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Research Article

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Does the Logic Underlying Micro and Macrostate Statistics Reflect Different Aspects of Cancer Cell Biology?

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Abstract

Do elements of microstate logic apply to macrostate events? What is the relation between macrostate two-valued logic and microstate quantum logic as they reflect deterministic or random events in biology and medicine or even in other fields. The relations between different classifications of probability and logic are not often discussed in the popular literature. It could be especially interesting if random and "chaotic" events in these two realms exhibited identifiable differences affecting outcomes which if more fully understood could have implications for biologic, medical or other fields. Do the two forms of logic reflect identifiable differences in cancer biology?

Keywords: Cell Biology; Quantum Chemistry

Introduction

Quantum mechanics is a theory of atomic and sub-atomic events in the "microstate" environment, which presumably is universally widespread [1]. How is any transition from a micro to a macrostate environment accomplished? Differences in logic often reflect observed differences in form and behavior of some studied process or idea. A logic does not impose its rationality on a process, inducing the appearance or non-appearance of some current or future event, but reflects conclusions associated with past events and current history. This certainly does not exclude suggesting future implications related to its tenets. This general viewpoint can be characterized as a form of "naïve realism",that operationally seems in common use [2]. We omit further logical "isms" from consideration but note that other formulations of these questions are available [1].

Particle Spin and Quantum Logic

"Spin" is a property associated with "Boson" force particles with whole spin numbers and including electrons and photons in states of symmetric wave functions , and Fermions, matter particles associated with fractional spin that is somewhat analogous to angular momentum [3,4]. Spin can be represented as two perpendicular directions, "up" and "down", or vice versa. From classical logic either one (0, negative, false) or the other (1, positive, true) is present, as (0,1) or (1,0). The "excluded" middle seems to be missing. Quantum logic allows either state to assume an identical value, yielding two additional values (0,0) or (1,1). These are non-commutative", that is, the order of their multiplication in calculations matters, and "up" or "down" cannot exchange orientation [4,5]. In ordinary logic only one of the two (01, 10) possible states can exist in a time and space. In the logic applied to a quantum superposition state, all four of the states could co-exist simultaneously [6] "Fuzzy" logic is concerned with values greater than 0 and less than 1. Quantum logic includes statements that can be true, false or indeterminate [5,6]. In ordinary logic AND distributes over OR but in quantum logic this distributive law fails.

Quantum logic depends upon the distributive laws of logic coupled with the superposition principle in which the result of adding together of other states is interpreted probabilistically, yielding new states representing a composite of their precursor [2,5,6-11]. There are other formulations of quantum logic. Bosons or "force" particles are characterized by Bose- Einstein statistics and Fermions ("matter" particles) by Fermi-Dirac statistics [3,4,12,13]. Conventional microstate logic and statistics includes formulations related to Cartesian and Boolean mathematics.

In a related interpretation, In the macroscopic world, only one of the four possibilities, 01,10, 00, 11 can exist in time and space. In a quantum superposition state, all four logical possibilities can be present at the same time [6]. Presumably various combinations, all of them probabilistic, may represent other logical outcomes, but further understanding of quantum logic is required to be certain of this.

Several Mechanistic Effects of Quantum Chemistry

Mechanistically there seem potentially to be two major identified quantum effects on atoms, sub-atomic entities, molecules and cells. The transduction of electromagnetic energy and the ability of some atomic and sub atomic particles and waves to circumvent energy barriers, as exemplified by hydrogen ion, electron and energy tunnelling [14,15], have been identified [4,16]. These properties are thought to have applications in photosynthesis, vision, olfaction, quantum biochemistry and cancer [10,13,17-20] and, in point of fact also other fields including non-biologic ones [19].

The widespread application of quantum mechanics in basic and applied applications; much of theoretical chemistry, transistors, integrated circuits, diodes, lasers .superconductivity, quantum computing, cryptography, medical Imaging as NMR , lasers etc., is to suggest a few of them [19]. Some of these processes likely apply to cells in different metabolic states, including those undergoing evolutionary and malignant transformations [21,22].

Interface between micro and macrostate logic

If quantum logic is universally present and likely preceded the logic we experience when confronted by more ponderable objects, how do they interface or overlap? Bose -Einstein and Fermi-Dirac statistics represent statistics applied to Bosons and Fermions respectively .It has been suggested that conventional "macroscopic" mathematics, logic and statistics represent quantum logic at the limit of its application to more complex aggregations of atoms, molecules, tissues, organs or individual organisms [15,20]. The two systems overlap and possibly represent a composite of probabilistic effects in the "terrain" between (0) and (1). The "law of large numbers" has been suggested to account by a sort of statistical averaging for the stability of ponderable objects [21], Innumerable physical variations summed in bulk in a mass action averaging exhibiting properties yielding the central limit theorem of macroscopic statistics.

Stated another way, atomic, subatomic and molecular interactions approach an astronomically large number of quantum mechanical wave additions and subtractions ("wave functions") with superposition and entanglement yielding an enormously complicated "gemisch" of mutually interactions of quantum wave functions can be imagined. If the original number of cells is limited, stochastic effects on some of them can result in a disproportionate number of "aberrant" cells with propertie3s distinct from the average. If the number of other cells is very large, their presence tends to dominate the outcome. Finally, the Higgs field and particle have been proposed as a major explanation for the stability of matter as we experience it. References [6,8-11,23] include further discussions of quantum logic.

Determinism Versus Randomness, Stochastic or Chance Events

For our purposes, determinism implies predictability, the ability of an effect to reliably follow from an identified cause. Presently for many individuals, random, stochastic or chance have the same implication of complete unpredictability. There are more subtle distinctions to characterize stochastic, statistical and quantum probabilities (11). If the results of stochastic events at the microstate level could be separated from random microstate or microstate events, that could be insightful. Were the randomness associated with chaos theory, different from the afore-mentioned categories, that would introduce an additional interesting complication [24].

Several kinds of cellular noise

Cellular noise is represented by random (or "chance"?) variation in biochemical processes during cell replication and metabolism [25,26]. It can be intrinsic or extrinsic in origin. Intrinsic noise is considered related to random events affecting transcription and translation. Exrinsic noise has been defined as different responses to two identically regulated genes among different cells. Have both intrinsic and extrinsic noise contributed to evolution and the development of malignant disease? Are most forms of noise random and others less so? Or at least less obtrusive? Is cell noise usually irrelevant, occasionally deleterious and rarely advantageous for the affected cell or organism? Does microstate noise differ from macrostate noise as to "targets", mode of action, timing, frequency, duration, intensity etc., taking in to account possible difference in their local environments?

Discussion

Presumably microstate statistics pervades the universe while macrostate statistics may represent a boundary condition of the former entity [16,17]. The random biochemical events available to either process depends upon the stage of development of the normal or aberrant "target" cells, tissue, organ or developing organism Presumably tunnelling can occur, whether as a component of cellular noise or as a somewhat independent random / stochastic aberration which could be very dissimilar when occurring in a micro versus a macroscale environment. By passing energy barriers by wave / particles and the modification of various atomic and sub-atomic structures by electromagnetism, electron and hydrogen atom tunnelling, the induction of DNA miscoding by these mechanisms or alteration in enzyme activity due to random atomic or molecular aberration represent potential statistical risks to a developing cell and its precursor molecules.

If outcomes of random stochastic changes in structure or function can be irrelevant, deleterious or occasionally beneficial to the cell, tissue, organ or animal, the largely unknown details of such events which seem to include two systems of statistics proceeding simultaneously whose molecular details should differ in time and place.

So would the use of a two valued microstate statistical program and a microstate quantum statistical program employed to characterize cellular developmental processes represent future opportunities to identify distinctive outcomes with implications for understanding additional features of cellular evolution and biomedicine? Randomness has probably provided opportunities for various life forms to escape from developmental cul de sacs and so this aspect is eminently worth thinking about.

Note to the Reader

Our original interest in the subject was related to the nature of any interface between two apparently different systems of logic and statistics. As this might affect differences in the consequences of random synthetic or other structural alterations during the development of biological organisms. The question is far beyond our ability to cope with it. Lacking serious knowledge of quantum theory and the underlying mathematics and logic used to characterize it, we members of the "laity" must rely on our limited understanding of the expert information provided by others [17]. And of course, there are additional formulations of quantum logic and the statistics used to characterize it [1,2,4,6,8-11]. Still the original question is intriguing, even if it seems somewhat unapproachable and inaccessible.

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