Volume 42, June 2010

iConstructivism

by Brian R. Gaines
University of Victoria
gaines@uvic.ca

One of the pleasures of retirement is the time to pursue research topics in depth and to read the relevant literature at leisure. I have taken advantage of this in the past decade to pursue a byway of personal construct psychology (PCP) that has been little investigated, its roots in Kelly's engineering background and wartime experience. He prepared his 1955 book in a transition era when notions of *cybernetics* and *electronic computers* were beginning to influence psychological theory, and his book includes several very interesting commentaries on the relevance of each of these topics to his development of PCP.

If one's interest is primarily in applied psychology one tends to pass over these discussions as part of the wide-ranging general commentary that Kelly includes in his exposition of PCP. However, his comments on cybernetics and computing as well as the more prevalent references to mathematics, geometry, logic and networks, and his logical development of PCP as a fundamental postulate from which emerges his major corollaries, indicate that he envisioned a profound theoretical psychology as a foundation for PCP.

I have found it fascinating to extract this foundational material and express it in terms of developments in mathematics, logic and computing in the decades since Kelly's last publications. How would he have expressed his theory in the light of these advances? How does it relate to the later development of *semantic networks*, *contrast sets*, *conceptual spaces*, *substructural logics*, *computational complexity* measures, and so on? Pioneers of some of these later developments cite Kelly's work as a significant influence on their own, and perhaps if he had lived longer he would have participated more fully in these initiatives and been more widely recognized for his contributions to them.

For example, Quillian's (1967) citation of Kelly (1955) in his seminal paper on *semantic networks*, and Kelly's emphasis that "no construct ever stands entirely alone; it makes sense only as it appears in a network" (p.304), situate him in the origins of semantic network models of human memory and reasoning. These models were formalized through the theory of *description logics* (Baader, Calvanese, McGuinness, Nardi and Patel-Schneider, 2003), as tractable sub-sets of first-order logics, where it also emerged that general negation is a fundamental source of intractable complexity in reasoning. Kelly's emphasis on *dichotomous opposition* within a *range of convenience,* rather than general negation leads to a substructural logic (Koslow, 1992) that resolves the tractability problem, but his contribution has long been forgotten in the semantic network literature.

Similarly, Frake (1969) acknowledges Kelly (1955) as the source of his notion of *contrast sets* that has not only became a foundational model in cognitive anthropology but was also adopted by Kuhn in his theory of conceptual change in scientific revolutions as a solution to

Gaines, B. R. (2010). iConstructivism. Constructive Interventionist, Newsletter of the Centre for Personal Construct Psychology 42, 6-8.

revolutions as a solution to Wittgenstein's problem of open texture in family resemblance (Andersen, 2000). Kelly's role is again forgotten in the derivative literature.

The reconstruction of Kelly's theoretical psychology within a modern framework is both of historic interest and also a potentially significant contribution to some of the current major issues in computational logic, cognitive science, psychology of science, and psychology of reasoning.

The paper, *Visualizing logical aspects of conceptual structures*, which Fay asked me to précis for this newsletter is one of a series deriving from this reconstructive research, none of which are central to it, but all of which are by-products that emerge when I am asked to contribute to a special issue or volume on any topic. It was prepared for a special issue of the *Journal of Visual Languages and Computing* on visual languages for logic. The paper derives the mathematical relations between representations of conceptual structures, including *Euler diagrams* (Euler, Brewster and Griscom, 1840), *conceptual grids* (Kelly, 1955), *semantic networks* (Quillian, 1967), *conceptual spaces* (Gärdenfors, 2000) and *logical symbolism* (Baader *et al.*, 2003). It proves the formal equivalence of these diverse representations, translating between what are apparently quite different approaches to modeling representation and reasoning processes, using Kelly's integration of the logic of "opposition" and "ordination" and its representation as a "conceptual grid" to provide a "cybernetic model" of the "geometry of psychological space."

It does this using another notion from Kelly, that constructs may be used to construe other constructs. The self-description of a construct network using as features of each pole the implied fit of other poles when the first pole is asserted to fit an experience generates a conceptual grid, and the principal components analysis of this grid generates a geometric model of the original network. The paper shows that the network, grid, logical and geometric models are equivalent and one can move freely between them. The mathematical equivalence, however, does not imply psychological equivalence. The various models are complementary constructive alternatives providing different insights into the construct systems they represent.

The paper also illustrates Kelly's assertion that a construct network supports anticipation by providing templets that can be fitted to experience, enabling present experience to be compared with past experiences. The abductive assumption that similar past experiences can be used to more fully represent present current experience allows additional aspects of that experience to be hypothesized.

The most recent volume of Margolis' (2010) epic series of books on American philosophy recounts the triumph of Dewey's pragmatism and constructivism as a synthesis of analytic and continental philosophy, and, in doing so, incidentally provides philosophical foundations for PCP. Kelly's achievement of extracting the essence of Dewey's notion that human psychology is characterized by our anticipation of the future, ruthlessly excising all associated notions, such as learning, motivation and affect, as deriving from this, and formulating this as a rigorous theoretical psychology and a powerful applied psychology, is a significant contribution to this triumph. Kelly operationalized Dewey's ideas to provide the foundations for his own clinical psychology but, in doing so, he also provided a

comprehensive rigorous model of pragmatic constructivism that others are only now beginning to rediscover.

Apple have popularized the use of the prefix "i" to indicate associations with "individual," "inform," "inspire" and "internet" and these terms seem also to be the appropriate associations for the modern reconstruction of Kelly's mathematical psychology—hence the title of this note. I believe he would have found it both interesting and amusing, the stimulus for yet another limerick, to see how his work is being reformulated in this information age.

References

The paper summarized and associated papers are available at https://cpsc.ucalgary.ca/~gaines/reports

Andersen, H. (2000). Kuhn's account of family resemblance: a solution to the problem of wide-open texture. **Erkenntnis** 52, 313-337.

Baader, F., Calvanese, D., McGuinness, D., Nardi, D. and Patel-Schneider, P., eds. (2003). **The Description Logic Handbook**. Cambridge University Press, Cambridge.

Euler, L., Brewster, D. and Griscom, J. (1840). **Letters of Euler on Different Subjects in Natural Philosophy**. Harper, New York.

Frake, C. O. (1969). The ethnographic study of cognitive systems. In **Cognitive Anthropology** Tyler, S. A., ed, pp. 28-41. Holt, New York,.

Gärdenfors, P. (2000). **Conceptual Spaces: The Geometry of Thought**. MIT Press, Cambridge, MA.

Kelly, G. A. (1955). **The Psychology of Personal Constructs**. New York, Norton

Koslow, A. (1992). **A Structuralist Theory of Logic**. Cambridge University Press, Cambridge.

Margolis, J. (2010). **Pragmatism's Advantage: American and European Philosophy at the End of the Twentieth Century**. Stanford University Press, Stanford, CA.

Quillian, M. R. (1967). Word concepts: a theory and simulation of some basic semantic capabilities. **Behavioral Science** 12, 410-430.