



Fig. 2. The three-world problem recast at two levels in terms of David Krakauer’s Ulam Lecture (Santa Fe, September 2011) on the ubiquity of **representation**, **algorithms** and **strategy** in all living organisms and at every level: individual and social, **information processing** and **relations**. Arrows suggest directed cycles. Placement of **information processing** and **patterned feedback** avoids the implication that the latter is reified as “distributed cognition.” Rather, from a not always consistent distillation of practices, patterned feedback emerges in roles and cohesively organized groups that can be represented in information processing of a biological entity, and a neural D-A link for representing interactive feedback but no directed A-D link because “interactive feedback” (external information) is not “neural” (internal information). There are network and environmental physical B-C brain-behavior loops and an A-B-C-D cycle with nonmaterial elements including internal information and external information. The network oval C evokes the idea that episodic behaviors are internally (experientially) and externally perceptual and can be represented as network flows with an episodically temporal ordering in behavior that draws on restructured and weakly encoded neural memory of episodic experience. *Solid and dashed ovals encircle material and immaterial elements, with causality between material items, pattern projections between internal and external information, and abstractions between material/immaterial counterparts: representations “perceive” internal and external experience episodically and algorithmically, while behavior “models” a response to external interaction.*

Comparing the anthropocentric Fig. 1 with its biological counterpart, the seemingly odd downward arrow from mind to brain in Fig. 1 now becomes clear. Brain “abstracts” by the way that algorithms become habituated through what seem to humans like higher order “cognition.” The human view of other beings, however, can only be “external” even though it is through the external world as part of their cognition that humans “think,” not so differently from others.