Simple Robotic Simulation of Perception, and Time Travel

Abstract

Simple NXT robots in configurations based on a type 2 Braitenberg configuration are used to simulate problems in time travel, flash-lag effects and other situations. The philosophical implications are briefly explored.

Introductory Comments

As Dawson (2010) shows, qualities such as free will, discernment, moderation, self recognition and narcissism can apparently be created in a robot using 40 lines of code, two motors and two sensors. DuPuis (Dawson, 2010a) gives a simple explanation in a very short video.

There seems no reason why much more complex ideas, such as physically travelling backwards and forwards in time, cannot be incorporated into such a system as required. On a less ambitious basis, mental time travel, both to the future and to the past, seems as if it may have somewhat similar psychological parameters associated with it (Yates, 2010). This process is almost the reverse of experimental philosophy. One alters or indeed creates a simple system to obtain just a few ideas which a philosopher could relate, if he wished, to properties of a mind. DuPuis (and for that matter Dennett (1993) and Braitenberg) refers to similar ideas as "The law of uphill analysis and downhill synthesis".

Continually one reads in papers on very simple robots a few lines to the effect that 'no memory has been incorporated into the system but it almost appears to have a memory of its own' (e.g. Wikipedia, 2011), Nowadays people frequently even refer to embodied cognition, i.e. intelligent behavior that emerges from sensorimotor interaction between the agent and its environment, without any need for an internal memory, representation of the environment, or inference (Sutton, 2006).

Clearly we can abuse this facility by holding the robot in suspense of its actual circumstances and looking for a reaction - to make it try to 'forsee the future', for example, or for other psychological experiments.

Further, as Fodor (1997) points out "not all the functions of a classical computer can be encoded in the form of an explicit program-some of them must be wired in". Many others including myself (Yates (2010) as stated in "Not Even Wrong - a view of current science of the mind") and others like Andy Clark and David Chalmers, would probably see this as at least a possible and reasonable viewpoint - and indeed would frequently go much further and more widely. I certainly would.

I deal with General Theoretical Concerns in Appendix 1 and Appendix 4 of this paper, the Flash-Lag Effect in Appendix 2 and A Relationship to Dreams in Appendix 3.

Experimentation

Many people have used Lego robots for scientific experimentation by now. Stafford (2010) points out that there can be wild swings when slightly different robots are used, which are duplicates of one another, and gives a graph which shows the wild swings he has obtained.

We find that even with the same robot, and mildly varied parameters and circumstances, swings can also be obtained. This is unsurprising, given chaos theory and the many other factors we have discussed in earlier papers.

Stafford also points out that experimental results with real people are likely to be even more varied. All this is normal enough in the field of experimental psychology, but the immediate result is that staying with simple Lego robots may make ultimate results slightly more significant. Dynamic systems theory indicated already that the use of further elaborate mathematical structures is unlikely to help immediately in most cases (Hannon , 1997). In short to build a simulated robot using simple computer mathematics probably will not help at this stage although the possibility must be retained.

The flash-lag effect was simulated in several ways. But to begin with it was done by allowing the NXT robot to experience colored lines and marks on the ground, using a color sensor triggered by viewing close proximity to the red lines or marks. This caused the robot to jump backwards (effectively immediately) but to retain the memory of previous stimulations to the right and left light sensors, which – other than the repulse reaction – were postdated for times from 80 milliseconds to 30 seconds. The Lego robot used in the early stages was an ordinary Braitenberg configuration, approximating to a type 2 Braitenberg vehicle. . We were prepared to use a Bluetooth connection to a computer running SciLab , but for the present simple purposes enough information could be programmed directly into the NXT brick. So in effect the robot's internal time was dated 80 milliseconds to 30 seconds earlier than the 'surrounding' time, except when the red ground was contacted. So we simulated a flash-lag effect for a reaction time of 80 milliseconds to 30 seconds. We can even simulate various forms of time travel using much the same equipment.

The possibility of adding 'stochastic resonance' effects to sensitise interactions, the use of various optical optical illusions, 'gravity hills', and even the Shams 'ventriloquist illusion' (Wozny, 2010) can be, and was, replicated on these very simple models. Most authors seem to have simply elaborated details of the Braitenberg vehicle, somewhat after the manner that Braitenberg himself tried to describe more and more complex versions of his vehicle, but an alternative approach is to simply alter the environment or the type of interaction with the environment without adding undue complexity to the model.

For interest, one of our videos (V1), is enclosed. Most of these robots do appear spontaneous and in fact in V1 the robot could seem – somewhat anthropomorphically – to be trying to work out how to escape from its enclosure and seems to be persistently looking for various alternative ways to do so !

The present experiments are using a wireless electronic marker to allow precise graphical plots so that a family of curves becomes available, for all types of mathematical analysis.

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Appendix 1

General Theoretical Concerns

Szpunar (2010) and many others points out that the contents of memory appear to be routinely sampled during the construction of personal future scenarios. There are many more papers (by Donna Addis, Chris Frith, etc) which attempt to delineate further details of such an idea and some of these may be useful for the construction of further robots.

Many people (Changizi, 2008) claim that humans already have a slightly developed sense of 'precognition' which helps them to survive, and indeed some people (e.g. Suddendorf, 2008) claim that this is also true of animals.

Whilst the amount of time this 'precognition' occurs in humans is quite small, being in the region of 80msec there is no reason why the effect cannot be incorporated into a robot for much longer periods. Folk psychology would indicate that the 80msec lag is simply a factor dependent on internal brain design but that seems to be an assumption based on B series Newtonian physics results. We already know that special relativity limits the use of Newtonian physics and counterfactual results may be obtained , e.g. in the case of the Andromeda paradox, if even special relativity is accepted as having complete rigor in evidently unsuitable circumstances.

The present work also bears in mind the work of Nyberg (2010) who examines (using fMRI) brain regions which seem to be similar to those we described in an earlier paper using experimental philosophy. But his work does not seem to show what the area is actually doing, which could need the use of appropriate brain damaged patients or patients with temporary brain damage, as could perhaps be imposed with rTMS.

In actual fact Nyberg's results showed that the left lateral parietal cortex was differentially activated by nonpresent subjective times compared with the present (past and future > present). A similar pattern was observed in the left frontal cortex, cerebellum, and thalamus. There was no evidence that the hippocampal region is involved in subjective time travel. These findings provide support for theoretical ideas concerning chronesthesia and mental time travel.

Further studies on this matter are often carried out using yoga and other mediational techniques, often considered as fringe science susceptible to mainline studies such as rTMS and fMRI. (Ramesan, 2010).

Here we use Occam's razor and try to avoid extra Newtonian assumptions about our system.

Appendix 2

The flash-lag effect as a typical case

The flash-lag effect has been interpreted in many ways (Pockett, 2002). To summarise:

1. One hypothesis is that there are differences in the visual persistence of flashed and moving stimuli.
2. A second hypothesis is that subjects extrapolate the motion of a moving stimulus about 80 ms into the future.

3. A third hypothesis is that the visual system takes longer to process a flash than a moving object.
4. A fourth hypothesis, called by its authors the postdiction hypothesis (Eagleman & Sejnowski, 2000a, 2000b, 2000c), is that at any particular point in time the percept of a moving object involves a time-weighted integration of all the information about that object which became available during the previous 80 ms.

Further, Changizi (2008) even asserts that the human visual system has evolved to compensate for neural delays, generating images of what will occur one-tenth of a second into the future. This foresight enables human to react to events in the present.

Nijhawan (2008) gives a large number of references in his review of the psychophysics of neural prediction and even goes so far as to say "Visual prediction has a strong logical basis and seems consonant with other visual phenomena ....Prediction may be a multi-level, multi-modal phenomenon found in both sensory and motor systems. ... This general approach to the study of prediction suggests possibilities that could unify research from single cells to cognition".

Setting up a case using the Lego models may allow the expansion of the 80ms time scale to a very large figure, and simulate the further development of machine or human intelligence. Clearly plenty of normal time-series prediction methods can be incorporated in any such program. We use open-source SciLab rather than MathLab for such work but generally either will probably do. In fact in this instance we simply used Lego robots with time delays from 1msec up to 100 seconds. These delays can often readily be incorporated into the robot itself without the need for a Bluetooth connexion to a computer.

Appendix 3

Theoretical Concerns regarding Dreams

The literature contains many references to the effect of external stimuli upon dreams, particularly REM dreams. Anecdotal information suggests that external stimuli may relate to dreams which occur roughly at the same time as the external stimulus. However the kind of dreams which seem to relate to this effect seems (e.g Solms) to be relatively uncommon and the idea that the dream occurs before the stimulation is as yet unproven.

The order of pre-awakening stimulus and dream seem to have been most frequently found using dream laboratories to be: First-stimulus. Second-relevant dream. The jury is of course still out, regarding the overall picture.

However the dream as anecdotally described so often seems to contain a long scenario. So there is still the mystery as to how the mind sets up such a scenario so fast. But this is the sort of problem we are always encountering during studies of consciousness. For example WikiBooks (2010) points out: “When a dog barks we see its jaws open at the same time as the bark and both jaws and bark are at the same location. We take this for granted but the brain must be engaging in some complex processing to achieve this synchronised and appropriately positioned set of objects and events."

Now the apparently unexpectedly fast degree of human brain comprehension could be due to strange microtubule effects, or even quantum computational effects, but it seems more likely that it is due to an inadequate formulation of the McTaggart A series. Just as Newtonian methods were not good enough to explain special relativity, so too may contemporary physics be - as yet and possibly always - incapable of adequately formulating the A series.

We have already mentioned and will discuss the apparently high levels of anthropomorphism and indeed apparent innate philosophical ability encountered with Braitenberg type 2 robots so an obvious step will be to use BVs to attempt to simulate various types of perception, including anomalous perception, to see what we get.

For a start, from the 'flash-lag effect' and the 'crank handle effect' it is obvious that strange delays in perceived results appear to relate to suppressed or unorganised perceptual results.

An obvious approach is to obtain visual results but delay them relatively to the knock-on or immediate results of contact. We may even be able to simulate dream perception using Bvs using variable delay times.

It must be stressed that the use of digital simulations is NOT sufficient for these experiments and we need real machines as I pointed out to begin with.

Appendix 4

Further justifications of using NXT brick and similar devices

The complex philosophical problems involving subjects like free will, the subconscious (if any) and action identification can only be mentioned in this brief work without detailed discussion or commentary. On the general subject of free will, the basic approach of Peter Strawson and more advanced models such as the attempts of Kane, Wegner , Marsh (2010) , Kuhn and Brass (2009) could be dealt with in detail as could the William James basic model which was of course refined by such as Margenau, Dennett, Popper and Heisenberg. Then there are illusionists like Smilansky.

And as a sort of summing up there is of course Honderich´s (2011) website – which promotes hard determinism, though somewhat leniently.

Action identification means that the actor is always sensitive to contextual cues at higher levels of identification but moves to lower levels of identification if the action proves difficult to maintain with higher level identities in mind.

Thus it is interesting to see what would happen at very basic levels of programming of the NXT brick, if we assume some merit for Wegner's (1987) idea.

To show how perspectivalism (or what Giere calls perspectivism) works, Giere (2006) suggests that colours , for example, are really the interaction of the world and the human physical system. He then generalises the argument to scientific observation and suggests for example that the output of scientific instruments is perspectival. He reckons that models based on complex scientific theories like that of Maxwell can be used to devise models which can make various claims about aspects of the world.

In an earlier paper we described the merits and actual value (in that we resolved the Andromeda paradox) of an approach like that of Giere (Yates, 2010a).

Thus we base a potential model, not simply on modern physics which is manifestly quite different to neurological observations although these are frequently explained in terms of modern physics, but on simple real models like the NXT brick, set up perhaps as a type 2 Braitenberg vehicle or something of similar general nature.

The work of Clayton (2003), Martin-Ordas (2010) and many others, suggests that the socalled 'mental time travel' of Tulving can occur for animals, 3-5 year old children and even birds. If so, a simpler model should perhaps also work for the NXT brick, after a fashion as there is no immediate imperative of some special additional concept like 'qualia', whether present or not.

We must beware not to revolt from this idea, remembering the 'uncanny valley' effect. Certainly the possibility seems easier to understand than the somewhat muddled ideas of determinism, freewill, and the lack of either which abound everywhere.

Also it should be testable with some ingenuity and mild difficulty.

In earlier work (Yates, 2008) we already gave a mathematical attempt to describe the so called 'unconscious' mind and its relationship to the conscious mind using complex system theory and a model based on potential reactions between a 'Romeo' and a 'Juliet' model.

Here there seems to be no reason why a roughly mathematical model – and hence possibly a real physical model – should not allocate 'conscious' and 'unconscious' elements to a simple NXT robot.