficient and successful practice of self-reformation.

## 5. SYNOPSIS

I have started this thesis with a discussion of John Sutton's notion of '*historical cognitive science*'. In this discussion I have tried to make it clear that the aim of *historical cognitive science* is to go beyond dichotomies such as past/present and nature/culture to arrive at a project in which insights from contemporary cognitive science can be incorporated in and confronted with historical investigations and vice versa.

The following two chapters contained my own research, which should be seen as exercises in historical cognitive science. In the second chapter I have argued that there is a structural similarity between Robert Hooke's thinking on the role of external memory in his "universal cure of the mind" and Clark & Chalmers's discussion of the "extended mind". In a further analysis provided in the fourth chapter, I discussed the use of making this analogy. A modest proposal would confer a mere heuristic function to the analogy: it is no more than a heuristic tool, enabling us to make certain things visible in Hooke's thinking which would have not been noticed without the invocation of the analogy. Already in chapter 2 I showed how the analogy enabled me to argue against Yeo's assertion that there is an important difference between the workings of external and internal memory for Hooke. In the fourth chapter I also proposed a more ambitious interpretation of the structural similarity, pointing at the role of phenomenological arguments in Clark's defence of extended cognition. The structural similarity could then be explained by the fact that Hooke himself experienced the (note)books he used as "transparent equipment", and that the way he conceptualised the role of this equipment bears testimony to this experience.

In the third chapter I discussed the concept of brain plasticity and its relation to notions of the self in the thinking of Descartes and Diderot. I have pointed out how in both cases plasticity was invoked in the context of self-reform, leading to a conceptual separation of the self from the plastic material being reformed by it. In the fourth chapter I have invoked Foucault's work on the genealogy of the human sciences, showing how the work of Descartes that had been discussed in chapter 3 could be seen as an instance of the entanglement of psychological practice and theory referred to by Sutton.

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q Examples: View examples of real and hypothetical studies that use content analysis. q Key Terms: Terms used in the Educational Research guides. q Annotated Bibliography: Complete list of resources used in this guide and beyond. Historically, content analysis was a time-consuming process. Analysis was done manually, or slow mainframe computers were used to analyze punch cards containing data punched in by human coders. Key theoretical approaches that inform content analysis include linguistics and cognitive science. Linguistic approaches to content analysis focus analysis of texts on the level of a linguistic unit, typically single clause units. Examples of shared cultural cognitive elements in the United States, for instance, would be a speaking knowledge of basic English phonemes, vocabulary, and syntax; familiarity with the currency; and recognition of the American flag. Not all normal adult persons born and residing in the United States share even these minimal cognitions, but universality is closely approximated in most communities. The analysis and classification of cultural structures in terms of the individual cognitive components of which they are the sum has not yet advanced very far. At the present stage of research into these matters, however, there are technical and semantic difficulties in analyzing the relationship between individual cognitive structures and those cognitive sums that we have here called a "culture."

Introduction to Cognitive Science History, methods, and contributing disciplines Images from Ashcraft, Sobel, Stillings and Thagard & www.wikipedia.org Outline i Scope of Cognitive Science i A Brief History i Overview of Major Concepts i Multidisciplinarity - Contributing Disciplines i Concluding Remarks- How to Become a Cognitive Scientist? What Is Cognitive Science? i i The (interdisciplinary) study of mind and intelligence. Watson, Skinner: Psychology as a science of behaviour. Historical Background i Logical tradition and analytic philosophy Axiomatization of arithmetic and logic as formal systems: Leibniz, Frege, Russell, Logical positivism: Russell, young Wittgenstein, Schlick, Carnap, Gdel