

## Box 1. Glossary

**Axioms:** Self-evident truth about consciousness (experience exists, it is irreducible etc.). The only truths that, with Descartes, cannot be doubted and do not need proof. They are existence, composition, information, integration, and exclusion (see text).

**Background conditions:** Fixed external constraints on a candidate set of elements. Past and current state of the elements outside the candidate set are fixed to their actual values.

**Candidate set:** The set of elements under consideration. Elements inside the candidate set are perturbed into all their possible states to obtain the TPM of the candidate set.

**Cause-effect repertoire:** The probability distribution of potential past and future states of a system as constrained by a mechanism in its current state.

**Cause-effect information (cei):** The amount of information specified by a mechanism in a state, measured as the minimum of cause information (ci) and effect information (ei).

**Cause information (ci) and effect information (ei):** Information about the past and the future, which is measured as the distance between the cause repertoire and the unconstrained cause repertoire (same on the effect side).

**Complex:** A set of elements within a system that generates a local maximum of integrated conceptual information  $\Phi^{\text{Max}}$ . Only a complex exists as an entity from its own intrinsic perspective.

**Concept:** A set of elements within a system and the maximally irreducible cause-effect repertoire it specifies, with its associated value of integrated information  $\varphi^{\text{Max}}$ . The concept expresses the causal role of a mechanism within a complex.

**Conceptual structure, constellation of concepts (C):** A conceptual structure is the set of all concepts specified by a candidate set with their respective  $\varphi^{\text{Max}}$  values, which can be plotted as a constellation in concept space.

**Conceptual information (CI):** A measure of how many different concepts are generated by a system of elements. CI is quantified by the distance D between the constellation of concepts and the "null" concept, the unconstrained cause-effect repertoire  $p^{\text{uc}}$ .

**Concept space:** Concept space is a high dimensional space with one axis for each possible past and future state of the system in which a conceptual structure can be represented.

**Distance (D):** In IIT 3.0, the Wasserstein distance, also known as earth mover's distance (EMD). It specifies the metric of concept space and thus the distance between probability distributions ( $\varphi$ ) and between constellations of concepts ( $\Phi$ ).

**Integrated conceptual information ( $\Phi$ ):** Conceptual information that is generated by a system above and beyond the conceptual information generated by its (minimal) parts.  $\Phi$  measures the integration or irreducibility of a constellation of concepts (integration at the system level).

**Integrated information ( $\varphi$ ):** Information that is generated

by a mechanism above and beyond the information generated by its (minimal) parts.  $\varphi$  measures the integration or irreducibility of mechanisms (integration at the mechanism level).

**Intrinsic information:** Differences that make a difference within a system.

**Mechanism:** Any subsystem of a system, including the system itself, that has a causal role within the system, for example, a neuron in the brain, or a logic gate in a computer.

**MICE (maximally irreducible cause-effect repertoire):** The cause-effect repertoire of a concept, i.e., the cause-effect repertoire that generates a maximum of integrated information  $\varphi$  among all possible purviews.

**MICS (maximally irreducible conceptual structure):** The conceptual structure generated by a complex in a state that corresponds to a local maximum of integrated conceptual information  $\Phi^{\text{Max}}$  (synonymous with "quale" or "constellation" in "qualia space").

**MIP (minimum information partition):** The partition that makes the least difference (in other words, the minimum "difference" partition).

**Null concept:** The unconstrained cause-effect repertoire  $p^{\text{uc}}$  of the candidate set, with  $\varphi = 0$ .

**Partition:** Division of a set of elements into causally, informationally independent parts, performed by noising the connections between the parts.

**Power set:** The set of all subsets of a candidate set of elements.

**Postulates:** Assumptions, derived from axioms, about the physical substrates of consciousness (mechanisms must have causal power, be irreducible, etc.), which can be formalized and form the basis of the mathematical framework of IIT. They are existence, composition, information, integration and exclusion (see text).

**Purview:** Any set of elements of a candidate set over which the cause and effect repertoires of a mechanism in a state are calculated.

**Quale:** The conceptual structure generated by a complex in a state that corresponds to a local maximum of integrated conceptual information  $\Phi^{\text{Max}}$  (synonymous with "MICS" or "constellation" in "qualia space").

**Qualia space:** If a set of elements forms a complex, its concept space is called qualia space.

**System:** A set of elements/mechanisms.

**TPM (transition probability matrix):** A matrix that specifies the probability with which any state of a system transitions to any other system state. The TPM is determined by the mechanisms of a system and obtained by perturbing the system into all its possible states.

**Unconstrained repertoire ( $p^{\text{uc}}$ ):** The probability distribution of potential past and future system states without constraints due to any mechanism in a state. The unconstrained cause repertoire is the uniform distribution of system states. The unconstrained effect repertoire is obtained by assuming unconstrained inputs to all system elements.