Thanks for the memories.....?

(Cellular Memory Article for Fortean Times)

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Over the years, *Fortean Times* has published several articles summarising examples of the phenomena generally referred to as "Cellular Memory" **[FT100:12, FT159:24, FT236:18-19]**. These involve people receiving transplanted organs from (primarily deceased) donors and then taking on characteristics of the donor or even having memories that relate to the deceased. Examples include: a woman with vertigo who became a climber; a lawyer who began eating Snickers, having always hated chocolate; a seven-year-old girl who had nightmares about being killed after being given the heart of a murdered child; and a 29-year-old lesbian fast-food junkie who became a heterosexual vegetarian after being given the heart of a teenage girl. Also, a man discovered that he had inherited some personality traits from his wife, such as liking baking and shopping, after she had donated a kidney to him. Some academics have developed theories to explain the phenomena, which it is claimed can affect at least 10 per cent of all people who have a heart, lung, kidney or liver transplant, although mainstream medicine remains sceptical **[FT236:18]**. In essence the theory is that memory does not sit only in the brain, as most materialists would argue, but it somehow permeates the whole body.

If you were to think that scientists would have researched these phenomena then you would be correct; but the history involved serves up much food for thought. It was towards the end of the 1950s that Dr James McConnell performed a series of experiments at the University of Michigan, seeking to demonstrate that memories could be stored in cells outside the brain. These involved common freshwater flatworm, *Dugesia dorotocephala*, which like mammals, and unlike creatures such as jellyfish, have a centralised brain. They are also able to regenerate themselves from tiny morsels of flesh: if you sever a flatworm's tail, within 14 days you will have an entirely new specimen, fully equipped with a brand new brain! Also, flatworms can be trained to remember a behaviour and perform it on cue; for example, electrical shocks can be used to teach them to respond to lighting cues by moving to a particular part of a petri dish. Therefore, if McConnell could demonstrate that flatworms could recall their training after their heads were cut off, and their brains grown anew, this would show that memories could live outside the brain.

And this is exactly what McConnell did find. He stated that "the tail regenerates", and "showed as good a memory of the original task as did the heads." His research was published in the *Journal of Comparative and Physiological Psychology*, a highly regarded psychology journal; which resulted in mentions in *Time, Medical World News, Newsweek,* and *Fortune*. Adding his charismatic personality to these perceived scientific accomplishments, he appeared on several TV programmes, notably *The Steve Allen Show*. Instead of dazzling audiences with complicated science, McConnell captivated them with awe-inspiring concepts[1].

McConnell hypothesised that a form of Ribonucleic acid (RNA), which he called "memory-RNA", was the means whereby long-term memories could be stored outside the brain: since RNA encodes information, and since living cells can produce and modify RNA in reaction to external events, it might also be used in neurons to record stimuli[2]. To test this McConnell fed ground-up bits of trained flatworms to their untrained brethren; hence this work being referred to as "the cannibalism experiment". McConnell claimed to find that the untrained flatworms performed behaviours

previously learned by the trained flatworms, i.e. the dead flatworms' memories had transferred to the untrained flatworms.

Unsurprisingly such spectacular research attracted the attention of competing universities, which sought to reproduce his study; as is appropriate to the scientific method. Whilst some reported obtaining similar results, the majority did not, with many (rightly) faulting him for his small sample size. They also argued that although the effect he reported was significant, it was also relatively weak. McConnell responded that other scientists had failed to reproduce his findings because they were unable to fully recreate his experimental conditions[1].

Ultimately, McConnell's work was cast aside, considered to be a failure; perhaps an example of Charles Fort's observation that things in science are nothing more than the proper thing to wear for a while? Even so, it remained to some degree in public consciousness. For example, the wonderful Alan Moore used it as a plot device in Saga of the Swamp Thing #21: believed to be dead, an autopsy on the Swamp Thing establishes that scientist Alec Holland did not turn into a plant mutant, but swamp vegetation had digested the mortal remains of Holland. It had absorbed his mind, memories, knowledge, and skills to create a new sentient being which believed itself to be Alec Holland[3]. Later in life, in 1985, McConnell was the target of Theodore "the Unabomber" Kaczynski's 10th bomb, surviving the explosion with mild hearing loss. He was one of the apparently random victims across the USA, but it is interesting to note that Kaczynski was a student at the University of Michigan while McConnell was undertaking his memory experiments[1]. McConnell died from a heart attack five years later at the age of 64.

Recent Developments

McConnell's research proposed a chemical transfer theory which goes against current and past conceptions of memory; hence, in part, the scientific community's rejection. Yet Science cannot offer conclusive evidence about exactly how memories ***are*** stored. Currently, when discussing the underpinnings of memory, researchers are unlikely to go further than saying information is stored in the brain's neural networks, in the connections that enable the transmission of information from one neuron to the next. There is no specific answer to how memories are encoded and decoded in the brain, and some researchers prefer to focus on the sorts of modifications taking place in the brain when memory is stored, such as changes in neuron structure, so they might reverse-engineer memory formation. But this is not the same as establishing how memory is encoded, or where it is stored[1].

The publication of a paper in the *Journal of Experimental Biology* in 2013 by Tal Shomrat and Michael Levin, from Tufts University, re-opened the whole debate[4]. Levin, a developmental biologist well known for his work on limb regeneration, stumbled upon McConnell's work and decided to try out the first memory experiment as a side project, utilising the same basic principles. Levin was familiar with the considerable literature on aneural organisms — organisms without a brain to begin with – that can learn. Some, such as plants, single-cell organisms and even sperm, can learn to run mazes. Therefore, he thought McConnell might have been at least partially right. Levin devised a simple training protocol and, critically, minimised human participation by using a fully automated process, thereby protecting his results from the scrutiny McConnell faced. The outcome was results that appeared to bear out McConnell's findings. Levin was completely transparent, being prepared to make available the tracking data and Quicktime movies to other researchers for them to analyse

themselves. However, he has yet to determine the mechanism behind his findings. He hypothesises that memories could spread beyond the brain because of electrical charges generated by cells in the rest of the body. Unsurprisingly the response from the science community was mixed, and the historical baggage from McConnell means that the bar for acceptance will be set that much higher[1]. McConnell argued for attention to be paid to those unusual things on the fringes of science that can disrupt the current way of thinking, and therefore arguably had a lot in common with Charles Fort. So if it transpires that Levin's work is reproducible and does ultimately gain acceptance, then might McConnell's reputation be revised to that of a pioneer?

Some Final Thoughts

I am no biologist but reading what I have about McConnell's research it appears to me that he might have been on to something in his first memory experiments, as Levin may well have shown. But his later memory experiments, feeding ground-up bits of trained flatworms to untrained flatworms, were a "bridge too far". The most obvious difference between the two is that the former involved flatworms that continued to live after their head was removed, while the latter involved flatworms that were dead and very mashed. Researchers most often iteratively build upon previous research, seeking to establish scientific breakthroughs and boundaries. What must always be hard is when they go past a boundary and the research does not "work" (i.e. have successful/ publishable results) for whatever reason. This is the situation I think McConnell found himself in, and his hubris, celebrity and perhaps self-delusion, caused him to publicise the results nevertheless.

This brings me back to the "Cellular Memory" examples that I quoted at the beginning of this article. All involved living organs, even though some donors may have been technically dead. This means that there is more in common with Levin's and McConnell's first memory experiments, and nothing in common with McConnell's later memory experiments. Therefore Levin could be pointing towards where an explanation for the phenomena will be found, but I suspect that this will be many, many years in the future. My final thought is, in some future sci-fi universe, where brain transplants become commonplace, is the brain being donated to the recipient, or is the body of the recipient being donated to the brain? And will the brain donor's memories become those of the recipient with none of the recipient's memories retained?

1,564 words

REFERENCES

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3 https://en.wikipedia.org/wiki/Memory_RNA

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