An information-theoretic account of experiential consciousness & its introspection

The Core Mysterian Intuition – Leibniz

• Leibniz, *Monadology* (1714):
  “One is obliged to admit that perception and what depends upon it is inexplicable on mechanical principles, that is, by figures and motions. In imagining that there is a machine whose construction would enable it to think, to sense, and to have perception, one could conceive it enlarged while retaining the same proportions, so that one could enter into it, just like into a windmill. Supposing this, one should, when visiting within it, find only parts pushing one another, and never anything by which to explain a perception. Thus it is in the simple substance, and not in the composite or in the machine, that one must look for perception.”
The Core Mysterian Intuition – Huxley

• T.H. Huxley (1866):
  “How it is that anything so remarkable as a state of consciousness comes about as a result of irritating nervous tissue, is just as unaccountable as the appearance of the Djin, when Aladdin rubbed his lamp”

The Core Mysterian Intuition – McGinn (1989)

“How is it possible for conscious states to depend upon brain states? How can Technicolor phenomenology arise from soggy gray matter? What makes the bodily organ we call the brain so radically different from other bodily organs, say the kidneys - the body parts without a trace of consciousness? How could the aggregation of millions of individually insentient neurons generate subjective awareness? We know that brains are the de facto causal basis of consciousness, but we have, it seems, no understanding whatever of how this can be so. It strikes us as miraculous, eerie, even faintly comic. Somehow, we feel, the water of the physical brain is turned into the wine of consciousness, but we draw a total blank on the nature of this conversion. Neural transmissions just seem like the wrong kind of materials with which to bring to consciousness into the world, but it appears that in some way they perform this mysterious feat. The [puzzle of consciousness] is the problem of understanding how the miracle is wrought, thus removing the sense of deep mystery. We want to take the magic out of the link between consciousness and the brain...”
"It seems to me that science is increasingly giving us a viewpoint whereby organisms are able to be seen as physiochemical mechanisms: it seems that even the behavior of man himself will one day be explicable in mechanistic terms. There does seem to be, so far as science is concerned, nothing in the world but increasingly complex arrangements of physical constituents. All except for one place: in consciousness… I just cannot believe that this can be so. That everything should be explicable in terms of physics … except the occurrence of sensations seems to me frankly unbelievable. Such sensations would be “nomological danglers.” … Certainly we are pretty sure in the future to come across new ultimate laws of a novel type, but I expect them to relate simple constituents … I cannot believe that ultimate laws of nature could relate simple constituents to configurations consisting of perhaps billions of neurons … Such ultimate laws would be like nothing so far known in science."

These two intuitions are in tension but consistent with each other

- Some philosophers take the Mysterian Intuition very seriously, and try to turn it into an argument against physicalism, defending various versions of dualism.
- Others take the Naturalist Intuition very seriously, and attempt to develop (philosophical) theories about consciousness, or more typically they spend their time on showing why the mysterian (anti-physicalist) arguments don’t work.
What is information?

• Information is in nature
  Objective -- doesn’t depend on minds or interpreters.
• Information is generated whenever an event occurs eliminating the number of possible alternative events that could have occurred -- let’s call this the source.

Information Transmission

• The information of what happens at the source can be transmitted to a receiver if the events at the receiver lawfully depend on what happens at the source
Informational Content

- Dretske's Definition (1981:65, KFI):
  
  A signal $r$ carries the information that $s$ is $F$
  
  $\neg DF$
  
  The conditional probability of $s$’s being $F$, given $r$ (and $k$), is 1 (but, given $k$ alone, less than 1).

  - $F$ = a property
  - $r$ = receiver
  - $s$ = source
  - $[k$ = what the receiver knows, if anything, about the possibilities at the source]
Some consequences of this definition

- There can be no false information, misinformation or disinformation. So the context “carries the information that \([s \text{ is } F]\)” allows exportation by implying that there is an \(s\) that is \(F\).
- However: a rudimentary level of intensionality imbues nature given that the expression of informational content will be propositional and it will reflect only **lawful** correlations between property instantiations:
  - If all \(F\)s happen to be \(G\) so that ‘\(F\)’ and ‘\(G\)’ are co-extensional (by chance), a signal that carries the information that \(s\) is \(F\) will fail to carry the information that \(s\) is \(G\).
  - So: **Substitutivity** of co-extentional predicates fails.

Further aspects of information

**Transitivity**
- IF \(s’s\) being \(F\) carries the information that \(t\) is \(G\),
  \(t’s\) being \(G\) carries the information that \(u\) is \(H\),
  THEN \(s’s\) being \(F\) carries the information that \(u\) is \(H\).

**Non-Uniqueness**
- Thus, if a signal carries the information that \(s\) is \(F\), then it carries all the information \(s’s\) being \(F\) carries.

**Nesting**
- The information that \(t\) is \(G\) is **nested in** \(s’s\) being \(F\) \(\equiv_{DF}\)
  \(s’s\) being \(F\) carries the information that \(t\) is \(G\).
Some Background Assumptions

- **Naturalism**
  Mind metaphysically supervenes on the brain

- **Representationalism**
  - Mind is essentially representational;
  - Mental Representations (both sensory and conceptual) are realized in the brain and have their semantic properties fixed by an appropriate Informational Psychosemantics.

- **Computationalism (optional)**
  - Central cognitive processes (thinking, reasoning, etc.) are computations defined over syntactically structured mental reps, concepts.

Architectural distinction between sensory and central conceptual systems

[Diagram showing the architectural distinction between sensory and central conceptual systems]
What makes sensory reps conscious?

• Sensory representations are *conscious* only insofar as the information contained therein is *available* to the conceptual system, even if it is not necessarily put to use.

• *Put differently:* (for the most part) the information contained in sensory representations is *consciously* available to the organism only insofar as the organism *can* conceptualize this information, i.e., only insofar as the information can be used in the acquisition and/or deployment of the relevant concepts (ONTOGENETIC LEARNING).

Functional Determinants of the Architectural Distinction between Sensory and Conceptual Systems

• Vertical vs. Horizontal Information Processing
  – Roughly: world-mental vs. mental-mental interactions

• Sensation vs. Perception
  – Roughly: perception, unlike sensation, involves categorization implicating central cognitive systems

• Analog vs. Digital Encoding of Information

• Extractable vs. Non-Extractable Analog Information

• Acquisition vs Deployment of Concepts
Analog vs. Digital Encoding of Information

• The most specific information a signal, \( r \), carries about a source, \( s \), is the information \( r \) carries about \( s \) in digital form.

• If \( r \) carries more information about \( s \) [or, about \( t (s) \)] in virtue of carrying this digital information about \( s \), then this extra information is said to be carried by \( s \) in analog form.

• Analog information is information nested (nomologically or analytically) in the information carried in digital form.

⇒ The semantic content (SC) (as opposed to the informational content – IC) of a concept is identified with the information it carries in digital form.
Intuitive Idea behind the Analog/Digital Distinction

- Specify at each point, according to an ordering scheme, the hue, saturation, and brightness.
- Express this information in a conjunctive statement
- This is the digital content of this picture
- The information expressible by “here is a cube” is analog information carried by this picture nested in its digital content.

More about digital sensory information – 1

- On the basis of your visual experience, you think that [there are three vertical colored stripes]
- Although this is a judgment thus conceptual, it also expresses a piece of analog information that your visual experience carries because it is nested in its digital information content.
- Here is a bit more specific info: [there are three vertical stripes colored red, green, red in that order]
- This information is nested in the color distribution at each point of the square area you are seeing.
- What information is available at each of these points, then?
- Color info, of course. But what can you know about colors just by experiencing it?
More about digital sensory information - 2

- The letters represent whatever property is instantiated in each arbitrarily chosen discriminable points on the colored surface that you see on the left.
- Your visual experience gives you the following information:
  - a=b, a=e, a=f, b=e, b=f, e=f
  - c=d
  - c≠a, c≠b, c≠e, c≠f
  - d≠a, d≠b, d≠e, d≠f

  without giving you the information about what those properties are (let alone their nature) — they turn out to be surface spectral reflectances.

- Our visual system can do this not only for simultaneously presented points in an expanse, but also for diachronically presented points.

- Think of this as an engineering problem that the physiology of our visual system has managed to solve.

- The visual system assigns some positive value or quantity for each identical points and makes this positive (determinate) information available to the conceptual system.

- As it happens, we label the properties represented by these values (primitive categorizations – both at the sensory and conceptual level) as colors. But the engineering problem is the same for any sensory modality sensitive to any array of properties – or determinate values of any property.

Intuitive Idea behind:

Extractable vs. Non-Extractable Analog Information

Camera

“Buzz”
The thing to keep in mind about: Extractable vs. Non-Extractable Analog Information

• (Extractability)
Necessarily:
  – whereas there is some analog information sensory representations carry in extractable format, the (primitive) conceptual representations carry all their analog information (contained in their vertical tokenings) in non-extractable format.

• The semantic content (SC) of a concept =DF the most specific (i.e., digital) information that its vertical tokenings carry.

Sensory Concepts

• Sensory concepts are those concepts whose digital informational content is also part of the digital informational content of the sensory representations from which they are acquired, so that the abstraction/ digitalization distance between the concepts and these experiences is minimal (maximally short).
Perceptual Concepts

- Our visual system is such that we can’t visually represent a geometrical figure without simultaneously representing the lines, angles, curves, edges, and corners that, in some intuitive sense, constitute the figure.
- These constituents are not more determinate instances of the same figure type, so that even the concept of a most determinate geometrical figure of that type will not have a maximally short abstraction distance between it and the sensory base it is directly acquired from — even though these sensory bases are the sole authoritative source of acquisition for such concepts.
- The information sufficient (and necessary?) for the correct application of these concepts is contained in the sensory base from which they are directly acquired. Typical perceptual concepts in the case of vision include concepts of spatial/temporal relations, geometrical figures, and shapes.

Abstraction Distance: Sensory vs. Perceptual Concepts
Abstraction/Digitalization Distance: Sensory vs. Perceptual vs. Observational Concepts

A modern building w/ a façade of all glass windows

Central Conceptual System

Inverted Spectrum (IS)

Mr. Normal

“RED APPLE”

(Both truly apply to the apple?)

Mr. Invert

“RED APPLE”

It is no accident that IS thought-experiments are always conducted in terms of secondary qualities. For their information is carried in digital form with the analog info nested in it in a non-extractable format (both by sensory experiences and sensory concepts), i.e., they don’t represent these qualities as having complex internal structure (or having any structure at all).
Inverted Shapes?

Mr. Normal

“SQUARE”

(Both truly apply to the shape before them?)

Mr. Invert

“SQUARE”

This doesn’t seem possible -- Why?

Inverted Shapes Possible (but not for us!)

Ms. Detector

2D shape Detectors: a and b

Emitting simple sounds or colored lights

Conceptual categorization

SQUARE

CIRCLE

Ms. Inverted Detector

“ping!”

“pang!”

“pang!”

“ping!”
TWO DEEP TRUTHS ABOUT AUTONOMOUS REPRESENTATIONAL SYSTEMS!

• Such systems are nomologically bound to be hooked up to their environments in a way that at some level of abstraction they will always harbor sensory representations that represent complex physical properties in their environment as simple or atomic, (or rather, do not represent them as having internal complexity).

• Necessarily, if an autonomous intentional organism has concepts at all (or a conceptual system, as opposed to just sensory representations), however primitive or sophisticated, then it has some sensory concepts in our sense.

Two Questions:

1. Can one acquire observational concepts even if one has been completely blind? [YES]
2. Can one acquire sensory color concepts even if one has been completely blind? [NO]

• WHY?
Intuitive Answer

• Sensory concepts are modal
  – They essentially depend on the sensory modality from which they are acquired;
  – This directly follows from the fact that there is no abstraction distance between these concepts and their sensory bases.

• Observational concepts are amodal
  – They don’t depend on any particular sensory modality for their acquisition and deployment;
  – The abstraction distance between them and any sensory experience is big enough to free them from the influence of any peculiarly sensory information through which they are acquired and deployed.

Slightly Less Intuitive Answer

• Sensory concepts, when they are directly and correctly applied to objects on the basis of sensory experiences from which they are acquired, carry information about the relevant aspects of these experiences.

• Observational concepts, when they are correctly applied to objects on the basis of sensory experiences, do NOT carry information about these experiences. [Examples?]
Technical Answer

• Sensory concepts do not completely digitalize the information about the instances of qualities (of objects external to the mind/brain) to which they apply.
• Observational concepts do completely digitalize the information about the objects to which they apply.

So What Makes Sensory Concepts Special?

Answer: the lack of complete digitalization!

Complete Digitalization \(=_{DF} \) the semantic content of an (observational) concept \(C\) is the most specific information carried by \(C\) about a source \((o)\) such that there is NO separate structure \((e)\) such that \(C\) carries the most specific information about \(o\) by carrying the most specific information about \(e\).
Manners of Tracking in Vertical Deployment of Concepts

There aren’t very many ways in which red can visually strike us: the sensory concept “RED” tracks red by tracking a feature of red experiences – so, it has dual information content (IC)=<redness, e-red> (e-red = reddish experience)

There are indefinitely many ways in which an apple can perceptually strike us: SO the observational concept “APPLE” tracks apples without tracking apple experiences.

[[ AN ASIDE: A Puzzle about Semantic Content

• Why do we require complete digitalization when assigning semantic content to an observational concept, whereas we drop this requirement in assigning a semantic content to sensory concepts?
• According to the definition of complete digitalization, the sensory concept RED does seem to digitalize the information about that particular feature of red experiences from which they are directly acquired.
• So why don’t we assign that as the semantic content of RED?
Problem for Informational Psychosemantics? ]]

• As a matter of fact, common sense takes sensory concepts to apply to extramental qualities of extramental objects.
• So, for instance, in the case of vision, we ordinarily attribute colors to surfaces of objects or spatial expanses outside of us.
• If informational psychosemantics (IP) assigns the wrong content by assigning color experiences as their semantic content, SO MUCH THE WORSE FOR IP!
  • [there is a nice response to this worry, but I'll have to skip it here]

So where is conscious phenomenology?

• Why, it is in the experience!
• It is in the experience of the world we live in and interact with; that is,
• In the sensorial representations of the world.
• But only insofar as the experience is located within a certain kind of cognitive architecture or informational organization.
• What kind?
• The kind of cognitive organization whose information-theoretic foundations I have tried to present here, where a sensory experience is an interface between specialized sensory systems and a central conceptual system capable of some degree of ontogenetic learning (i.e., of new concepts acquisition from those very same experiences).
Introspection is not necessary

• For sensory representations (interfacing sensory and conceptual systems) to be phenomenally conscious, they need NOT be introspected.
• An autonomous intentional creature can be phenomenally conscious even when it doesn’t have the capability of introspecting; a fortiori, even if it doesn’t have any phenomenal concepts.
• Indeed: many animals and small infants are probably in this condition:
• they enjoy phenomenally conscious experiences insofar as they sensorially interact with the world, and on that basis, perceptually/conceptually come to know about the world, without the capability of reflecting on, thus knowing about, their experiences.

What is intuitively necessary and sufficient

for having phenomenally conscious experiences is the availability of information in the sensory array to a conceptual system sophisticated enough to be able to digitalize this information in the service of conceptually representing the world and thus interacting with it more selectively depending on the behavioral needs of the organism.
Some consequences of this picture - 1

- **Having a conscious (sensory) phenomenology is not intrinsic to whatever in the brain realizes this phenomenology (i.e., sensory experiences).**
- **Rather, it’s informational, functional, thus relational:** some brain processes get to be conscious only if they carry information about the world in a certain way and they are hooked up with a suitably sophisticated conceptual system that serves the needs of the organism.
Some consequences of this picture - 2

• But having a particular phenomenology is intrinsic to the brain processes realizing those kinds of experiences.
  
  – So inverted spectrum is possible
  – But zombies are not.

[More on this later…]

Perception vs. Introspection

• So far, all the concepts we have examined are concepts that apply to extramental reality: we have been talking about perception, or better, exteroception.
• How do we detect, conceive and think of our experiences and their qualities?
• How do we introspect?
  What concepts do we deploy in introspecting?
Phenomenal Concepts

• Phenomenal concepts are the concepts that give us the ability to detect and categorize the phenomenological qualities of our sensory experiences.
• It is through them we come to notice and thus come to know what it is like to see colors, hear sounds, smell odors, feel warmth, etc.
• The ability to thus reflect on our experiences is a sophisticated cognitive achievement.
• So, where do phenomenal concepts come from and what are they, exactly?

Intransitive Bodily Sensations

• We have a few phenomenal concepts (PC’s) whose acquisition and deployment follow a different pattern than the rest, and do not require a lot cognitive sophistication.
• These are the concepts of intransitive bodily sensations such as pains, itches, tickles, tingles, orgasms, and a few others.
• Let’s focus on pain.
The Concept of Pain

- According to the ordinary concept of pain, pains are essentially sensory experiences.
- They exist insofar as they are felt (their subjectivity),
- They are private to the sufferer,
- They are self-intimating (if you feel pain, you know that you feel pain),
- They are the source of incorrigible knowledge (if you believe you are in pain, then you are).
- All these seem to point to the fact that when we notice we have pain, we deploy a concept of pain that applies in the first instance (directly and immediately) to the experience, i.e., to pain.
- The concept of pain is already a phenomenal concept! So-called pain “perception” is a form of introspection!

Identical Information Flow but Different Semantics

IC("RED")=<redness, e-red>, but SC("RED")=redness
So “RED” is sensory concept!

IC("PAIN")=<damage, e-damage>, but SC("PAIN")=e-damage
So “PAIN” is a phenomenal concept!
Sensory Concepts Becoming Phenomenal Concepts

• **Introspection** is precisely that mechanism which takes the second element in the informational content (IC) of sensory concepts and makes it their semantic content (SC), turning them into phenomenal concepts deployed in detecting and categorizing experiential qualities.
  
  • Let’s denote phenomenal concepts by prefixing a ‘p-’ to the name of sensory concepts.
    
    – E.g., The sensory concept, call it s-RED, becomes the phenomenal concept p-RED.
  
  • RED carries info about red by virtue of carrying info about e-red.

\[
\text{IC("RED")=}<\text{redness, e-red}> , \ SC("p-RED")=e-red \\
\text{SC("s-RED")=redness}
\]

Phenomenal Concepts are closest, in terms of abstraction distance, to what they apply

• When PAIN or p-RED is vertically applied to the relevant aspects of their sensory bases, they carry the most specific information about those aspects (which are then made the concepts’ semantic contents).
  
  • These aspects are brain processes realizing the experiences.
  
  • But the way PCs carry this piece of digital information about these processes makes the analog information nested in them non-extractable.
  
  • Thus, the information about the internal complexity of these brain processes is not available for further digitalization: The abstraction distance between them is minimal.
Experiences as Information Generators - I

- When there is information in a signal about a source, what makes this possible is the elimination of alternative possibilities at the source that could have occurred, and the nomological dependency of the signal on these.

- If we want to talk about sensory and phenomenal concepts carrying information about experiences, we have to treat experiences as information-generating sources on their own — even when much of the information thus generated at the sensory level nomologically depends on the elimination of possibilities at a source beyond them, i.e., in the world.

Experiences as Information Generators - II

- Experiences are venues for information entry to the central conceptual system.

- There is as much information generated at the sensory level for pick-up by the conceptual system as there are different venues (sensory modalities and submodalities), distinct dimensions within these venues (pitch, frequency, amplitude; color, geometry, light intensity, etc.), and different (usually continuous) values each of these dimensions can take (red, orange, yellow, etc.; loud, very loud, even louder, etc.). Not only can we discriminate reds from oranges, oranges from yellows, but we can also discriminate a color from the spatial expanse of which it is the color, as well as discriminate visual experiences from tactile, auditory, gustatory, and olfactory ones.

- It is this multiplicity of information entry that allows us to treat sensory experiences and its parameters as information-generating sources, that both the sensory and phenomenal concepts pick up.
So How and When Does the Switch Occur?

- The evidence from developmental psychology indicates that this capacity is acquired only after the acquisition of intentional concepts and a modicum of folk psychology.
- Children seem to acquire these concepts and this mastery fairly early — approximately between the ages of three and four.
- It is no accident that the acquisition of the capacity to introspect one's experiences emerges only after this development.

How Does the Acquisition of Intentional Idioms Help?

- (ES) When p-RED is applied to experiences of red, it is impossible not to categorize the experiences, by this very application, as the epistemic source of the perceptual judgment/ categorization of a distal stimulus. But this is just to categorize these experiences as representations of redness of a certain kind, i.e., of the kind this [sort of brain state] subserves — if and when we have the necessary intentional concepts.
Standard Form of Introspective Judgments

• When we vertically apply p-RED to our experience of *redness*: the semantic content of the introspective *de re* judgment involved is something like:

  • *This* (p-RED) *is how redness is [registered]*
    (or, experienced, sensorially represented, etc.),
  • Or: *this* (p-RED) *is how red visually looks*

• where 'this (p-RED)' picks out a certain brain state type realizing the red experience primitively (only eliminating the relevant alternative possibilities), i.e., without revealing its constituent structure.

  • Note: The square brackets are used to indicate that the term is used "transparently" (not opaque). The regular parentheses are used to indicate that the phenomenal concept referred by the expression within has no natural public language translation.

Put differently…

• (ES*) It is the very “same concept” that is used both in picking out the relevant brain state (thus, eliminating the relevant alternative) and “commenting” on it as a [*sensory registration*] of *redness*.

• "sensory registration" ("experience" etc.) is the *intentional concept* involved in the semantic shift.

• This intentional concept at work can be quite rudimentary and basic — to the extent that the acquisition of folk psychology permits it in its earliest phases.
RECAP: The Anatomy of Phenomenal Concept Deployment in Introspection

In the introspective judgment about an experience of red, it is as if the same cognitive/brain structure were used twice over simultaneously:
- as p-RED applying to the experiential quality &
- as s-RED applying to worldly redness

“This (p-RED) is how I experience red”

More on Phenomenal Concepts -1

- When we conceive of our own conscious experiences, and wonder about what it is like to have a certain kind of experience, we do so through phenomenal concepts.
- They are our special ways of representing to our selves our own experiences and their qualities.
More on Phenomenal Concepts -2

Various facts make them special:

• We acquire them directly from our own experiences as we ourselves experience the world, and we deploy them in the same manner.

• No other concept in our entire conceptual repertoire (not even sensory concepts) has this kind of immediacy with what it represents: there is no appearance/reality distinction associated with their application.

More on Phenomenal Concepts -3

• Just like sensory concepts, they don’t represent their objects (aspects of experiences = certain brain processes) as having any constituent structure or complexity (that is why what they present does NOT seem “brainish”)

• Just like sensory concepts, they are capable of carrying digital information about what turns out to be complex (brain) properties without making this complexity available for further digitalization, i.e., in a non-extractable format.

• I.e., they don’t represent brain events they carry info about as having any internal physical complexity. That is partly why we don’t conceive of them as physical (how could anything lacking any internal constituent structure or complexity be physical?)
More on Phenomenal Concepts - 4

- They are perspectival in that no other concepts can represent our own experiences in the way PCs represent them, this directly and immediately.
- Relatedly, they work in a way analogous to indexicals or demonstratives in that they acquire their semantics from the special contexts in which they are formed and deployed.
- But they are not merely indexical or demonstrative: they are predicative, they positively identify and reidentify the experiential/brain properties they represent, a capacity they borrow directly from the sensory concepts they depend on. [[see slide "More about digital sensory information - 2"]]
- Sensory and phenomenal concepts are the only concepts that positively identify the quality they directly apply to without saying absolutely anything about their possibly complex nature (in any usable format).

Textual Resource

A comprehensive and detailed examination of the basic issues covered in these two lectures can be found in an article forthcoming in Noûs, 39(2): 197-255, (co-authored by Güven Güzeldere).