



Review for Cognitive Systems Research of the book *The Brain and AI*, by authors Karl Schlagenhauf and Fanji Gu

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Abstract

The human brain is often considered the most complex system known. It has a fantastic capacity to learn and remember, to recognize patterns in space and time, solve problems of all kinds, innovate tools and machines, create beautiful art and science. Is it reasonable to believe that we, in a foreseeable future, will be able to understand all the wonders of our own brain, enough to be able to mimic it and build artificial brains and minds that correspond to or even surpass the capacity of the human origin? Can we seriously believe that we (soon, or ever) will be able to build robots that know of and can reflect upon their own existence?

This review of the book, *The Brain and AI*, deals with such issues, but in a very special way. It is written as a fascinating dialogue between the two authors, Chinese scientist Fanji Gu and German engineer Karl Schlagenhauf, where they discuss the development of neuroscience and artificial intelligence (AI) with a critical examination of given “truths” in these fields. *The Brain and AI* is indeed worth reading for many reasons, regardless if you are a student or researcher in any of the many fields of science discussed here (e.g. physics, computer science, neuroscience, cognitive science psychology, social science), or if you are just interested in the current and future development of brain research and artificial intelligence. The book is both educating and entertaining and can be strongly recommended.

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1. Introduction

The human brain is often considered the most complex system known. It has a fantastic capacity to learn and remember, to recognize patterns in space and time, solve problems of all kinds, innovate tools and machines, create beautiful art and science. Is it reasonable to believe that we, in a foreseeable future, will be able to understand all the wonders of our own brain, enough to be able to mimic it and build artificial brains and minds that correspond to

or even surpass the capacity of the human origin? Can we seriously believe that we (soon, or ever) will be able to build robots that know of and can reflect upon their own existence?

Indeed, it seems that almost everybody today is talking about and has an opinion on artificial intelligence, AI. Either hoping such systems will solve all kinds of problems that humans can, or currently can't solve, or fearing that AI will soon take over and make humans obsolete, or both. Some enthusiasts even believe AI systems eventually can become conscious and have a will of their own, an own agenda. How realistic are these hopes and fears?

Having been involved in computational neuroscience for over thirty years, I've often been thinking about these and

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related problems, and lately focusing on what is required to have consciousness and free will. I therefore gladly accepted the invitation to review the book, *The Brain and AI*, which I had heard about for some time, but had not found time to read yet. Now, this gave me a good opportunity to do so, and I surely didn't regret my decision. It was like reading a thrilling science fiction story, or more accurately, taking part in an extremely interesting dialogue between two highly informed and competent experts in their respective fields, Chinese scientist Fanji Gu and German engineer Karl Schlegel (from now on referred to as just Karl and Fanji).

2. General comments on the book style and structure

The Brain and AI is unique in many respects. Perhaps the most unusual and fascinating aspect of the book is that it is based on the email exchange over five-six years between two authors from quite different backgrounds and cultures, who have never met physically. In fact, the book consists almost entirely of their numerous and long emails (which inevitably had to be somewhat edited to fit a book). Sometimes there are several weeks in between letters in their feedback loop, as if they seriously considered the letter sent by the other and carefully planned for their response (which they probably did). Through this process, a true friendship seems to have developed, apparently based on mutual respect and understanding, and sharing a genuine curiosity.

The book is a social adventure with two young (in their minds), but experienced gentlemen explore a multi-dimensional space, trying to find their way through a myriad of facts, theories, and wild ideas. The authors compare themselves with small children who are curious and ask naïve but sincere questions, which people in general wouldn't do. In order to give a taste of the witty and humorous style of the book, I will in this review frequently quote the authors when appropriate.

Karl and Fanji themselves refer to their interaction as a *discussion*, but I think it is rather a good example of an excellent *dialogue*. For example, Fanji says that, "Discussion, especially with a smart friend, is the best whetstone to sharpen one's mind. Many puzzles become suddenly clear. Some ideas, which one has never thought of, would come to one's head during discussion." To me, this seems to better fit with *dialogue*, which is often considered to be more explorative, by integration, than a discussion, which typically aims at examining a topic by breaking it up in parts. A good dialogue is characterized by mutual respect, a willingness to give and receive, and a readiness to change your mind. Above all, a dialogue can be seen as a cooperative search for understanding and meaning, which may provide new insights to everyone involved. I think the book is like a handbook for this kind of dialogue.

In addition to an exchange of facts and theories, the dialogue in this book is spiced up with a great sense of humor that both authors share. They could say something like, "I

cannot exclude the possibility that I am totally wrong", or "I was impressed by how many things I didn't know or forgot", or "No goldmaker can fool Fanji, neither Markram nor Kurzweil. I'm proud of you again, my dear friend".

In the beginning of their email exchange, the frequency of letters was quite high, with typically 1–2 days between, but towards the end the letters tend to come less frequently, with typically 1–2 months in between. All emails are quite long, much longer than what is common, and more like old-fashioned letter conversations. Both Karl and Fanji are all the time very polite, and often start their letters by quoting the other's main point(s), which they then comment on. A typical starting phrase in the letters could read (Fanji): "Thank you very much for your detailed reply and kind words. I completely agree with every point you mentioned in your mail", or (Karl): "Thank you for your beautiful letter and your kind words. Well, I have to tell you that it is sheer fun to follow your hints and questions which always contain so much wisdom and add new perspectives. Without you I would never have taken the effort to immerse myself in all those thrilling matters you've been drawing my attention to or to formulate ideas I was dealing with for quite some time."

Also the ending of the letters are often full of polite or even "childish" humor, such as: "I am also looking forward to hearing your story about your meeting with (Popper, 1976) and Korzybski, a little similar to the king in the *Stories from the Arabian Nights*", or in another letter: "Oh! You are really a modern Scheherazade, who always reached the most interesting point when daylight came and asked the Sultan if he wished to know the end of the story. Of course, he wished! Although I am not the Sultan, and you are not Scheherazade, please do tell me the other half of your criticism!"

The Brain and AI is divided into three parts (which each could be a book): I. *Brain Research, a New Continent to be Explored*, II. *Mystery of Consciousness and Myth of Mind Uploading*, and III. *The Third Spring of AI*. The 62 email letters are listed as 31 pairs, with ten letters in each one of the three parts. The pairing is somewhat artificial, because it is more like a continuous stream of letters, flowing like a meandering river through a landscape of neurons and computer chips. However, in the Introduction there is a very helpful guide for readers, where all the letters are grouped (again somewhat arbitrary) into five main topics: 1) Scientific Methodology, 2) Open Problems in Brain Research, 3) Disputing Problems in Artificial Intelligence, 4) The Mystery of Consciousness, and 5) Big Science Plan. In this way, it is easy to find the letters which are focusing on a specific topic, even if they also contain many other things.

3. Comments on the content

Even if *The Brain and AI* is mainly about the development of neuroscience and artificial intelligence (AI), primarily with a critical examination of given "truths" in

these fields, it also addresses many issues in science and technology in general, as well as commenting on political and social developments in Germany, China and elsewhere. Indeed, the title of the book could well have been *The Brain and All*.

The main theme throughout the book is the criticism of the strong claims and promises with regard to AI that are given by (some) researchers in the field, and by the European Human Brain Project (HBP) in particular. In fact, it was when Fanji read about the claim that this HBP would create an artificial human brain model within ten years - “down to the level of ion channels, or even molecules, up to the level of consciousness” - that he became very skeptical. He started to investigate rather deeply the background and scientific-technological developments that (im)possibly could lead to such a result. It was also with these doubts Fanji first turned to Karl, with whom he had got in contact through their common friend Hans Braun.

It was soon obvious that Karl shared Fanji’s well-founded skepticism against the hype of AI, where promises as well as worries seem far too exaggerated. For example, Karl responding to one of Fanji’s letter says: “I can say that your inbuilt skeptical Fanji-mode not to buy into every kind of bullshit because it’s published in great magazines or by great names is a good x-ray method to inspect the emperor’s new clothes. You were right with your critical attitude against the HBP and I think you are right again with your skeptical view on all those brain-like technical phantasies. I would even go further and say that it is much worse than you have suspected. The gap between a) pretention and promises and b) real performance is just ridiculous.”

The authors give several arguments for their skeptical view, in particular that we still do not know enough about the brain and its processes to make an adequate model of it. For example, we do not yet know what the basic element of the brain is (the neuron, the synapse, the ion channel, the neuronal assembly, or the micro-column or hyper-column), or maybe there is no universal basic element at all. To choose the appropriate basic element depends on the context, and in particular when exploring the mind, we don’t have a clue. We don’t even know what kind of coding is relevant. Perhaps the nervous system uses different coding schemes for different situations? The firing patterns may not carry all the information, but instead other factors have to be considered, perhaps involving the entire nervous system. The complexity of the human brain is usually underestimated in any attempt to describe or make any useful models of it.

In the first part, but actually throughout the whole book, Karl and Fanji give a fascinating account of the history of brain science and AI research, but also of the philosophy of mind. This history is characterized not only by successes, but also by a series of disappointments, often because of too high expectations. The authors also discuss specific matters, such as different kinds of learning and memory (human and computer), the scientific history and

what today is known about various memory mechanisms and functions, and how they are modeled.

The authors often cite or refer to many more or less famous scientists, inventors, or philosophers with quotations, which they also comment upon. (I have myself met many of the cited people personally, and I can easily, with some amusement, relate to the stories Fanji and Karl tell). One of their (and my) favorites is neuroscientist Walter Freeman, whose work on cortical neurodynamics (Freeman, 2000), as well as his ideas on the action-perception cycle, intentionality and meaning (Freeman, 1999a,b), both authors appreciate and praise. Actually, Fanji had known Freeman for a long time, and introduced his work and ideas to Karl, who then exclaims: “I generally find Freeman’s view very refreshing. . . . And here he comes to the conclusion that the whole idea of the brain as an information processing machine is wrong and misleading. He says (again) that this idea was imported by computer people and logicians and that the discipline of mind-research is confused since this wrong perspective became the paradigm. . . . I’m not sure whether his alternative to ‘information’ as the mind’s currency which he postulates as ‘meaning’ is the ultimate solution to the problem. But in any event, I can say that your friend Walter has changed my point of view in a field where I believed to be on safe ground.”

Another time, Karl expresses his appreciation of Fanji’s description of Freeman views on various brain-mind issues: “You gave an excellent and crisp interpretation of Freeman’s position about how the brain deals with perception, meaning, expectations, and intentions. Actually, it’s the best and clearest I have seen anywhere! To me, he gets closest to the problem among all the authors I have read so far.”

Of course, Karl and Fanji also refer to many other scientists and experts, even those they think are not so smart. For example, they give several examples of how people have over-estimated the capacity of the artificial systems of the time, often with promises that in a few years (sometimes decades), the artificial systems (or AIs) will be as powerful as a rat, a cat, or even a human brain. One example is when the so-called Perceptron was presented in the late 1950s by New York Times as, “*the embryo of an electronic computer that [the Navy] expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence.*” Another quote is from the AI guru, Marvin Minsky, who in 1970 declared: “*In from three to eight years we will have a machine with the general intelligence of an average human being.*” (Minsky 1970) This was about 40 years before the similarly bold HBP claim was given, and not much had happened in between that could make such a prophetic claim more likely to become true.

One of the negative consequences of exaggerated enthusiasm and promise making, is that it results in disappointments and halted funding when science and technology can’t deliver. The authors refer to several “AI winters” in the past, and concludes: “the most efficient way to spoil

the reputation of a scientific field and lead it to a cold winter is to wildly exaggerate the power of this field or give unrealistic magnificent prospects.”

I think this historical outlook should be a good lesson to scientists and funders regarding the current hype with AI. A little modesty and realism in their claims and prophecies wouldn't hurt (and would probably avoid eventual embarrassment and disappointment later on), but modesty is not the strategy used in the race for grants and government money. Or, as the Karl and Fanji state in the book: “In hindsight, everybody who was bold enough to put a date on such AI-promises over the last 30 years actually made a fool of himself.”

The main criticized figure in the book is Henry Markram. Like detectives, Fanji and Karl have dug up the background of Markram's approach to the EU - in particular regarding his earlier project, *The Blue Brain Project* (Markram, 2012), and his clash with IBM - with the idea of HBP, which he eventually came to lead (Markram et al., 2015). No doubt, Markram has been an excellent salesman for his scientific projects, and the successful marketing process could well be extended to other areas of global/EU/US/China policies and investments. But warning signals should be taken seriously.

In addition to criticizing Markram and the HBP for promising too much, Karl and Fanji are very critical to Ray Kurzweil and the prophecies made, particularly in his book, *The Singularity is Near* (Kurzweil, 2006) and others (Kurzweil, 2012). The “singularity prophecy” says that some day (soon) humans will be outsmarted by their AI systems, and this is also a central issue discussed and dismissed throughout the book. The authors regard it as mere science-fiction (and unlikely to happen, at least not within the time frame given by Kurzweil, who has been hailed as a guru). Karl expresses this clearly: “It isn't difficult to see the similarity between Kurzweil's singularity message of technical salvation and the biblical promise of Moses leading his people to the promised land of milk and honey”, or elsewhere, “Kurzweil wants his readers to believe that everything in the world can be calculated if you only have the right algorithm. Actually, many people do believe this and I have the impression that the less they understand about natural sciences and math the more they seem to believe in this myth.”

In general, the authors are skeptical towards all Big Science, which usually costs a lot of money. They argue that funding of (young) individuals or small groups often could be more successful in solving problems of AI and the like, and give examples from garage inventors, such as those of Google, Facebook etc. Pouring Big Money into Big Science doesn't necessarily lead to Big Progress in neither science nor technology.

Karl and Fanji again and again come back to the general criticism, that the tasks to explore and describe the brain and its functions, and to develop a brain-like, or even a “brain inspired” (a word which Fanji prefers) intelligent machine are quite different. Their main idea is that you

don't have to understand the brain or human intelligence in order to build powerful artificial intelligence. Technology can sometimes benefit from being inspired by biology, but doesn't necessarily need to copy it. A typical example discussed is the development of airplanes, as partly inspired by birds and their wings, without copying the flying behavior of birds.

In the second part of *The Brain and AI*, the authors discuss an(other) interesting book, *Conversations on Consciousness* by Susan Blackmore (2005), where she interviews 21 leading scientists and philosophers on issues relating to consciousness. Fanji and Karl discuss the different answers given there (regretting that Walter Freeman is not among the interviewed), and are not satisfied with any of the answers given to the important questions. Yet, about half of the interviewed scientists/philosophers seem to agree with Fanji that the special difficulty with consciousness studies lies in the subjectivity and privacy of consciousness. Historically, scientists have only studied *objective* phenomena, using a third person perspective, and any subjectivity had to be avoided. However, in consciousness studies, subjectivity itself becomes the topic to be studied, and hence, some of the interviewed thought the available theories could not solve the mystery of consciousness, and that new theories should be developed. The other half of the interviewed scientists/philosophers denied that there is any “hard problem” to solve, and that consciousness is no different from any other problems in science.

Both Fanji and Karl seem to adhere to the rather common view that consciousness emerges from brain activity (and hence, they are skeptical towards panpsychism and similar ideas). The big question, which the authors don't discuss very much is whether this emergent phenomenon also could have causal effects on the neural parts at lower levels of the (nervous) system organization. This rather controversial issue of downward causation seems to be necessary if there could be any free will, which the authors discuss to some extent later on. It is also a problem to see how an emergent phenomenon could also be irreducible, as suggested.

Fanji's conclusion is that computer simulation may help us to shed light on the brain mechanism of behaviors or some observable functions, but that it can't explain how subjective experience emerges from objective processes. There is no way to confirm that any program run on a computer is having subjective experience, even if it could declare it had.

Karl is perhaps more optimistic about the technological advancements, and is convinced that engineers will outperform natural scientists and will build more intelligent machines much faster than biologists will comprehend the functioning of the brain, especially such complex phenomena as consciousness. Karl believes that technical progress is developing at an exponential rate, while progress in biology and understanding the brain is only linear.

In the third and final part of the book, the authors go through the current state of AI research, in particular in the US and China, and its possible development in the near future. Despite their general skepticism apparent throughout the book, the authors give some final positive remarks about AI systems, which seem to have advanced faster than and beyond what they initially believed. Actually, Karl and Fanji are more impressed with the advancements regarding image/pattern recognition and language translation than with computer games, or problem solving in general. However, they don't think "machines" will understand (e.g. a translation, or anything else) in a foreseeable future, if ever. While they both believe that mind-uploading is very unlikely, and that any "singularity" (i.e. that AI systems become smarter/more intelligent than humans) is not near in time, they (in particular Karl) do not rule out that it might happen in the future. However, Fanji thinks it is questionable if any artificial system will ever have a will of its own, and even if we would know how to implement it (which we are far from), there seems to be no reason to try to create such a system.

Indeed, the question is if even humans have a *free* will. I was actually quite happy to see that Fanji and Karl also have a discussion on free will, which is a topic that has interested me for many years (in particular lately as I'm now working on this in an international collaborative project, the *Neurophilosophy of Free Will*, www.neurophil-freewill.org). Fanji quotes Samuel Johnson, who Susan Blackmore mentions in her book on consciousness: '*All theory is against the freedom of the will; all experience is for it.*' For Fanji, and many others, free will is the ability to choose between different possible courses of action unimpeded, but then the question is whether such choices are conscious or unconscious, a problem which is in focus of our own current research project. Again referring to Walter Freeman's view on the topic, Fanji believes that the complex neurodynamics of the brain, involving circular causality in a continuous action-perception cycle, provides a possibility for free will, even if some of it is also unconscious. With reference to complex hierarchical systems, where "different laws may hold for different levels", Fanji considers free will to be an emergent property, apparently similar and related to consciousness.

Karl seems to agree with all of what Fanji says about free will, and stresses (which is also my own view) that the experiments Benjamin Libet (Libet, 1985) carried out in the 1980s, with small movements of a finger, is far too simple to say anything about free will. He expresses this as, "Planning a career or a marriage is a different kind of game than lifting a finger or pressing a button after a signal is given." In addition, Fanji points out the important aspect of a *social* dimension to our individual free will, which is often ignored by neuroscientists. I agree and believe this aspect needs much further consideration and research.

The last letter in the book is by Karl and ends with an optimistic view on the future, where he believes both he

and Fanji, and the rest of the world, can be hopeful and curious about what "wonders the young generation will surprise us with."

4. Summary and concluding remarks

Having read the entire book rather carefully, I can conclude that it has given me both great joy and new insights. Also many new details regarding the background and circumstances around the European HBP and similar huge projects in the US and China, as well as many other interesting things. In short, I have learnt a lot from *The Brain and AI*. In this review, I have only been able to give a few glimpses through my comments and reflections on central themes in the book, but hope it anyway can give some justice to the authors' intentions with it.

I found only very few flaws in this book, but in order not to sound exclusively positive, there are a few issues, which I'd like to bring up with the risk of instead sounding extremely pedantic:

- (a) The book lacks an index and a list of references, and a few pictures or figures wouldn't have hurt either. It would also have been useful with the name of the author (Fanji or Karl) on top of each page, to easier see who says what, since it isn't all the time easy to see, if you browse through the book, as you are bound to do - probably several times - even after you have read it. The style and wit of both authors are so similar so it is sometimes hard to distinguish between the two.
- (b) I think it is quite appropriate to compare the discussion/research on life and consciousness, but to say that the problem of life is already solved, as the authors assume (p II:91), is not correct - far from it. We have some knowledge about what characterizes living systems, but we don't know what life is, and not even how the first cells came about.
- (c) In many places in the book, the human brain is called a "machine". Actually, Walter Freeman emphasized that the brain is not an information processing machine, but rather a meaning creating *system/organ* - not a *machine!* - as is stated in the book. I don't think Freeman ever called the brain a "machine", or at least, he didn't think it works like a machine, that just follows predetermined and mechanistic rules. In fact, the machine metaphor, which has been used for humans and other biological systems since Descartes, is inappropriate and misleading, and should have been abolished long ago. Also John von Neumann (who is quoted in the book, page II:141) emphasized that the brain is not a machine, where algorithms are calculated, and that it is not a digital device but an analogue one (Von Neuman, 1958). Indeed, the whole discussion in the current

book seems to support a view of the brain as non-machine like, so the usage of the machine concept for the brain is somewhat confusing.

- (d) The statement (page I:84), “. . . now we know from experiments that action is often a few hundred milliseconds ahead of feeling”, is probably referring to Libet’s experiments on the readiness potential, which appears about 500 ms before a feeling of agency, but that is not the same as to say that action precedes feelings. If it refers to the reflex of moving e.g. a hand from a hot stove, before you actually feel that it hurts, it is not an “action” in a normal sense, it is just a muscle movement.
- (e) The authors often use the word ‘complicated’ (about the brain) rather than ‘complex’. There is a difference between complicated and complex, which is not made clear in the text (e.g. on page II:12). A system can be very complicated while not complex. A complex system (usually) have emergent properties and behavior, which cannot be calculated or predicted with the precision you can with a complicated system, given sufficient computing power.
- (f) There is a statement (page II:12), that “we know the human brain can emerge consciousness. As for other species, primates or even vertebrate animals may be conscious, parrots and crows are likely, but insects are not.” First, I would say that we don’t really *know* that consciousness *emerges* from the activity of the human brain, even if it is a fair assumption. Secondly, most scientists would probably agree that mammals and birds are conscious, and most likely other vertebrates, but it is more doubtful with regard to invertebrates, such as insects, even though several scientists, including Walter Freeman, do argue for consciousness also in at least social insects. Since we don’t really know what consciousness is, it is hard to say anything about it in any species, or when in evolution it first appeared. (This is one reason why some turn to panpsychism as a possibility, meaning some kind of consciousness is everywhere).
- (g) The authors argue *against* the scholastic approach, but I think they might have missed an important aspect of this approach, which places a strong emphasis on dialectic reasoning, rigorous conceptual analysis and a careful drawing of distinctions. A topic is often broached in the form of a question, where the opponents’ responses are given, a counterproposal is argued and the opponents’ arguments rebutted. This, I believe, is in line with the approach in the current book.
- (h) A little surprising, there is no mentioning of Roger Penrose and his criticism of AI, although he already in his 1989 book, *The Emperor’s New Mind* (Penrose, 1989), discussed many of the issues raised in the current book. Penrose’s main criticism with

regard to AI and conscious artificial systems, is that consciousness is a *non-computable* process. The only time when Penrose is mentioned in the book is when the authors (on p. II.69) quickly dismiss Penrose’s and Hameroff’s ideas on quantum theory and consciousness, which has been much debated in the literature. Unfortunately, many people think this is the main point made by Penrose, while instead he used this as a possible(?) example of a non-computable processes. Another scientist that I miss in the book is Max Delbrück, “the father of molecular biology”, whose book, *Mind from Matter?* (Delbrück, 1986) touches upon many questions that is dealt with by the authors, in particular with relation to life and mind, and their origin(s).

In addition to the points raised above, I also feel that the authors are maybe a bit too critical and skeptical to the possibilities that computational methods can give any interesting insights in how the brain works. For example, it is stated (on p. II:56) that, “The only thing artificial neural networks have in common with the neural nets in our brain is the naming”. As the authors also recognize, models, computational or not, are simplified representations of the real thing or process, and so with artificial neural networks. Even Walter Freeman, and many others (including my own group) have been trying to mimic the structure and circuitry of various brain areas, including different types of inhibitory and excitatory neurons and their interactions, that result in a neurodynamics, which resemble what can be seen with e.g. EEG (Freeman, 2000, Liljenström, 2012). This dynamics can then be related to certain functions, such as associative memory, perception, or volition. Certainly, with many free parameters you can simulate almost anything you want, but if (almost) all parameters are constrained by experimentally measured data, computational models may aid in our understanding of the relations of neural systems and processes, and even predict the outcome of new experiments. With regard to the “hard problem” of consciousness, subjectivity and qualia, I agree that we don’t know (yet) how to approach that with computational (or any other scientific) methods. However, when it comes to describing and tracing neuronal signals and the relation between structure, dynamics, and (some) function, computational methods can be very helpful.

To summarize, *The Brain and AI* is indeed worth reading for many reasons, regardless if you are a student or researcher in any of the many fields of science discussed here (e.g. in physics, computer science, neuroscience, cognitive science psychology, social science, . . .), or if you are just interested in the current and future development of brain research and artificial intelligence. Actually, I strongly recommend this book to anyone interested in the

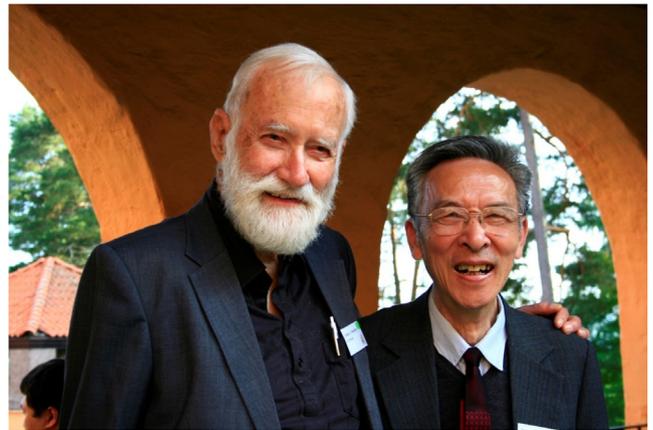
human brain, AI, and whatever might connect the two (even though there is not much on the risks with AI, for example using face recognition for social control, although that could come in a second edition). The book is a must for researchers in the field(s) and a delight for anyone interested in intellectual dialogues of any kind. Indeed, I found myself quite often nodding in agreement, and every now and then I heard myself laughing loudly when reading the highly witty and humorous letters, as if I really took part in the dialogue between these knowledgeable and talented gentlemen. I end this review with a few quotations from the book, which I think exemplify the elegant and humorous style all through, and which hopefully will inspire you to read more.

Many formulations by both Fanji and Karl are true gems, which could fit as inscriptions on the walls of universities, temples or government buildings, such as: “*Worshipping a person for everything he says is a fault but denying everything he says is another one*”, “*Being human includes being vague and not precise*”, or “*If you want to find out whether a bottle contains wine or vinegar, you don’t have to drink the whole bottle*”.

In addition to their own quite brilliant “proverbs”, Fanji also sprinkle the dialogue with some old Chinese wisdom, e.g. “*Even a wise man sometimes makes a mistake; while even a fool occasionally hits on a good idea*”, or “*A fool can ask more questions in an hour than a wise man can answer in seven years*”, and “*Facts speak louder than words*”. Finally, with reference to some of the characters in the current book, Fanji tells a story from a Chinese Kungfu novel, *Luding Ji*: “*Wei Xiaobao, the leading character of the novel, was very good at telling absurd stories to his opponents to make them believe what he said. The trick which he played was to talk nonsense at the key point, while giving a lot of true details on secondary matters. It seems that all the gurus, no matter Western or Eastern, ancient or modern, adopt a similar strategy!*” Hans Braun presenting the Chinese and English versions of the book “*The Brain and AI*” at the International Conference on Cognitive Neurodynamics, ICCN’19, in Alghero, Italy, Oct 2019



Walter Freeman and Fanji Gu at the International Conference on Cognitive Neurodynamics, ICCN’13, in Sigstuna, Sweden, Jun 2013



Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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