The Woman Who Changed her Brain: Unlocking the Extraordinary Potential of the Human Mind by Barbara Arrowsmith-Young. London: Square Peg, 2012. ISBN 9780224095181. New York: Free Press, 2012. ISBN 9781451607932. 268 pp. Kindle e-book. ISBN 9781451607956.

This book describes the difficulties experienced by Barbara Arrowsmith-Young of growing up with severe learning difficulties; the means whereby she found the techniques, not to live with those difficulties, but to actually address and resolve them; and how she has brought those techniques to children and adults through her 35 Arrowsmith Schools now established in various parts of Canada and the U.S.

Barbara grew up in Peterborough, Ontario, where for the first 26 years of her life, she "lived in a fog." She could make no sense of the relationship between the hour and minute hands of a clock, so could not tell the time. She could not add or subtract double-digit numbers; had difficulty reading; got the wrong words for common objects; could not tell the difference between the right and left hands; was accident-prone; kept getting lost; and could not tie her shoelaces.

Barbara could however remember (parrot) accurately the 9 o'clock news and was evidently gifted with a remarkable memory and sense of determination. These abilities got her through school and university. The change came in graduate school when she happened across Alexander Luria's 1972 classic *The Man with the Shattered World: The History of a Brain Wound* which described the cognitive deficits of a brain-injured soldier from WWII. Barbara identified with the soldier among whose difficulties was the inability to tell time following his brain injury. Around the same time she came across some work by Mark Rosenzweig (Rosenzweig, Love, & Bennett 1968) which demonstrated that the brains of rats could physically change in response to stimulation. If it was possible for rat brains to change, then maybe it was possible for human brains to change also.

She created flash cards with pictures of clocks and studied every day for up to twelve hours each day, gradually making the tasks more complex (like adding second hands and day hands) and demanding faster response. She does not say how long she worked at this but it appears to have been several months. Eventually the fog cleared, she not only could tell time but points of logic, grammar, and math now made sense. Now she could suddenly understand, not merely parrot, the TV news programs.

Not all her difficulties were resolved by the clock exercises, so she developed new cognitive exercises to address each difficulty in turn based on knowledge of the functional anatomy of the brain. These exercises are now routinely used in the Arrowsmith program.

Since individual parts of the brain are involved in multiple activities, a defect in one part may have multiple consequences. Therefore, the first step is to isolate which part is causing the manifest difficulty through psychological testing. These component cognitive deficits are described on the Arrowsmith website (Arrowsmith 2012) and in the book. There is sufficient detail that it would be possible to isolate which of the 19 brain functions isolated is in deficit for a relative or acquaintance, though probably not as accurately as with the formal tests.

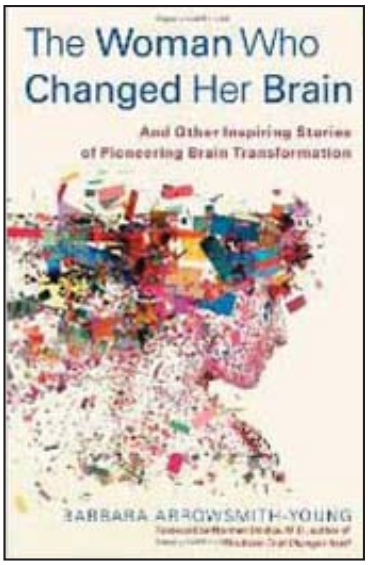
For example, the facility for "motor symbolic sequencing" is involved in reading, writing, and speaking. People with impairments to this facility often misread texts, their handwriting is poor, and copying text is slow and inaccurate. Spelling of the same word can vary from instance to instance. They often make apparently arithmetical errors but in reality they are making motor errors due to thinking the right answer but writing another. In severe cases they may have difficulty communicating ideas because they ramble and leave out much information, making it difficult for others to follow.

There are some hints also of the kind of exercises that could resolve the various difficulties, but clearly attendance at one of the Arrowsmith schools is advised.

One of the exercises for the above symbolic sequencing deficit is to trace Chinese (or other foreign) characters with the right (dominant) hand while wearing an eye patch over the left eye. The idea is to stimulate the left supplementary motor area responsible for eye–hand coordination. The several motor symbolic sequencing disabilities mentioned above tend to resolve without being directly addressed.

The exercises are arranged in sequence to gradiently address the difficulty. The tasks must be neither too easy nor too hard so that the student has to, and is able to, make a conscious effort to engage with the task. Once the difficulty is resolved, the change is permanent.

The average student is usually enrolled for 3 to 4 years, but progress is maintained through the period so if a student is unable to complete the three-to-four year program, they nevertheless benefit for every year they are in the program. In one study (Lancee 2005) of 79 students aged between 5 and 19 (average 11) who were assessed on 15 standard educational attainment tests for reading, writing, comprehension, and arithmetic, 29 had between 1 and 7 scores below the 25th percentile, the lower end of the normal range. These students were considered to have the *least* severe learning difficulties. The average attainment in this group was at the 15th percentile at entry but after one year the average was at the 41st percentile. Even the 10 most severely affected students at intake (all 15 test scores below the 25th percentile) with



average attainment at the 5th percentile had average attainment at the 25th percentile after 3 years. Age, gender, and IQ do not evidently affect the rate of progress significantly.

It must be stressed that these cognitive exercises are not the same kind of thing as the computerized "brain-training exercises" that are the current fad and evidently form the basis of a multi-million dollar industry. A six-week study (Owen et al. 2010) of 11,430 participants who "brain-trained" several times each week showed that there was no evidence that the training led to any improvement in untrained tasks or any general improvement in cognitive functioning. Improvement was observed on the specific tasks trained only. Evidence that some exercises aimed at "surface abilities" over a six-week period are ineffective is not evidence that some exercises aimed at specific "atomic abilities" for several hours per day over several months to several years are not effective.

Cognitive learning difficulties can lead for those affected to social isolation and exploitation, thus compounding their difficulties. Emotional and arousal problems that may arise through this mechanism are not addressed by the Arrowsmith program. Of course emotional and arousal problems can occur through psychosocial mechanisms in those not affected by learning difficulties. A wholly different approach to these appears to be needed.

What is interesting about the efficacy of these cognitive exercises is what they say about the philosophy of mind. Since they are based on an understanding of the correlations between brain anatomy and brain function, they may seem to give physicalists no cause for concern and even vindication of their "mind is brain" stance. But as we are constantly reminded, "correlation does not prove causation." The puzzle in philosophy of mind is how physical processes can give rise to consciousness. There have been numerous "solutions" to this puzzle, including the idea that consciousness has no causative powers and influences the workings of the body (and brain) with the same power as "the steam-whistle which accompanies the work of a locomotive engine . . . without influence upon its machinery" (Huxley 1912). This stance known as "epiphenomenalism" is

commonly held in some philosophical (Pauen, Staudacher, & Walter 2006), neuroscientific (Soon, Brass, Heinze, & Haynes 2008), and psychological (Wegner & Wheatley 1999) circles. It is flatly contradicted by the fact that the Arrowsmith exercises are done with *conscious* effort. It may not be psychokinesis, but the evidence is that the brain is changed by the continued effort of a conscious mind. At least that is the simplest and most direct explanation.

The Arrowsmith program deserves to become known and applied worldwide. I hope the organization Barbara Arrowsmith-Young has put together will be able to cope with the demand and the inevitable criticism and conflict that will follow.

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