POSTULATES OF BRAIN SCULPTING

Dr Ben Denham
Artist and Writer

By way of introducing this paper it is useful to provide some background to the notion of the brain sculpting artist. This is an idea that developed out of reading a neuroscientific paper by Lauren Stuart called 'Do musicians have different brains?'. In this paper Stuart suggests that musicians 'constitute a model, par excellence, for studying the role of experience in sculpting brain processes'(Stewart 2008, p.304)(more on this paper later). As an artist with an interest in the relationship between neuroscience and creative practice this suggestion struck a chord, and led me to consider how the brain itself might come to be seen as a medium that the artist quite deliberately sculpts. While I have now developed this idea in relation to specific aspects of neuroscientific literature I cannot point to examples of artists who are currently working explicitly in this terrain. The purpose of this paper, therefore, is not to establish the notion of the brain sculpting artist as an explanation for current contemporary arts practice, but rather to tentatively lay out what I see as being a potential field of investigation for my fellow creative practitioners.

In this sense my paper can be read as a kind of speculative manifesto intended to provoke thought and discussion and inspire new ways of making art, rather than being a comprehensive description of a field of inquiry. For this reason, in relation to the arguments that I make here I would encourage you to ask - as Brian Massumi suggests in his discussion of Deleuze and Guattari's work - 'not, Is it true? But, Does it work? What new thoughts does it make possible to think? What new emotions does it make possible to feel? What new sensations and perceptions open in the body?'(Massumi 1992). Or, more explicitly, what new possibilities for the framing of art propositions[1] do these postulates of brain sculpting offer?

In order to be more precise in defining the role of the brain sculpting artist it is necessary to consider how recent developments in our understanding of experience-dependent structural plasticity (or the way the brain is reshaped by experience) might allow the artist to deliberately 'sculpt' the neural medium (which I do later in this paper). The question of how the activities of the brain sculpting artist differ from the learning or training that creates the experience-dependent changes in brain structure that occur in the subjects of the studies cited here also needs to be addressed. What I propose in this paper is that the brain sculpting artist be guided by the musical example in which autonomous areas of brain function (fine motor control and audio processing) are joined through a creative practice that reshapes the brain. This will involve creating new forms of creative practice whose aim is to connect other autonomous areas of brain function.

Obviously documentation of the activities that aim to create such connections will be an important aspect of the work of the brain sculpting artist. However the designing of activities that connect autonomous areas of brain function is only the conceptual logic and starting point for the brain sculpting artist and the works themselves may be as varied in their manifestations as contemporary art practice currently is, and will hopefully produce even greater variety. For this reason this is not a manifesto that aims to outline formal characteristics of the works that might emerge from these processes, but rather to sketch out a conceptual logic for the creation of art that directly engages with some of the neuroscientific insights around experience-dependent structural plasticity.

Before I discuss the neuroscience that can inform the activities of the brain sculpting artist I want to briefly outline how this way of making art might be seen as an extension of the performance art notion that the body is the artists material. Kristine Stiles offers us a sense of how performance artists have thought about this subject in the following quotation:

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[1] Here I am thinking of Joseph Kosuth's discussion of the art proposition (Kosuth 1993, pp.29-30)

> The artists who began to use their bodies as the material of visual art repeatedly expressed their goal to bring art practice closer to life in order to increase the experiential immediacy of their work...Emphasizing the body as art these artists amplified the role of process over product and shifted from representational objects to presentational modes of action. (Stiles & Selz 1996, p.679)

Clearly the brain sculpting artist owes a lot to these performance art antecedents. In fact it could be argued that process has even greater ongoing importance to the brain sculpting artist than it does for the kind of performance artist Stiles describes. After all it is only through a sustained engagement with the processes aimed at connecting autonomous areas of brain function that the artist will succeed in reshaping their brain. Which leads us to the question of whether or not the reshaped brain assumes a kind of importance as the product produced by the brain sculpting artist. I would argue that this potential product is far less important than how we use the insights of neuroscience to devise neurologically interesting creative activities that can become the basis of rigorous training. For this reason the move to working with the brain as the medium also requires a shift in our reading of performance. Whereas performance art invites us to consider the significance of the act or process the brain-sculpting artist invites us to consider the significance of the training.

Indeed training is central to the neuroscientific understandings that inform the work of the brain-sculpting artist. It is training, in various forms, that has given us the most significant insights into experience dependent structural plasticity. The effects of training were certainly part of what is perhaps the most famous example in the study of this form of structural plasticity. This study compared the brains of London taxi drivers with healthy control subjects. It found that the training associated with memorizing and navigating through mental maps of the streets of London led to the enlargement of a specific part of the hippocampus, an area of the brain associated with memory and navigation (Maguire et al. 2000).

The training that mathematicians receive has also been studied in order to determine how it changes the brain's structure. These studies have shown 'significantly increased cortical gray matter' in areas of the brain 'which are known to be involved in arithmetic calculations and visuospatial processing'(Aydin et al. 2007). While we would expect the area of the mathematician's brain that works on arithmetic calculations to be more developed, the idea that mathematicians also rely on visuospatial processing is an interesting result, and one that appears to reinforce the notion expressed by eminent mathematicians who tell us that 'abstract concepts feel almost real, to the point that it is as if they exist in the brain and can be manipulated like real objects.'(Phillips 2008). One of the things about the mathematical example that is of interest to the brain-sculpting artist is that there seems to be advantages to working across to two areas of brain function (visuospatial and arithmetic) in solving advanced maths problems.

Studies of the bilingual brain (Mechelli et al. 2004) and the brains of people as they learn to juggle (Draganski et al. 2004) have also demonstrated the effects of experience dependent structural plasticity. While all studies that show how training can shape the brain are useful to the brain-sculpting artist the example of the musician's brain is perhaps the most exciting and relevant.

Here I return to Lauren Stewart's assertion that 'Musicians constitute a model, par excellence, for studying the role of experience in sculpting brain processes'(Stewart 2008). As I hinted at in the introduction the most interesting musical specialization for the would be brain sculptor stems from the fact that playing a musical instrument involves the integration of two relatively autonomous areas of brain activity. The precise movements of the hands and fingers required to play musical instruments lead to refined and specialized functioning of the motor cortex, while the need to closely monitor the sound that is being produced means that the audio-processing areas of the brain are also engaged in a way that is in inextricably bound up with fine motor control.

Perhaps even more profound than this linking of different areas of brain function is that fact that the simultaneous motor and auditory processing involved in playing a musical instrument seems to have benefits for auditory processing over and above training that is aimed only at improving the ability to perceive subtle differences in sound (Lappe et al. 2008, p.9637). Or to put it another way, by training the body in movements that produce sound we are able to fine tune our listening to a degree that isn't possible if we restrict our training to the perception of sound alone.

So why is this important for the brain-sculpting artist? Firstly it suggests the possibility of sculpting brain processes by linking other relatively autonomous areas of brain function. This would involve developing dependent relationships between brain processes that generally function separately. Secondly the musical example we've just considered suggests that the simultaneous engagement of different brain processes could actually help to improve the autonomous functioning of those areas of the brain.

This leads us to consider two distinct ways of working with the neural medium. Firstly the development of specific areas of the brain through a rigorous engagement with certain activities, (as exemplified by the London taxi drivers). And secondly brain sculpting as the connecting of areas of relatively autonomous brain function. As I indicated earlier it is the second of these possibilities that seems to offer a richer set of possibilities for the brain sculpting artist and it is that possibility that is the focus of the remainder of this paper.

Thinking through how relatively autonomous areas of brain function might be linked through training requires an understanding of the anatomy of brain function in relation to specific activities. While a comprehensive description of such an anatomy is beyond the scope of this paper, it is possible to venture a few preliminary ideas regarding how we might use our knowledge of neural systems to speculate on the bringing-together-through-training of autonomous areas of brain function.

We can start this process by building on the musical example in a number of ways. Firstly we can think about potential connections between the auditory processing areas of the brain and those areas that are most active during juggling. In the study cited above the authors state that:

> juggling, and consequently the perception and spatial anticipation of moving objects, is a stronger stimulus for structural plasticity in the visual areas (used for the retention of visual-motion information) than in the motor areas (involved in the planning and execution of coordinate motion... (Draganski et al. 2004)

Here we can begin to speculate on a musical instrument that would be mastered by training our 'perception and spatial anticipation of moving objects' rather than our capacity for fine motor control. Juggling-balls, suitably fitted-out with sensors that register whether the ball is rising or falling and the impact of catching the ball, could become controllers for an audio signal that would make them a musical instrument that would sculpt the brain in a different way to instruments that rely on fine motor control. This would involve creating connections between the areas of the brain associated with auditory processing and those that are activated by our perception and spatial anticipation of moving objects.

Another music-related possibility for the brain-sculpting artist involves working with the fact that singing relies on an area of the brain that is quite separate from the area that we use when we are speaking (Schlaug et al. 2008). This is illustrated by the fact that some aphasic stroke-patients, (i.e. those who have lost the ability to speak), are still able to articulate words through song. Studies have shown singing exercises can help to restore speech in those aphasic patients (Schlaug et al. 2008). A rhythmical tapping of the left hand is one aspect of the therapy that was used in the study cited here. The authors of this study speculate that this tapping might play a similar role to that of gesture in facilitating speech. They also speculate that the tapping might help patients to regain speech in much the same way that a metronome works in therapies aimed at the recovery of other types of motor activity. The question for the brain-sculptor is how the areas of the brain associated with singing and speech might be linked outside this therapeutic context.

One possibility is through the practice of rapping and freestyling (improvised poetry produced in time with a beat). As a highly rhythmical form of language production that exists somewhere between singing and speech, rapping is an activity that might link areas of autonomous brain function while also potentially giving us insights into how rhythm and rhyme affect the way that language is processed by the brain and how this type of language production might differ from the melodic variations of singing and the neural patterns associated with everyday speech. So rapping can be thought of as an activity that not only might link singing and speech but that might also help to create stronger connections between the language centres of the brain and those areas that are responsible for processing rhythm.

The neurological relationship between speech, gesture and the motor system is also potentially fruitful for the brain-sculpting artist. This line of reasoning starts with the identification of the two independent systems for motor control that exist in our bodies. In their paper 'Growth points from the very beginning' McNeill et al. help us to understand these independent systems by describing the case of IW who:

> Due to an autoimmune-induced, large sensory fiber neuronopathy at age 19… was deafferented over his entire body below the neck. With great effort, IW, now in middle age, has reestablished control of his motor system using cognition and vision in the complete absence of proprioception and spatial position sense (see Cole, 1995). If his vision of his own actions is occluded, IW cannot perform instrumental actions. He can, however, without any other sense of what his hands are doing, perform morphokinetically well-formed gestures that synchronize with speech as normal. (McNeill et al. 2007)

From IW's case when learn that, at the level of the brain, there are two separate motor systems; one that controls instrumental action in which 'orientation to specific objects in the world directs action' (McNeill et al. 2007) and another, which we might call the linguistic motor system, that controls speech and gesture. These independent neurological systems are further candidates for brain-sculpting activities that are aimed at bridging relatively autonomous areas of brain function. We might imagine activities aimed at linking our linguistic motor system to our ability to perform instrumental actions. One approach would be to develop our gestural vocabularies in connection with instrumental actions. This would involve developing a greater awareness of gesture so that new gestural forms might develop and become integrated into the linguistic motor system. Studies of the cross-cultural transfer of gesture already indicate it is possible to build our gestural vocabularies (Pika 2006).

While this paper might be a little light-on in terms of concrete examples of a brain sculpting practice, hopefully the examples that I've covered here offer a sense of the possibilities that the brain-sculpting artist might explore. Obviously this paper is in no way represents a comprehensive map of the field but rather it offers a few tentative suggestions for how it might develop. Future investigation in this field will involve working with a more comprehensive anatomy of brain function that will allow practitioners to identify areas of brain function that might be bridged through various types of creative activity. One area of investigation that might be particularly fertile for the brain sculpting artist is around control systems for the creation of sound and visual art. The juggling audio controller described above is one example of a logic for the evolution of work in this field.

Clearly several important questions remain unanswered. One is the role of neurological feedback in giving the artist some sense of how their brain sculpting activities are reorganizing the structure of their brain. Many of the studies cited in this paper use fMFI imaging in combination with a technique called *voxel-based morphometry*. This is a statistical technique that allows researchers to compare the brain anatomy of individuals and groups. We might then imagine collaborations that would allow artists to work with scientists who are well-versed in this technique in order to get feedback on their brain-sculpting activities. These sort of collaborations would obviously be useful for the artist and would hopefully be of some interest to the scientists involved, however, as I mentioned at the beginning of this paper, the development of the field does not depend on collaborations between artists and scientists.

In the absence of such collaborations the neuroscientific literature can still serve as a fertile ground of information for the development of neurologically interesting creative activities. This would be a practice driven neuro-aesthetics that, instead of using neuroscience to account for aspects of the art-historical canon, would be aimed at engaging directly with neuro-plasticity. Operating in this way without fMRI feedback, brain-sculpting would be an almost entirely speculative enterprise. Its success would not be measured in increased grey matter, but rather in the interest generated by the creative activity. Of course there are many examples of art using science as a springboard for speculation without the need for scientific feedback, not the least of which is science fiction and while brain-sculpting has the potential to plug directly into the work of the scientist, there is also the potential for it to develop as a purely speculative enterprise.

In this case a thorough understanding of the anatomy of brain function can be put to use as a catalyst for speculation and creativity that is utterly unfettered. It is important that this paper ends on this speculative note because an openness to unfettered speculation is surely one of the great strengths of contemporary art as a broad discipline. While the positivistic knowledge of science is a great source of ideas and inspiration for the artist, this does not mean that the artist is in the process of becoming scientist. Just as it is the differentiation of various neurological systems that is particularly productive for the brain-sculpting artist, it is also the differentiation between the broad disciplines of science and the arts, in terms of their procedures and goals, that can make their meeting productive and mutually enriching.

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