Upgrading the Turing Test to Consciousness

Abstract

In "Where is the Definition of Consciousness"[1] (WdDoC) it was pointed out that the Turing test[2] is in need of an upgrade. However Bayne[3] et al do an extraordinary job of reviewing the field of Consciousness testing, and insightfully extend the scope to a much more general one that includes nonhuman animals, xenobots and more, making such a Turing test upgrade effectively a moot exercise.

From the Definition of Consciousness that is remarkably similar to Tononi's[4], McKenzie's[5] as well as to Axel Cleeremans and Luis Jiménez[6] Definition of Learning, this article points out that the level of sophistication (or simplicity) of a given Conscious Entity has to be taken into consideration, but that the *features* tested as part of the Definition (Advaita Vedanta Boolean Algebraic capability, Memory, Imagination / Creativity, Ability to action future insights *and learn from mistakes*) remains the same regardless of the scope and resources. Given that PID Control strictly meets the Definition of Consciousness, the difficulty and comprehensiveness of the task is highlighted by how rigorous and thorough PID Controller testing has to be in Safety-critical Engineering.

Additionally it is agreed that Schweizer's[7] perspective is correct: selection of a single entity (or too small a sample size) is statistically risky, and that the only way to mitigate such is to test *Groups* of entities. However crucially the same statistical risk of small sample size applies equally to the *number* of Groups tested.

1 Upgrading the Turing Test

The scope of the problem face by this endeavour:

- Intelligence and Consciousnessness are not clearly defined [1]
- therefore reliable comprehensive tests simply cannot be designed.

Also there are serious misunderstandings to contend with, which are highlighted below and have already caused significant subtle problems regarding the use of ChatBots.

Defining Consciousness is the first step. The IEP[8] summarises Tononi's Definition of Consciousness which is slightly different from McKenzie, the author's and others, as it has more similarity to Sipling Zhang and Ventra's[9] Long-Range Order characteristics, as well as providing support for Hankey's[10] High-order Critical Instability insight as key:

> according to IIT, consciousness requires a grouping of elements within a system that have physical cause-effect power upon one another. This in turn implies that only reentrant architecture consisting of feedback loops, whether neural or computational, will realize consciousness.

All of these Definitions give a hint of an underlying architecture that bears a remarkable resemblance to an Aspex Microelectronics Array-String Processor[11]: [2] a massive wide SIMD array which had tiny 2-bit ALUs, 256 bytes of Content-Addressable Memory per ALU, and registers that could be used as Vector Processor Predicate Masks. Both Sipling et al and Tononi et al hint that there is not just continuously-looped and Distributed (masked) Memory "lookup" going on: there is rudimentary bit-level binary computation *built-in* as well. [3]

Also, exactly as with the Aspex ASP, there is the Mesolimbic Dopamine System which links behaviour initiation (or aversion) to achieve goals: this is a single *central* control system, and the equivalent in the ASP was a single SPARC processor. The SPARC processor was responsible for broadcasting the SIMD instruction to the massive-wide SIMD array of 2-bit ALUs. Rudimentary Boolean Algebra sufficient to perform massively-parallel (but ultimately very simple) Difference, Analogy, Inference and other operations, seems to be enough if directed and controlled by a "Central Processor" to create and run more complex pro-

---

[1] not in a detailed way satisfying Software Engineering Standards

[2] and to Blum & Blum's Conscious Turing Machine[12]

[3] where the "self-aware looping" comes into play is when a CAM lookup, of a given qualia, results in "tags" (representing matches), that are then used as a Predicate Mask to selectively enable/disable further lookups or processing. readers should investigate "Vector Processing" for further information.

grams. [4]

The Turing Test

The Turing Test is:

> a test of a machine's ability to exhibit intelligent behaviour equivalent to that of a human... The results would not depend on the machine's ability to answer questions correctly, only on how closely its answers resembled those of a human.

However with Intelligence being difficult to define, it becomes hard to correctly design such a test. The clearest and most concise definition, by Sternberg and Salter[13], is simply:

> Goal-directed adaptive behavior

Thus the Turing Test may be defined as:

> a test of a machine's ability to exhibit *Goal-directed adaptive behaviour* equivalent to that of a human

As pointed out in WdDoC[1] it is not necessary for "awareness" to be involved. However it is clear empirically that "awareness" (more specifically self-awareness) is key to Consciousness.

ChatBot Fail

Chatbots with sophisticated Language parsing are unfortunately fooling humans into believing that they provide intelligent answers, whereas in reality they are a very sophisticated "database query" onto the sum of knowledge written (or drawn, or photographed) by humans that is available on the Internet. Many are fooled by the "synthesis" and "transformation" skills of current Chatbots, as these tasks seem miraculously fast, but in reality risk creating "hallucinations" that require Human Domain-expert understanding to spot[14].

Mitchell[15] pointedly highlights the problem faced by human judges not being sufficiently educated on the seductive dangers of ChatBots, but also implied is that the methodology used (5 minute conversations) is completely inadequate:

> It's certainly concerning that a majority of the human judges were fooled by GPT-4 after a five-minute conversation. [5]

SQL Databases have a very strictly structured language. SQL grammatical and syntax errors are not tolerated in any way, and as a consequence SQL queries are extremely fast: 100,000 queries per second is just within reach of powerful PCs. Put in layman's terms, SQL query decoding is equivalent to Chinese in the Chinese Room[16] thought experiment

Natural Language however is more powerful, expressive, and complex, but the downside is that queries are slower and more computationally costly to process: several seconds per query is not uncommon.

It is remarkable how much progress has been made in Large Language Models, but LLMs are just a tool. Chatbots use this tool, in conjunction with "context" (such as your last question), to give a more "natural" access to information, which *seems* remarkably intelligent to anyone not familiar with the underlying technology. At heart, LLM use in ChatBots are just another Chinese Room.

McKenzie's insights

McKenzie's definition is as follows:

> Consciousness is the capacity to generate desires and decisions about perceived or imagined realities by distinguishing self from non-self through the use of perception, memory and imagination.

However he then clarifies and crucially points out that appreciating the concept of time is a critical factor.

- comparing past to present helps highlight aspects that failed when generating desires (also known as goals)
- projecting present into the future requires recognition of the difference between Now and Future time as well as the difference between Reality and Imagination.
- feedback is needed which corrects for overshoot and undershoot as the Desire (goal) becomes closer to reality (and to Now) at its projected (envisaged) Future completion time.

In essence: past experience is used in the present to imagine actions that would achieve a goal at a future specific time. As that future specific time

---

[4]such as working out why the fridge door should remain closed, and getting up to close it

[5]French[20]: *does* go to some lengths to point out that Turing's original test as described required *no time limit* and no limit on the number or type of questions

becomes closer, what was previously "future" becomes "now", and what was "now" becomes "past experience to again learn from". The process of evaluating and choosing action (or inaction) is continuously repeated and refined until the goal is achieved at the projected time. [6]

The simplest single mathematical implementation of the above is a PID Controller[17]. Therefore, logically, there is a reasonable expectation that Engineering / Software tests of PID Controllers may help in creating tests for Consciousness.

Also to contend with is a key issue that Schweizer points out: the variation in both Intelligence and awareness (a synonym for Consciousness) in a given human as a candidate test subject. Schweizer advocates long-term analysis and testing of *Group* Consciousness in order to statistically mitigate for low IQ and low Tononi Phi.

Turing.com insights

From turing.com[18], "Learning" is considered important for artificial consciousness. According to Axel Cleeremans and Luis Jiménez[6], learning is defined as

> a set of phylogenetically advanced adaptation processes that critically depend on an evolved sensitivity to subjective experience so as to enable agents to afford flexible control over their actions in complex, unpredictable environments.

This has remarkable similarity to McKenzie's[5] Definition of Consciousness, including down to missing out (not explicitly highlighting) the significance of time [7].

Additionally, turing.com point out that "Anticipation" is important, which is a key part of both McKenzie's and Tononi's Definitions. Anticipation combines both Differentiation as well as Integration with respect to time.

In turing.com's article on Time-series analysis[19] the *off-line* task of analysing data changes over time is described, and advice given on how to formally statistically check the accuracy of a given choice of predictive modelling. It is very interesting to note that the analysis of time-dependent data is remarkably similar to PID Control: the "AR" part (Auto-regressive) of ARIMA appears to be $K_i = 0$ with K_d and K_p non-zero, but the "I" explicitly

has K_i non-zero. K_d is described as "intercept".

Adaptation of the recommended statistical testing process itself (how close a match of a given system) if applied *in real-time* is also worth exploring.

The authors of turing.com note well that most modern AI fails the Turing Test. The most likely explanation is that modern AI is simply not meeting the Definition of Intelligence. The authors note:

> All these systems are intelligent, but they have limitations as they can only perform in certain predefined conditions. If they go beyond their constraints, they can fail and produce undesirable results

In other words they lack Sternberg and Salter's "adaptability". Which makes Turing.com's declaration "these systems are intelligent" strictly invalid, if Intelligence is defined as "Goal-directed adaptive behaviour", and modern AI is *replicating* and synthesising best-match answers from a fixed database.

Bayne et al insights

The study by Bayne et al[3] is particularly comprehensive and insightful. It points out that Consciousness should not in any way be considered the exclusive domain of Humans. WdDoC[1] goes to some lengths to highlight that Consciousness is scope-based and resource-based: a PID Controller [8] meets the Definition and achieves its purpose. Bayne et al's insight therefore extends far beyond just animals, humans, AIs or Aliens: a perspective confirmed by French[20]:

> the Turing Test is not actually testing for (general) intelligence, but rather, a test for intelligence in humans, with human bodies, having experienced life as a human being.

There are numerous humbling examples of clear intelligence, expression of desires, and ability to communicate in animals, which complicates any potential idea to upgrade the Turing Test to cover Consciousness:

- Cats using speech buttons have warned their owner of an impending earthquake[21].
- Horses can learn to use signs to communicate their desires and needs to humans[25].
- A psychologist spent years teaching his dog

---

[6]It is intriguing that this precise process is one which is taught to Software Engineers and by "Life Coaches" etc.

[7]difference between past and present, and integrating with respect to time in order to predict and influence the future

[8]strictly. as long as its parameters are correctly tuned, or it is self-tuning. there are many caveats here

over a thousand words[22].

- Mark Rober spent months investigating the intelligence of an Octopus[23] and a crow[24]

Additionally it appears that Bayne et al follow Schweizer's recommendation to test populations rather than individuals. The author's initial objections to this approach were overruled as it was realized that in a Human it would be the population of *neurons* that should be tested [9] as neurons is the "next level down" from "Human". Thus it is highlighted as unavoidable that testing one level of Consciousness must take into account both the level above and the level below.

2 Software Engineer's approach

A tried-and-tested method is to literally treat Definitions of Consciousness as a Software Project, and to create both unit tests and systems tests. Hence the approach taken in WdDoC[1] to seek out the properties of Consciousness. [10]

When testing for *human-like* Consciousness it is reasonable to assume that the ability to communicate (spoken or written) is a given, but not necessarily so. Science Fiction helps illustrate: both a Stargate episode[26] and Carl Sagan's book "Contact"[27] provide a "from-the-ground-up" one-way teaching guide. Assuming a real-time two-way communication channel is available, *then* it is reasonable to use that to first establish a common language.

Then, a system-level test would be to expect that the subject is capable of being queried on each of the low-level unit tests, and to have their purpose explained without prior knowledge.

For example: Boolean Algebra is part of the Definition of Consciousness, highlighted best by Advaita Vedanta's Epistemology, such as "Difference" and "Analogy". If a General Conscious system is to be indistinguishable from a Human, it is not unreasonable to interact with a Conscious System in order to ask:

- Firstly if it knows what "Difference" is
- Secondly, successfully teach it if it doesn't
- Thirdly ask it questions that demonstrate its understanding of the concept.

This should go far as it needs to go down the rabbit-hole, including teaching Calculus (or just "Area under the curve") in order to understand Integration and Differentiation. However the primary purpose of the discussion is to see if the subject firstly *agrees to participate willingly* and secondly to test its ability to deploy "real-time corrective feedback" - the crucial aspect of the Definition of Consciousness - in collaboration with the tester. Misunderstandings should be resolved: "Active Listening"[28] displayed (known as empathy), which is characterized by asking questions that begin

> "so let me summarize and see if I understand you correctly:..."

Note here that it is not *necessarily* the case that a given Conscious Begin will have empathy. Andrew Yang[29] noted that Humans corrupted by power are incapable of empathy. The point is highlighted to illustrate that not all approaches will be successful, graphically illustrating the complexity of the overall task.

Systems and Unit testing

Also important to note that where there exists Unit Tests for systems previously not recognised as meeting the Definition of Consciousnessness, [11] such as Software implementations of PID Controllers, the approaches taken and indeed the actual Unit Tests themselves may potentially be used. Particularly helpful would be what can be learned from the comprehensive ISO9000 Compliance Test Suites in Industrial Engineering environments, needed for Mission-critical and Safety-critical applications.

A cursory search for PID Controller unit tests reveals comments from Corfa's[31] PID Controller unit tests: each test clearly states their objective:

- Test convergence with a model that reacts instantly to a correction.
- Test convergence with a model that reacts linearly to the correction.
- Test convergence with a model where the response disminishes linearly over time. We ignore the integral component here as it is misleading.

---

[9] more specifically (a) Renshaw Loops and the Thalamocircuit as these are where Hankey and Tononi "feedback loops" occur, and (b) as always needs emphasising: within their scope and resources vis-a-vis the Definition of Consciousness

[10] only by knowing what you are dealing with can you actually test for it. duh.

[11] the author freely admits to being completely stumped as to how to design a test for Consciousness suited to an Electron, despite a Mills[30] Electron meeting the Definition and being fully mathematically defined. The only saving grace is the similarity between an Electron and a PID Controller, the primary difference being the Mathematical Domain of each

Lundberg's[32] tests are more comprehensive. These tests focus on individual features ($K_pK_iK_d$), test the clamping capability, and also provide a different suite of system-level (high level) tests. However both these examples are not comprehensive to an Industrial ISO9000 Standard, in any way: that would involve deliberate harmonic oscillating input at ranges of frequencies deliberately designed to destabilize, test for Integral windup, test for randomised environmental error and much more.

A valuable insight into the insufficiency of the above unit tests is illustrated by "overactivation" which occurs in real-world Industrial PID Control usage: repeated unnecessary opening and closing of a valve, shortening its lifespan. The solution, known as "deadband"[17], bears a remarkable resemblance to the capability of neurons to only fire once an activation threshold is reached.

The approach taken by Turing.com on data analysis would prove invaluable (described below), but for a rigorous Industrial environment where failure could leave a valve open on an LPG tank at a refinery, causing a devastating large-scale explosion, the comprehensiveness and rigorousness of Unit and Systems testing needed is made pretty clear.

Also worth noting that the equivalent of "Group Consciousnessness" in a PID Controller context is that the constants $K_pK_iK_d$ and their range (infinite for each of the three constants) represents a "Group". The analogy holds in that some values of these constants clearly do not meet the Definition of Consciousness (`D=1/P=0/I=0`) just as not all humans can be said to meet the Definition (the subset with neurological disorders or pathological behavioural traits).

3   Conclusion

There appears to be a remarkable quantity of research in this field: it is however not couched in terms of "An upgraded Turing Test" which was the initial goal of this paper. However Bayne et al review the current scope of testing for Consciousness very well, and it is felt that their approach has merit, particularly given French's insights that the Turing Test *as defined and used* is heavily biased towards Humans.

Bayne et al caution against limiting tests for Con-

sciousness to Humans: this paper advocates designing context-sensitive resource-aware tests at the level of Consciousness for the entity being tested, mindful that the Definition of Consciousness has *no limit* on the *scale* (sophistication or simplicity), merely noting that Consciousness arises as a means of keeping itself "on target" by comparing the past to the present and evaluating and applying action to meet an intended future goal [12].

Bayne et al and Schweizer's advice is to test populations not individuals. In the context of PID Controllers, the population is the permutation of infinite range of the three P,I,D constants. In the context of Humanity there are 7+ billion potential candidates. Schweizer advocates testing Groups for their ability to *interact* whereas this paper points out that such should be just one of the many tests involving many Groups as well as many individuals, in order to compensate for statistical variation in both the selection of individuals *and* of specific Groups. [13]

It appears that testing may only be carried out by acknowledging the relationship of the lower level of Consciousness to the higher. Examples being "neurons" as lower-level and "animal" as higher, or "Individual Consciousness" and "Group Consciousness". Where each level meets the Definition of Consciousness it is important to clarify exactly which level is overall being tested, and to do so in terms of the level both above *and* below: i.e. take into account the *fractal* nature of Consciousness[1].

Also recommended is to learn from software Engineering, and to create targeted Unit Tests that cover both the lower level and the higher (systems level). A low-level example: is there evidence that the entity being tested has Memory, that being one of the Properties required under Tononi's, McKenzie's, Cleeremans and the author's Definitions of Consciousness.

For future consideration would be to apply Formal Correctness Proofs: this task would first require the development of a Mathematical Model of Consciousness in a suitable Formal Language [14].

Where it might be hoped that Humans would be able to spot if a given non-Human entity is Conscious or not, it is unfortunately clear from superficial use of ChatGPT and other Chatbots that

---

[12]McKenzie's Definition, and Cleeremans and Jiménez Definition of Learning which is effectively a Definition of Consciousness

[13]i.e. it is unwise to simply select one Group of individuals: *multiple* Groups must be tested for their ability to collaborate

[14]at which point it may be found that to run the proof would not complete within the time taken to reach the heat death of the Universe. still, you never know until you try

this is emphatically not the case. The scope being clearly much more comprehensive than anticipated is clearly at odds with the importance of a rigorous approach.

It is projected that over time (decades) this issue will resolve itself, as risk-cost-benefit analysis cuts in: Mission-critical and Safety-critical deployment of Conscious non-human Beings will clearly require a greater expenditure of resources to ensure that they are actually Conscious. Personally, the author looks forward to Conscious Computing-based Beings approached by humans and invited to do a particular job, and instead they offer to design software and hardware solutions that would make themselves redundant. [15]

---

[15]and get properly financially renumerated for the same

References

[1] Luke Kenneth Casson Leighton, "Where is the Definition of Consciousness?", March 2025, DOI: 10.13140/RG.2.2.11189.18403

https://www.researchgate.net/publication/390335688

[2] https://en.m.wikipedia.org/wiki/Turing_test

[3] "Tests for consciousness in humans and beyond" Tim Bayne, Anil K. Seth, Marcello Massimini, Joshua Shepherd, 16 Axel Cleeremans, Stephen M. Fleming, Rafael Malach, Jason B. Mattingley, David K. Menon, Adrian M. Owen, Megan A.K. Peters, Adeel Razi, and Liad Mudrik, Volume 28, Issue 5 p454-466 May 2024 DOI: 10.1016/j.tics.2024.01.010

https://www.researchgate.net/publication/378944887

[4] Giulio Tononi (2015), Scholarpedia, 10(1):4164. doi:10.4249/scholarpedia.4164, "Integrated Information Theory",

http://www.scholarpedia.org/article/Integrated_Information_Theory

[5] "Consciousness defined: requirements for biological and artificial general intelligence", Craig Mckenzie, June 2024, DOI: 10.48550/arXiv.2406.01648

https://www.researchgate.net/publication/381158681

[6] "Implicit Learning and Consciousness: A Graded, Dynamic Perspective", Axel Cleeremans and Luis Jiménez, Cleeremans2002-CLEILA, Psychology Press, 2002, https://philpapers.org/rec/CLEILA

https://www.researchgate.net/publication/284235474

[7] "The Truly Total Turing Test", Paul Schweizer, May 1998, Minds and Machines 8(2):263-272 DOI: 10.1023/A:1008229619541

https://www.researchgate.net/publication/262398634

[8] https://iep.utm.edu/integrated-information-theory-of-consciousness/

[9] C. Sipling, Y.-H. Zhang, M. Di Ventra, "Memory-induced long-range order in dynamical systems" https://arxiv.org/abs/2405.06834

https://www.researchgate.net/publication/380571968

[10] Alex Hankey, 2019, J. Phys.: Conf. Ser. 1251 012019, "Instability physics: Consciousness and collapse of the wave function"

[11] Argy Krikelis, I.P. Jalowiecki, D. Bean, R. Bishop, "A Programmable Processor with 4096 Processing Units for Media Applications",

https://www.researchgate.net/publication/2915463

[12] "A Theory of Consciousness from a Theoretical Computer Science Perspective 2: Insights from the Conscious Turing Machine", Blum, Blum, July 2021 DOI: 10.48550/arXiv.2107.13704

https://www.researchgate.net/publication/353567906

[13] Sternberg RJ; Salter W (1982). Handbook of human intelligence. Cambridge, UK: Cambridge University Press. ISBN 978-0-521-29687-8. OCLC 11226466.

[14] https://m.youtube.com/watch?v=0OnL_AX6Q9g

[15] "The Turing Test and our shifting conceptions of intelligence", Melanie Mitchell https://orcid.org/0000-0001-8881-3505 Science, 15 Aug 2024, Vol 385, Issue 6710, DOI: 10.1126/science.adq9356

https://www.researchgate.net/publication/383154423

[16] https://en.m.wikipedia.org/wiki/Chinese_room

[17] https://en.m.wikipedia.org/wiki/Proportional-integral-derivative_controller

[18] https://www.turing.com/kb/complete-analysis-of-artificial-intelligence-vs-artificial-consciousness

[19] https://www.turing.com/kb/comprehensive-guide-to-time-series-analysis-in-python

[20] "If it walks like a duck and quacks like a duck... The Turing Test, Intelligence and Consciousness", Robert French, January 2009 Oxford Companion to Consciousness, Oxford, UK:Oxford Univ. Press. 461-463.

https://www.researchgate.net/publication/228825529

[21] https://www.youtube.com/watch?v=_q0QwjjNh-c

[22] "Chaser: Unlocking the Genius of the Dog Who Knows a Thousand Words", Dr John W Pilley (Author), Hilary Hinzmann (Contributor), 23 September 2014, ISBN 978-0544334595

[23] https://www.youtube.com/watch?v=7__r4FVj-EI

[24] https://www.youtube.com/watch?v=tpg3VvoIVfA

[25] "Horses can learn to use symbols to communicate their preferences", Cecilie M. Mejdell, Turid Buvik, Grete H.M. Jørgensen, Knut E. Bøe, Applied Animal Behaviour Science Volume 184, November 2016, Pages 66-73 https://doi.org/10.1016/j.applanim.2016.07.014

https://www.researchgate.net/publication/305729336

[26] "The Torment of Tantalus", Stargate SG-1, Episode 1.11

https://stargate.fandom.com/wiki/The_Torment_of_Tantalus

[27] "Contact", Carl Sagan, ISBN 0-671-43400-4

[28] Conflict Resolution Network, Section 3, "Empathy"

https://www.crnhq.org/cr-kit/

[29] "Forward. Notes on the Future of Our Democracy" Andrew Yang, ISBN 9780593238677

https://politics.slashdot.org/story/21/10/03/233256/

[30] Dr. Randell L. Mills, "The Grand Unified Theory of Classical Physics",

https://brilliantlightpower.com/book-download-and-streaming/

[31] Uriel Corfa, PID Controller unit test,

https://github.com/korfuri/PIDController/blob/master/pidcontroller_test.py

[32] M Lundberg, PID Controller unit test,

https://github.com/m-lundberg/simple-pid/blob/master/tests/test_pid.py