

Individuation and organization of holons in living ecosystems: Recursive integration and self-assertion by holon-lymphocytes

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The complexity of living ecosystems and organisms is interweaved with the complexity of the immune systems. Our mammal immune system has emerged from the **co-evolution of cells with their environment** during phylogenesis and ontogenesis. The immune system develops as a cognitive bio-diversified ecosystem with **dynamic interactive perceptive, reactive and adaptive network of cells and molecules**. Emerging from stochastic processes, the adaptive immune system organizes from the early ontogeny, in the fetus. Then, with historicity **transmission from mother's** immunoglobulins and microbiota, the immune system network is required to preserve the identity and integrity of our complex **holobiont poly-genomic organism**.

Stochastic molecular and cell events, progressively allow to diversify, a dynamic set of heterogeneous cell populations. The particularity of the adaptive immune system is to emerge from the progressive differentiation of **somatically diversified lymphocytes**. Each lymphocyte acquires an **identity at the somatic level**: hypermutation processes generate a **unique and stochastic type of immunoreceptor** for antigens, displaying a unique amino acid sequence in variable regions. Then each lymphocyte has an intrinsic individuality of "**immunoception**" meaning differential interaction, perception/adaptive reaction capacities to its changing environment. This identity contributes to the functional recursive "**self-assertion**" and "**integration**" of each autonomous lymphocyte to its environment. **Degenerative properties** of the immunoreceptor allow each lymphocyte to potentially interact with a million of stochastic antigens with differential affinities, leading at the lymphocyte population level to a quorum sensing and global immunoception. With their **adaptive capacities**, each lymphocyte is then able to capture local signals and **integrate** the messages as potential information's from its environment and modulate its behavior: the lymphocyte can induce its proliferation and clonal expansion, or its clonal cell death and extinction, and orient its functions according to changes in local environment. Then, the **dynamical behaviors** of the body cell and molecular networks, act in turn as constraints to the adaptive landscape of the lymphocyte population repertoires, according to the changing context of the cell/organism environments. Therefore, **various levels of stochastic variations**, are progressively introduced into biological entities co-evolving under various processes: by stochastic combination of V-D-J gene regions, stochastic addition and deletion of nucleotides, protein combinations and receptor triggering, and degeneracy of molecular and cellular interactions in lymphoid tissues. From a "theoretical" stochastic lymphocyte receptor repertoire, an "emergent" repertoire of somatically diversified and adaptive lymphocyte heterogeneous populations is produced. Then, from the tissue distributed "available" repertoire, upon antigenic interactions, the clonal selection activates for an adaptable time an "actual" lymphocyte repertoire able of inflammation and rejection, submitted to feedback regulations.

A dynamic modeling of the differentiation, interaction and selection/regulation of lymphocytes is proposed. At a global level, the immune system preserves the molecular and cellular identity and integrity of each organism, by the emergence of **dominant functions, as tolerance or rejection of antigens**. Complex links allow for the emergence of immunological memory, with adaptive anamnestic responses, allowing for the resilience of the holobionte organisms, adapting to stochastic changing environment. I propose an abstraction with dynamic interacting discrete holons: Holon-cells, Holons-lymphocytes, and Holon-organisms able to individualize, react and organize altogether from the stochastic interactions, as a complex multi-level emerging functional system. The recursive self-assertion and integration of living holons, allow for emergence of new links and functions, in the complex communicating dynamic multilevel ecosystems that can progressively co-evolve and functionally organize together, at the various scales. The immune system and the holobionte organism are rather robust and resilient to perturbations, unless aging and repeated multi-level perturbations disorganize them.

References, link to pdf: <https://immunocomplexit.wordpress.com/an-overview-on-modelling-t-lymphocyte-dynamics-from-physiology-to-perturbations-of-immune-system/>

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