

Human Conceptual Thought and Quantum Structure

Diederik Aerts*, Bart D’Hooghe*, Emmanuel Haven†

In a earlier work [1, 2, 3, 4] we have put forward the hypothesis that two layers of thought can be identified in the human thought process, which we have called the ‘classical logical’ layer and the ‘quantum conceptual’ layer. In the classical logical layer thought processes are given form by an underlying Boolean logical conceptual process, its non deterministic ‘lack of knowledge’ version modeled by Kolmogorovian probability and in an idealized form by a stochastic process. In the quantum conceptual layer, the thought process gets form under the influence of the *totality of the surrounding conceptual landscape*. The key event within this layer is that different concepts figure as individual entities, *even* when they are combinations of other concepts. A phenomenon of *conceptual emergence* is taking place in the quantum conceptual layer mathematically described by *superposition* within the quantum formalism used to model this layer. The quantum conceptual thought process is indeterministic in essence; i.e. there is not necessarily an underlying deterministic process. It is however an equally well structured layer than the classical logical one, and we believe that it is mainly the lack of insight about the structure of this quantum conceptual layer that often leads to the idea that the thought processes described in it are mainly unstructured and correspond to intuitive or irrational thought. In the present paper we analyze more in detail the cognitive and mathematical structures of these two layers of thought. More specifically we put forward a concrete episode of human thought process, work out in detail its quantum mechanical representation, and analyze the different aspects that we have introduced in [1]. We comment by means of the specific findings in our elaborated example on the multitude of examples in a variety of areas of knowledge such as economics and psychology, where observed paradoxes can be explained within the double layer argument that we propose.

Acknowledgments This work was carried out within the project G.0234.08 of the Research Programme of the Research Foundation–Flanders (FWO).

References

- [1] Aerts, D. and D’Hooghe, B. (2009). Classical logical versus quantum conceptual thought: examples in economy, decision theory and concept theory. To appear in *LNCS*, in the proceedings of the *Third International Quantum Interaction Symposium (QI-2009)*, March 25–27, 2009, Research Center for Artificial Intelligence (DFKI), Saarbruecken, Germany. Springer.
- [2] Aerts, D. (2007a). Quantum interference and superposition in cognition: A theory for the disjunction of concepts. Archive reference and link: <http://uk.arxiv.org/abs/0705.0975>
- [3] Aerts, D. (2007b). General quantum modeling of combining concepts: A quantum field model in Fock space. Archive reference and link: <http://uk.arxiv.org/abs/0705.1740>.
- [4] Aerts, D. (2009). Quantum structure in cognition. *Journal of Mathematical Psychology*. Archive reference and link: <http://uk.arxiv.org/abs/0805.3850>.

*Leo Apostel Center for Interdisciplinary Studies, Brussels Free University, Belgium. E-mails: diraerts@vub.ac.be, bdhooghe@vub.ac.be

†SoM, University of Leicester, UK. E-mail: eh76@le.ac.uk