Kicking", in Joel Parthemore and Blay Whitby (eds.), *Re-Conceptualizing Mental "Illness": The View from Enactivist Philosophy and Cognitive Science* - AISB Convention 2013 (Hove: AISB), 47-49.
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Re-conceptualizing Mental "Illness": The View from Enactivist Philosophy and Cognitive Science

Joel Parthemore and Blay Whitby (editors)

AISB Convention 2013 • University of Exeter • 3rd–5th April, 2013

Foreword from the Convention Chairs

This volume forms the proceedings of one of eight co-located symposia held at the AISB Convention 2013 that took place 3rd-5th April 2013 at the University of Exeter, UK. The convention consisted of these symposia together in four parallel tracks with five plenary talks; all papers other than the plenaries were given as talks within the symposia. This symposium-based format, which has been the standard for AISB conventions for many years, encourages collaboration and discussion among a wide variety of disciplines. Although each symposium is self contained, the convention as a whole represents a diverse array of topics from philosophy, psychology, computer science and cognitive science under the common umbrella of artificial intelligence and the simulation of behaviour.

We would like to thank the symposium organisers and their programme committees for their hard work in publicising their symposium, attracting and reviewing submissions and compiling this volume. Without these interesting, high quality symposia the convention would not be possible.

Dr Ed Keedwell & Prof. Richard Everson
AISB 2013 Convention Chairs

Published by
The Society for the Study of Artificial Intelligence and the Simulation of Behaviour
http://www.aisb.org.uk

ISBN: 978-1-908187-35-2

CONTENTS

Re-conceptualizing Mental Illness: The View from Enactive Philosophy and Cognitive Science

In the late 20th and early 21st Century, the dominant trend in philosophy of psychiatry and mental health has been toward pathologizing a wide range of mental phenomena under the headings of "disease"/"illness", "disorder", or "disability" and treating the ones labeled "illness" on a par with physical illness, to be treated primarily by drug-based interventions.

That said, certain recent trends in cognitive science and philosophy of mind – notably Andy Clark and Dave Chalmers' extended-mind hypothesis and the enactivist school associated with Evan Thompson, Francisco Varela, and others, and the Tartu school of semiotics embedding mental life into a "semiosphere" – have challenged the familiar equating of the boundaries of the physical body with those of the mind. While the various approaches differ at key points, all agree that, although the mind must be physically realized, it extends in substantive ways into the environment, its boundaries subject to constant negotiation and re-negotiation.

As such extended-mind critics as Robert Rupert point out, re-conceptualizing the boundaries of mind and world in this way can only be justified if there is some empirical payoff. A small but increasingly vocal group within the extended-mind/enactive community believe that one of the best places to look for such payoff is in the field of mental health. They suggest moving away from a model based on physical illness towards one that emphasizes each person's history and embedding in a social context: such identified conditions as Asperger Syndrome and high-functioning autism may be better understood as instances of cognitive diversity rather than impairment; while conditions such as schizophrenia or manic-depressive disorder must be understood, and treated, as problems of the patient's immediate community and not just the patient herself. Furthermore, they must be understood, and treated, in light of the patient's history of interactions with her environment and not just the presenting symptoms. The risk of much contemporary treatment is that, like aspirin, it treats the symptoms and does not address the underlying issues.

As an emerging community and not just a scattered collection of "lone voices", the field is brand new, and it is cutting edge. It touches on such key themes as the nature of mind and its relationship to environment; the possibilities for computer models of mind that draw on exciting new paradigms; and the breadth of cognitive science, from theoretical explorations in philosophy of mind to concrete applications and new directions in treatment.

Seven of the nine papers included in the present volume address these issues from various directions: from philosophy of mind, psychology, psychiatry, and cognitive science; from broad overview or specific diagnosis; from more critical and more sympathetic perspectives on enactivism. The final two papers place the discussions into a wider context of enactivism: its foundations and its future.

Along with these contributors – and a tenth contributor, Sanneke de Haan (University of Amsterdam), whose contribution is not able to appear here because of its submission elsewhere – we welcome Mark McKergow of the Centre for Solutions Focus at Work (http://www.sfwork.com) and Nick Medford of the Brighton and Sussex Medical School as our keynote speakers.

Chairs

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20 Years After The Embodied Mind–Why is Cognitivism Alive and Kicking?

Vincent C. Müller [1]

Abstract. I want to suggest that the major influence of classical arguments for embodiment like ”The Embodied Mind” by Varela, Thomson & Rosch (1991) has been a changing of positions rather than a refutation: Cognitivism has found ways to retreat and regroup at positions that have better fortification, especially when it concerns theses about artificial intelligence or artificial cognitive systems. For example: a) Agent-based cognitivism’ that understands humans as taking in representations of the world, doing rule-based processing and then acting on them (sense-plan-act) is often limited to conscious decision processes; and b) Purely syntactic cognition is compatible with embodiment, or supplemented by embodiment (e.g. for ’grounding’). While the empirical thesis of embodied cognition (’embodied cognitive science’) is true and the practical engineering thesis (’morphological computation’, ’cheap design’) is of- ten true, the conceptual thesis (’embodiment is necessary for cognition’) is likely false - syntax is often enough for cognition, unless grounding is really necessary. I conclude that it has become more sensible to integrate embodiment with traditional approaches rather than ”fight for embodiment” or ”against cognitivism”.

1 Cognitivism / Computationalism

The classic view of what is called ’cognitivism’ or, more accurately, ’computationalism’ is that syntactic processing over symbolic representation is sufficient for intelligence, or perhaps even necessary as well (Newell and Simon 1976). It follows that its reproduction in computing machines will result in intelligence. On this classical view, artificial intelligence and cognitive science are just two sides of the same coin:

> Artificial intelligence is not the study of computers, but of intelligence in thought and action. Computers are its tools, because its theories are expressed as computer programs that enable machines to do things that would require intelligence if done by people. (Boden 1977: xi)

See also the classic Textbook: Artificial Intelligence: A Modern Approach, by Stuart Russell and Peter Norvig where they say at the outset ”We define AI as the study of agents that receive percepts from the environment and perform actions.” (Russell and Norvig 2010: viii). This expression has remained the same in the 1995, 2003 and 2010 editions. The only thing that was added in the latest edition is ”We place more emphasis on partially observable and nondeterministic environments” (Russell and Norvig 2010: ix). Philosophically, the main thesis of classical computationalism is that the human mind is a functional computational mechanism operating over meaningful representations. These representations are caused by information-theoretical processes (Dretske 1981, 1995) or biological function in a ”teleosemantics” (Macdonald and Papineau 2006; Millikan 2005). This account is motivated by classical ’machine functionalism, going back to (Putnam 1960) and nicely characterized by Churchland: ”What unites them [the cognitive creatures] is that [...] they are all computing the same, or some part of the same abstract <<sensory input, prior state>, <motor output, subsequent state>>function.” (Churchland 2005: 333). The set of functions that can be computed in this fashion is delineated by the ’Church-Turing thesis’: All and only the effectively computable functions can be computed by a Turing machine–i.e. step by step, fol- lowing an algorithm (definite and finite rule). Machine functionalism together with a semantics make the basics for classical cognitive science and AI.

1.1 Critique of the computationalist picture

Of course, classical computationalism has come under criticism from many directions over the years, and some of that criticism has coincided with a perceived lack of tech- nical progress in technical AI.

We will not aim to give any details here, but allow me to mention a few mile- stones in that debate.

- Computation alone cannot generate intentional states of agents, especially the state of ’meaning something’. This problem has prominent forms in the ’Chinese room argument’ (Preston and Bishop 2002; Searle 1980), the critique of ’encodingism’ (Bickhard 1993; Bickhard and Terveen 1996), and others.
- The ’frame problem’, one version of which seems to show that a computational system cannot make decisions without representing a very large number of facts (Dennett 1987; Pylyshyn 1987).
- Digital items like ’concepts’, ’words’ or ’phonemes’ play little or no cognitive role, perhaps no representation plays much of a cognitive role (or none) - anti-representationalism and sub-symbolic cognition: (for example Bermúdez 2003; Calvo Garzón 2006).
- Human cognition presupposes a human condition (Dreyfus 1992–originally 1972; Wheeler 2005).
- Cognition is goal-dependent, thus a property only of certain biological creatures, that act–”enaction” or ”deep embodiment” (Di Paolo et al. 2010; Froese and Di Paolo 2011).
- All and only the cognitive agents are embodied, cognition is largely a function of a body, etc. (Clark 1997, 2003; a useful introduction Hoffmann et al. 2010; Varela et al. 1991).
- ...

And from all this, one might conclude: ”Cognition is not computation!”

[1] Anatolia College/ACT, Greece & University of Oxford, UK
Web: www.sophia.de

1.2 Two notions of computing:

At this point, we shall not discuss whether all these arguments and positions are any good. We will just try to clarify their impact, actual and argumentational. For these purposes, it might be useful to remember that there are two basic notions of 'computation' at stake here, that are fundamentally different:

- Computing over meaningful representations (GOFAI, 'cognitivism') (e.g. Dretske 1995; Fodor, 1998).
- Computing over meaningless syntactic tokens.

The failure to make this distinction has some pretty nasty effects:

Mistake 1: [Type: Throw baby out with bathwater]

> "Cognitivism is false, therefore cognition is not computation and AI [via computers] won't work."

Mistake 2: [Optimistic extrapolation]

> "I am not making Mistake 1, therefore cognition will still be computation and AI [via computers] with work."

2 Some Forms of Embodiment

Classical Embodiment

Allow me to expand on these forms of embodiment a little bit, to see the arguments Useful surveys are (Calvo Garzn and Gomila 2008) and (Shapiro 2011, 2012). Classical Embodiment is largely a negative thesis against Cognitivism and stresses the bodily experience:

> By using the term *embodied* we mean to highlight two points: first, that cognition depends upon the kinds of *experience that come from having a body* with various sensorimotor capacities, and second, that these individual *sensorimotor capacities are themselves embedded* in a more encompassing biological, psychological, and cultural context.
>
> ... sensory and motor processes, perception and action, are fundamentally inseparable in lived cognition. (Varela et al. 1991: 172f)

An evolutionary motivation (Wolpert)

"Why do we, and other animals, have brains? ... Now you may reason that we have one to perceive the world or to think. That's completely wrong! ... We have a brain for one reason, and one reason only, and that's to produce adaptable and complex movements. There is no other reason to have a brain." (Wolpert 2011)

Embodiment as offloading (Pfeifer)

Starting with an intuition against "Cartesian" centralized control, we try to design robots with simple local control, exploiting body dynamics and interaction with environment. This results in "The Emergence of Cognition from the Interaction of Brain, Body, and Environment" (Pfeifer and Bongard 2007; Pfeifer et al. 2007). The main illustrations are things like A) 'passive dynamic walkers' i.e. walking robots that need no energy, no motors, just walk down a slightly downward sloping surface exploiting their body dynamics in interaction with the properties of the environment (e.g. friction). B) Insect walking. For example a cockroach has ca. 1 million neurons, of which only 200 descending to body, so the walking movements of each of the six legs is not centrally controlled [Roy E. Ritzmann], but rather the result of locally controlled movement. C) Trout swimming–a trout can remain steady in a flowing stream by exploiting the eddies and whirls of the stream and of its own body with minimal or no energy use for sidewise movement (a dead trout can retain this position for some time). D) A host of robots that show complex behavior with little or no control, just due to their morphology. The 'Crazy Bird' robot with two constant motors but no sensors showed various behaviors with minor modifications of motor speed or leg friction[1].

An animal can thus walk over a rough surface by exploiting the elasticity of its body and reducing computation whereas "a robot built from stiff materials must apply complex control to adjust to uneven ground and will therefore be very slow." (Pfeifer and Bongard 2007: 97). This notion is (unfortunately) called 'morphological computation' but is really a non-computational aspect of intelligence (Mller and Hoffmann in preparation). One why this approach can only be part of the story is the inherent tension between the stability of morphology and the flexibility required for complex intelligent behavior.

Embodiment as enaction (O'Regan)

Perception in general and seeing in particular is a kind of action–and this explains 'how it feels' to us (O'Regan 2011). Since perception is a kind of action, it requires a body (not just passive sensors).

Cangelosi

There are a number of cases where embodiment influences cognitive processing in more or less surprising ways–thus discrediting the traditional 'Cartesian' view of cognition as totally detached from a body. One method in empirical research to bring out these influences is 'priming' and thus a detection of a bias. For example:

- Image recognition tasks: Subjects will press a button faster with the right hand than with the left if primed with images that suggest usage of the right hand–an object with 'affordance' to grasp with the right, e.g. a coffee cup with its handle on the right.
- If people are made to nod, they are much more likely to agree to a given statement.
- Priming with 'elderly' words (or slow animals) make people walk more slowly.
- Priming with rude words make people more likely to interrupt a conversation.

Embodiment as grounding (Steels)

Under the impression of arguments against intentional states (esp. meaning) in computational systems, Harnad formulated the 'grounding problem': "How can the meanings of the meaningless symbol tokens, manipulated solely on the basis of their (arbitrary) shapes, be grounded in anything but other meaningless symbols?" (Harnad 1990, 335). Researchers in robotics have worked on systems that provide this 'grounding' through interaction with the world, sometimes interacting with other robots and thus generating a 'convention' for symbols that denote objects or classes in their environment. Luc Steels has declared this problem 'solved' (Steels 2008), though tongue-in-cheek and I have my reservations (see below).

3 What was the argument, again?

It would not be totally surprising if at this point some confusion had set in, for what was supposed to be the argument, and for which conclusion? A number of candidates come to mind:

- Hardware matters for robot performance (more than we thought)

[1] `http://www.eucognition.org/index.php?page=behavioral-diversity---crazy-bird`

- Sensation is largely a kind of action (and thus needs a body)
- Large parts of the Brain deal with sensorimotor issues
- Representations need grounding
- Handicapped humans can't think (or think differently) [???]
- Computers without bodies won't be intelligent
  Clearly, this needs some clearing up and I want to suggest that there are three different kinds of theses in here, an empirical, a practical and a conceptual one.

3.1 Empirical,practical,conceptual

The theses are the following, in a first approximation:

- An *empirical thesis* (about natural cognitive agents, esp. humans). With the- se agents, it so happens that cognitive, affective and bodily aspects are inter- twined and inseparable (e.g. Ziemke @ EUCog 2011).
- A *practical engineering thesis* (on how to best make artificial agents with certain abilities); a thesis on 'cheap design'.
- A *conceptual thesis* (about the necessity of a body for cognition, or a particular body for particular forms of cognition).

4 Re-grouping: Non-cognitivist, non-embodied computing

To see how the opponents of these embodiment theses have re-grouped it is necessary to pick up on our point above that computing may be understood as a syntactic process (in fact, I think it must be understood in that way). A basic point is that computing as far as it is well understood is centrally digital computing, i.e. it operates on discrete states that are tokens of a type (e.g. the type '0'). The operations on these tokens are algorithmic, i.e. precisely defined step-by- step and 'effective' (leading to a result). This stands in a certain tension to classical computationalism–which Varela et al. call 'cognitivism', putting an emphasis on its notion of 'central processing' rather than on the form of this processing, namely computing.

4.1 Syntactical Computationalism

In order to motivate that there can be another form of computationalism, we need to explain a few things on the notion of computation.
Levels of description

A given computer can be described on three levels of description, and properties that it has on one level, it will typically not have on another. The levels are a) physical, in terms of its realization in a particular hardware with its physical properties; b) syntactic, in terms of its digital properties that can be described formally, and c) in terms of semantics, what the digital tokens represent, if anything.

Computational sufficiency

- At some functional level (perhaps several), the brain operates as a digital computer (syntactically, not over representations). This is sufficient to generate cognition.
- *Computational sufficiency thesis (CST)*: "... the right kind of computational structure suffices for the possession of a mind, and for the possession of a wide variety of mental properties." (Chalmers 1994, 2012; Shagrir 2012a, 2012b)

Computational universality

- *Church-Turing Principle* "Every finitely realizable physical system can be perfectly simulated by a universal model computing machine operating by finite means" (Deutsch 1985: 99)
- "... everything that the laws of physics require a physical object to do can, in principle, be emulated in arbitrarily fine detail by some program on a general-purpose computer, provided it is given enough time and memory." [the problem is how the brain generates new explanations] (Deutsch 2012)

Multiple realizability

Strictly the same computation can be realized on different hardware (on several lev- els) and the same hardware can realize different computations if interpreted different- ly (on several levels). Here is an example:

We have a logic gate with two inputs, one output. The output is of 5 V if both in- puts are 5 V, otherwise 0 V (based on Sprevak 2010). This computes AND: output of 5 V ('true') iff both inputs are 5 V ('true'). This also computes OR: output of 0 V ('true') iff at least one of the inputs is 0 V ('true'). Which function is computed de- pends on how this system is used, which interpretation of the voltages is preferred. So this is a many-to-many relation: strictly the same computation (e.g. OR) can be realized on different hardware, and the same hardware can realize more than one computation. This suggests the *multiple realizability thesis*:

If a system is not multiply realizable, then it is not computational.

4.2 Example I: Brain functionalism

One growing area where syntactic computationalism is used is the representation of brain function in purely computational terms. Here is a classical starting point from Christoph Koch's *Biophysics of Computation*: "The brain computes! This is accepted as a truism by the majority of neuroscientists engaged in discovering the principles employed in the design and operation of the nervous system." (Koch 1999: 1) And what does that mean? It is thought of a sequence of incoming data–encoding–computational operations–control of output and a very liberal notion of computing is at play here. Something "can be thought of as computation as long as it can be mapped on one or more mathematical operations that perform some useful function" ... if it is "actually being exploited by the organism" (Koch 1999: 2). His example is that a marble running down a hill computes the "local minimum of a two-dimensional energy function".

If this is the way to see things, then perhaps we could scan the brain and emulate in different hardware? Given *computational sufficiency* (due to *computational universality* or for further reasons) and *multiple realizability*, this should be possible!

We do know the 320 neurons of the notorious C. Elegans nematode but as Koch says "We have no idea what the 302 neurons are doing!" (Ch. Koch, talk 2011). Ef- forts are now under way by David Dalyrumple to generate a full simulation of this organism (`http://nemaload.davidad.org/`), which achieves very complex behavior with these neurons–including finding food, reproduction and some learning.

For humans, the task would be just a tiny bit more complicated, with ca. 64 billion neurons (plus glia cells, etc.), ca. 200 cell types, ca. 7000 connections each via a long dendric tree that can span across the entire brain (Deca 2012). But efforts to detect the 'human connectome' of these connections are now under way and the EU has just awarded one of the two huge FET Flagship projects (10 years, 1 billion) to a computational study of the whole human brain in the

'Human Brain Project'. Several authors expect that whole-brain emulation might be the fastest way to high-level AI because it seems to require essentially scientific 'grind' on a large scale, but not deep 'insight' into the complexities of human cognition (Kurzweil 2012; Sandberg 2013).

4.3 Example II: 'artificial general intelligence'

Some AI researchers see the time has come to return from technical and specialized AI to the original aim of a universal intelligence, not unlike the human one, an 'artificial general intelligence' (AGI). If one starts on the assumption that an intelligent agent is one that successfully pursues their goals in a given environment by selecting the right action, then a more intelligent one can do this in more environments–this kind of consideration provides a general measure of intelligence (Legg and Hutter 2007). In this vein, one can work towards AGI with machine-learning techniques that essentially optimize output, given certain sets of input (normally with probabilistic techniques). Despite the fact that the original model has some unrealistic assumptions (agent has infinite computing power, is not part of environment, is immortal), there are substantial projects underway that create such agents (like AIXI) (Hutter 2012; Visser et al. 2006).
Note: Problems of 'Action-Selection' Allow me to note that this apparently innocuous line of research makes one particular assumption that seems problematic from an embodied point of view, namely that intelligent agents solve a problem of 'action selection', of 'what should I do next?' This is the outcome of a "Model-Plan-Act" view of action (with "Intention-Belief-Desire" psychology), which is dubious, even for humans.

In fact, life and cognition are continuous; there is no 'next step'. What counts as "next action" depends on the granularity of description (e.g. raise foot vs. go to supermarket), so there is no "set of possible actions" (life is not like chess). In this ac- count, it must be decided what is relevant information and which beliefs must change with action–the 'frame problem' is coming back to us. As an illustration, note that many intelligent agents do not 'select actions' at all: This seems apparent in lower- level animals (a slug or even a cockroach), in certain non-classical designs for AI and in coupled embodied systems; e.g. a passive dynamic walker.
Syntactic approaches Of course, there are more important models along these lines, in particular dynamic systems theory (e.g. Johnson et al. 2008; Spencer et al. 2009) or the view of the brain as probabilistic prediction machine (Clark forthcoming 2012). The point here was just to indicate that this kind of position exists and that it is untouched by several of the classical 'embodiment' arguments–in fact the latter two are advanced as endorsing embodiment.

4.4 Grounding ('Weak embodiment')

There is one other way to re-group in the face of embodiment but maintain a classical research program: admit that the symbols in a computer are initially meaningless, but try to ground these symbols through interaction with the world. What the precise shape of the 'grounding problem' is and whether it has been solved is a long story (Müller 2011, forthcoming), but I suggest to make the following distinction between two grounding problems:
The easy problem of symbol grounding

"How can we explain and re-produce the behavioral ability and function of meaning [and other intentional phenomena] in artificial computational agents?" This is an empirical question and a practical question, where solutions to the one are definitely useful for the other. Often practical proposals in 'epigenetic robotics' have been said to shed light on the mechanism in humans (Cangelosi and Riga 2006). As we mentioned above, some argue that the problem has been solved and the suitably constructed computational mechanism acquires a semantic network in interaction with other such mechanisms(Steels 2008), but this is hardly universally accepted (Cangelosi 2009).

Proponents of "deep embodiment" would have to say that computational-robotic solutions are bound to fail. None of these systems have any intentional states, desires or goals because they don't have a life, in particular a precarious one. Thus, they do not have the right functional architecture, the right causal connections for symbol grounding (Di Paolo 2010).
The hard problem of symbol grounding

Even if this problem is solved, there might be a harder problem, namely "How does physics give rise to meaning and other intentional properties?" To solve this would require to reproduce not only behavioral ability and function but also the right inner mechanism in order to "Get the system to mean what it says". In humans, the experience of understanding is an elementary part of what we call 'understanding', which is why the Chinese Room Argument turns on the presence or absence of this experience. (This relies roughly on a Grice's analysis, which Searle shares, namely: To mean what I say is to try to get someone else to recognize my intentions of meaning something–which might be different from what my words mean (Grice 1957).) It should be obvious that the hard problem directly involves conscious experience, i.e. it involves solving Chalmers' 'hard problem' of consciousness (Chalmers 1996). This problem is untouched by evolutionary robotics.

Given this situation, my view is that we should return to the 'easy problem': "How can we explain and re-produce the behavioral ability and function of meaning [and other intentional phenomena] in artificial [mainly] computational agents?" This is not a philosophical problem but one that can be solved with cognitive science. If symbol grounding is necessary for cognition at some 'level', this problem must be solved in order to achieve artificial cognition at that 'level'.

5 Is Cognition like adding numbers or like growing apples?

5.1 Causal powers

Given multiple realizability, would reproducing the computation in a cognitive sys- tem reproduce the behavior? I don't think so. The reason is that features on the physi- cal and semantic levels of description are not necessarily reproduced–but these are crucial for the causal powers, i.e. the behavior.

Given that *hardware-dependent features are not computational* (and thus "morphological computation" is not computation) we cannot expect such features to be identical in different realizations. For example, if one realization produces a red light, another might produce a barrier down. To use a more general example: A computational model of an apple tree does not produce apples (but only apples* in the model).

Given that *semantics-dependent features are not computational* ("GOFAI com- putation" is not computation in my terminology), we cannot guarantee that these will be identical in different realizations either. If one realization produces a YES, another might produce a NO, depending on the interpretation of the output. (Note that this is not the same point as the one above concerning AND and OR, which concerned syntax.)

5.2 Purely syntactic structure may be just what is needed for cognition...

As we illustrated above, there is some hope to think that purely syntactic structures might be just what is needed for a successful account of cognition that allows for successful artificial cognitive systems. Perhaps the syntactic properties that are maintained across multiple realizations are sufficient? Perhaps any realization of 2 + 2 = 4 adds 2 + 2? Or is this the old fallacy where "=" means something to me, and I thus assume that it means something to the computing machine? In any case, the challenges for artificial cognitive systems will remain gigantic, even if embodiment is not as much a game-changer as some have thought (Gomila and Mller 2012).

Also, we need to remember Mistake 2: (Optimistic extrapolation) - "I am not making Mistake 1 [no computationalism, thus no computing], therefore cognition might still be computation and AI via computers will work". This is not a given, this needs to be established.

6 Conclusion

As far as the three theses are concerned, if we remember that they are logically indepenent–and this is usually forgotten–, then we can say:

- The empirical thesis is true
- The practical engineering thesis is true
- The conceptual thesis is likely false (i.e. syntax is often enough) ... unless it should turn out that symbol grounding (easy or hard) is necessary, and that is not implied by the truth of the empirical thesis above.

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