



# What is the Algorithmic Complexity of Subjective Experience? - An "Uncertainty Principle" for Subjectivity-



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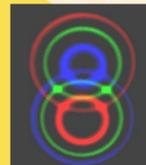
## Motivation: Should the mind be considered a fundamental or derivative feature of nature?

It is currently unclear if a **complete theory of mind** can be a derivative theory that **supervenes on other "working theories"**, say, **neurobiology**, or whether it more appropriately belongs within a more fundamental theory of nature. One approach is to **focus on features** that **distinguish** between **"working theories"** of nature and **fundamental theories**, and examine their possible relationships to a theory of mind.

Well, two basic features of "working theories" (e.g., classical physics, current neurobiology) are **local reality** and **determinism**. So a theory of mind that supervenes on these should also share these features.



On the other hand, **EPR-type experiments** seem to demonstrate that any fundamental theory of nature must exhibit (a) **violations of local reality** and (b) truly random, or **algorithmically incomputable** processes.

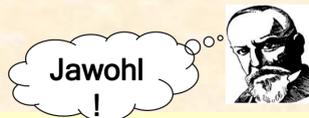


Entangled photons

So if a **complete theory of mind is fundamental to a theory of nature** as a whole, then it should exhibit these features.



A **complete theory of mind would account for all observable aspects of experience**. Although conscious experience has many diverse aspects and features, the **only directly observable** feature of experience is its **subjectivity**.



So, **focus on the so-called "hard part", subjectivity:**

While subjectivity trivially lacks the property of 'objectively real' in the usual sense, it is investigated here in the sense of EPR-type experiments. In fact, **we will argue this property is tied to algorithmic complexity**.



This motivates the key question: **does subjectivity exhibit algorithmically complex features?**

## Correlations with physical states require bit-string representations of subjective states

What are even you talking about? **Subjectivity isn't an objective 'thing'** that you can capture with a bit-string! That's why there is a "Hard Problem" in the first place...



That may or may not ultimately be right; but still, and independent of your ontology; **if you believe that subjective states can at least be meaningfully and unambiguously correlated with physical states**, you have no choice but to accept that there must be some **bit-string representation (code) of subjective states**.

Sounds really weird....



Not really so weird; in fact, **natural languages do provide finite bit-strings** (coded as words) associations for **certain aspects** of an experience. But these are highly **incomplete codes**. Here, by contrast, we are looking for a **complete coding** for the entire subjective experience.

OK, but assuming there is always some aspect of experience that is inherently private, then the only **operationally meaningful definition** of a bit-string code **C** for an experience **q** is for the **subject** experiencing **q** to **principally be able to associate** a bit-string **C(q) → q**.



But here's the rub: the **subjective act** of associating **C(q) → q** alters **q** (remember, **q** is the entire subjective experience, not just a single aspect of it), and **introduces** a nonzero "measurement error"! This is a **principle limitation on the accuracy of any coding and can never be eliminated**.

This feature of subjectivity can be seen as being as fundamental to the **coding of subjective experience** as Heisenberg's Uncertainty Principle is to **physical measurement**.



So any bit-string coding has an irreducibly random component to it: **subjectivity is algorithmically incomputable**.

## Algorithmic complexity of subjectivity implies a violation of local reality

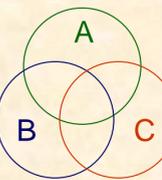
Note that the randomness here is **true randomness**, that is principally **not algorithmically computable** as in classical dynamics and fields of large **N** systems. That is, the set of codes **C** form a truly incomputable subset of the real numbers.

Some consequences are:

1. Each code **C(q)** requires an infinite length bit-string to specify. This has an **inherent intuitive appeal** in the sense that it expresses the notion that no amount of "objective words" can completely "capture" a subjective experience.
2. If we insist that physical states correlate with subjective states, we need a **physics which provides a framework for true randomness**. Currently the only such established theory is quantum mechanics.
3. **Subjective states violate local reality in the sense of hidden variables** since it follows from above that there can be no computable mapping from any "hidden variable space"  $\Lambda \rightarrow C$  for codes of experience.

Finally it is interesting to note we can straightforwardly frame Bell's Inequality in terms of the experience of observations as follows:

- Let **C(A,B,...)** be codes for qualia having, among others, the aspects (**A and B and ...**) (e.g. **A="seeing red" and B="feeling not happy"**).
  - Let **Q(A,B,...)** be an appropriate measure for the set **C**
  - Then it is easy to see from the Venn diagram at right a **Bell-type inequality**
- $$(1) \quad Q(A, \text{not } B) + Q(B, \text{not } C) \geq Q(A, \text{not } C)$$
- whenever (**A,B,C & negations**) can be experienced



Clearly this broad inequality will be violated whenever it's not possible to be aware of both "A" and "not B" at once.

**Note that (1) reduces to a Bell inequality** for spin 1/2 systems in the special case when **A="observed spin-up at 0 degrees, not B = "observed spin-down at 45 degrees, etc.."**



\*See e.g. David Harrison, U Toronto

Is there a deeper connection between subjectivity and violations of Bell's inequality beyond these formalisms?