around. Quantum models of cognition offer formal exercises that might produce impressive fits to data but, by their foundational assumptions, cannot offer some of the most basic insights into the causes, effects, and relevant factors that underlie the workings of human cognition.

Jaynes (1983, p. 269) puts the physicists’ epistemological dissent bluntly, saying “I am convinced, as were Einstein and Schrödinger, that the major obstacle that has prevented any real progress in our understanding of Nature since 1927, is the Copenhagen Interpretation of Quantum Theory. This theory is now 65 years old, it has long since ceased to be productive, and it is time for its retirement.” It would be unfortunate if a theory ready for retirement in its professional field of physics were to enjoy a second hobbiest career in psychology.

Grounding quantum probability in psychological mechanism

doi:10.1017/S0140525X12003147

Bradley C. Love
University College London, Cognitive, Perceptual and Brain Sciences, London WC1H 0AP, United Kingdom.
b.love@ucl.ac.uk
bradlove.org

Abstract: Pothos & Busemeyer (P&B) provide a compelling case that quantum probability (QP) theory is a better match to human judgment than classical probability (CP) theory. However, any theory (QP, CP, or other) phrased solely at the computational level runs the risk of being underconstrained. One suggestion is to ground QP accounts in mechanism, to leverage a wide range of process-level data.

Pothos & Busemeyer (P&B) make clear that quantum probability (QP) theory offers a rich array of theoretical constructs, such as superposition, entanglement, incompatibility, and interference, which can help explain human judgment. The authors illustrate how these concepts, which are strongly contrasted with the basic tenets of classical probability (CP) theory, can be used to accommodate aspects of human choice that deviate from normative CP accounts. For example, the conjunction fallacy is explained in terms of incompatible questions requiring sequential evaluation, which induces an interference effect.

Although new frameworks can provide novel insights, one worry is that QP will recapitulate some of the shortcomings of rational CP approaches by sticking to a computational-level analysis. To the authors’ credit, they acknowledge how notions of optimality in CP approaches can be impoverished and not match the goals of QP approaches by sticking to a computational-level analysis. The move to mechanism is made, second generation questions can be asked, such as which QP model best accounts for human judgment. My guess is that moving away from evaluating general frameworks to testing specific proposals will hasten progress. As the authors note, it is very difficult to invalidate an entire framework, as ancillary assumptions can always be made (e.g., CP models can be modified to account for the main findings in the target article). In contrast, particular models can be evaluated using model selection procedures.

My prediction is that moving toward evaluating particular models grounded in mechanism will lead to a rapprochement between QP and CP approaches. For a view that allows for superposition, many aspects of the CP are very rigid. For example, according to the approach advocated by the authors, statements are either compatible or incompatible. One possibility is that successful models will be more fluid and include a mixture of states, which is a notion from CP. Given the complexities of human cognition and decision making, it would be surprising if one unadulterated formalism carried the day. Although physics undergraduates may complain about how confusing QP is, human cognition will likely prove more vexing.

Cognition in Hilbert space

doi:10.1017/S0140525X1200283X

Bruce James MacLennan
Department of Electrical Engineering and Computer Science, University of Tennessee, Knoxville, Knoxville, TN 37996.
maclennan@utk.edu
http://web.eecs.utk.edu/~maclennan/

Abstract: Use of quantum probability as a top-down model of cognition will be enhanced by consideration of the underlying complex-valued wave function, which allows a better account of interference effects and of the structure of learned and ad hoc question operators. Furthermore, the treatment of incompatible questions can be made more quantitative by analyzing them as non-commutative operators.

Pothos & Busemeyer (P&B) argue for the application of quantum probability (QP) theory to cognitive modeling in a function-first or top-down approach that begins with the postulation of vectors in a low-dimensional space (sect. 2.1), but consideration of the high-dimensional complex-valued wave function underlying the state vector will expand the value of QP in cognitive science. To this end, we should import two premises from quantum mechanics. The first is that the fundamental reality is the wave function. In cognitive science, this corresponds to postulating spatially distributed patterns of neural activity as the elements of the cognitive state space. Therefore, the basis vectors used in QP are basis functions for an infinite (or very high) dimensional Hilbert space. The