Action Research: Its History and Relationship to the Scientific Method

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This paper presents a Western philosophical view on the development of belief systems and theory-based methods over time and their relationship to the development of Action Research (AR). It is the first of two papers that seek to demonstrate the close relationship between traditional scientific methods and Action Research.

A philosophical basis for Action Research (AR): The Greeks

There is no simple answer to the question "What is AR?" (Checkland and Holwell 1998a; Reason and Bradbury 2001). This paper therefore presents a Western philosophical view on the development of belief systems and theory-based methods over time and their relationship to the scientific method and the development of Action Research (AR).

In Ancient Greece the "rise of mental coherence" (Singer 1959) involved inquiry, debate and discovery of concepts of reality. But while his predecessors had asked "what is it made of", Pythagoras (569 - c.500 BC) asked "what is its pattern" (Bateson 1964) implying that the essential components of matter were numbers and particularly geometry. In other words from a broad "inductive" perspective, some concepts of reality which started with observations, ended up with theories. Hence from about this time some of the first theories about the conceptualization of reality followed (Singer 1959; Spangenburg and Moser 2004) and a religious philosophy was perhaps first challenged by mathematically based inquiry processes and the concept of a Mathematical Universe (Checkland 1993).

For Heraclites (c 500 BC) inquiry and conceptual thinking involved a "becoming" reality where all things involved unending struggles and strife in a continual state of flux. The only thing of permanence was the principle of change itself (Singer 1959). However opposing Heraclites, Parmenides (c.515 - 450 BC) presented a "being" concept of reality interpreting it not experientially, but by using an early form of dialectic inquiry to think logically. Attacking observational science, Parmenides asserted the primacy of logic claiming that the senses were deceptive and that observation was inferior to logical argument. Also from a dialectic perspective, Socrates' (469 - 399 BC) largely abandoned inductive inferences (Ellinor and Gerard 1998) to favour broadly "deductive" inference where concepts of reality started with theories and from them, sets of action principles were synthesized. Importantly Socratic "truth by discussion" perhaps first allowed for a mixture of inductive and deductive inferences. From this question and answer technique, early "abductive" inferences thus allowed for a "scientific method" via the formation of hypotheses and promotion of contextual action. Aristotle (384 - 322 BC) further contributed to the foundation of the scientific method by basing his knowing on testing, inquiry and experience.

In summary the Greeks had "argued for the sole purpose of arriving at the truth and, with argument as their chief weapon; argument used deliberately, consciously, and carefully, developed into a technical method" (Checkland 1993). This foreshadows Pepper's (1942) root metaphor of *Formism* and we therefore associate rudimentary observational science, never-ending change and different forms of inferential logic as embryonic contributors to Western philosophical thinking, the scientific method and the very early development of AR.

The philosophical basis for Action Research: The Scientific Age

Leading to the scientific age, Ackoff (1993) paints a bleak picture of the Middle Ages, Singer (1959) agrees referring to this time as "the failure of knowledge". However, during this time, the Arabs preservation and translation of Greek texts ensured that the systemic development of knowledge might be progressive and cumulative. Later we stress the cumulative importance of reflective thinking in contemporary AR but as the scientific era dawned deductive logic increased its legitimacy as a method for securing truth.

The "revival of learning" of the *renaissance* (Singer 1959) saw what Walsh (1992) encapsulates as man's focus shifted from *a fulfillment beyond this world, to a state of perfection within it.* Observation and measurement became co-contributors to the 'neo-sciences', the intermediary phases that preceded what were later to become methods of the scientific methodology. Checkland (2000: 36) provides a succinct account of method and methodology and we take his view that a methodology is at a meta-level with respect to a method. Methodology is therefore a body of methods used in a particular activity.

With the application of observation and logic to the neo-sciences came great discoveries and a greater attention to their methods of creation. Soon "incredible" discoveries in the new field of *science* began to threaten the conformist theological doctrine. Hence Francis Bacon (1561 - 1626) emphasized the importance of data but Harvey (1578 - 1657) went further showing how to record accurate data from observations. His seminal theory of blood circulation demonstrates the importance of three aspects of scientific enquiry: speculative reason in the formation of hypotheses, accurate quantitative analysis and a blend of induction and deduction.

Now observation followed by mathematics, the dialectic and logic aggregated into a holistic scientific technique. Consequentially, the iterative interplay of inductive and deductive inference consciously and carefully brought maturity to the emerging scientific technique. In addition, the processes of reflective assessment and iteration were established as its tools of refinement. In setting prediction as a standard for scientific theory, man moved away from divine determinism. We acknowledge the immense power of the dialectic as a method for establishing concepts of reality through discussion. As Einstein (1879 - 1955) put it "science without religion is lame, religion without science is blind". Hence classical Socratic thought evaluated the scientific and theological doctrines. Thus Butterfield (1958: 17) suggested that "how things worked" became the catch cry of the next worldview the *scientific revolution.*

In the *scientific revolution* we had a time labeled as *the* most extraordinarily productive in the entire history of pure science (Debus 1992). There we had an emerging technique where tools of measurement represented a triumph of observation (experience) over logic. We believe this brought an important and interesting ongoing dynamic in the form of the induction-deduction process, which in addition to an early form of abductive logic, inference in which explanatory hypotheses are formed and evaluated provided the basis for the reflective iteration within the double loop learning processes that characterise contemporary methods of Action Research (Bateson 1964; Argyris 1982; Nonaka 1994; Nonaka and Takeuchi 1995; Checkland 2000). But perhaps more importantly, we also link reflective iteration with the refinement of a whole of AR methodology. This view is evident in Checkland's (2000: 19) description of his Soft Systems Methodology (SSM);

"*...the methodology is presented as a sequence of stages with iteration back to previous stages, the sequences being: analysis; root definition of relevant systems; conceptualization; comparison and definition of changes; selection of change to implement; design of change and implementation; appraisal.*"

We contend that the dialectic of analysis/induction and synthesis/deduction created a cyclic process for a universal scientific paradigm. The steps of that paradigm: observation, hypothesis, experimentation and generalization became indoctrinated into all particular methods of science. Newton's thinking often began with intuition, the great abductive process, later supported by experiment, deductive inference and mathematical confirmation. Supporting this view, Stuewer (1970) says that 'Newton invents theories, he proposes a radically empiricist methodology, and he claims that he has obtained the former with the help of the latter'. Philosophically, the scientific paradigm suggested that belief secured from the pillars of physics, chemistry and biology could be explained by relatively simple sets of mathematical laws. However, problems in physiology, psychology and some of the newer sciences on the whole struggled with attempts to integrate Newtonian mechanics into their methodologies. Hence the appropriateness of subjecting the metaphysical and social scientific worlds with strains of measurement appropriate to the physical sciences came to the fore.

The subsequent development of "softer" perspectives of reality can be linked to the times of the German Idealist Immanuel Kant (1724-1804). Kant suggested that empiricism and rationalism went hand in hand creating a resolution of paradox. But from Kant's reflection on failed attempts to explain various aspects of human nature came his concept of *a priori* knowledge where, though common principles have to be accepted as existing independently from our sense perceptions, they cannot be proved. Kant also declared that the methods of the physical sciences were founded on *a priori* concepts "as well as" sensory experiences. He went on to say that the securing of knowledge in the physical world really occurred by using subjective perspectives of rational systems such as mathematics. He therefore contested the appropriateness of the scientific methodology as a means for dealing with reality in the metaphysical and social scientific worlds. Kant's thinking is an important precursor to Piaget, C.S.Peirce and Pavlov. We highlight the significance of Peirce's logic, semiotics and four main methods of fixing belief (tenacity, authority, a priori and science) in linkages we make in a later paper (Barton, Haslett et al. 2007) through James, Singer, Simon, Churchman, Forrester and Ackoff to culminate in Beer's (1972; 1979; 1985) Viable Systems Diagnosis (VSD). Applebaum (1992: 169) says that Peirce (1839-1914) rectified an empirical imbalance by suggesting not only the justification of analysis or "scientific" knowledge, but by positing the issue of knowledge growth through the circular reflection and a blend of empiricist views and *a priori* concepts of logic to improve knowledge. This "pragmatic" view of epistemology thence gained popularity in areas other than the physical sciences, as an acceptable way of securing reality.

At the turn of the 19th century empiricism and induction contributed to rigor in the observational and formation of hypothesis steps on one hand, while on the other, the deductive or rational approaches advanced rigor in the experimentation and generalization steps. The importance of this is shown by Kemeny quoted in Quade and Miser (1985) who describe the scientific methodology by way of Einstein (1879 - 1955):

"*As Einstein has repeatedly emphasized, First of all the scientist is an observer. Next he tries to describe in complete generality what he saw, and what he expects to see in the future. Next he makes predictions on the basis of his theories, which he checks against the facts again. The most characteristic feature of the method is its cyclic nature. It starts with facts, ends in facts, and the facts ending one cycle are the beginning of the next cycle. A scientist holds his theories tentatively, always prepared to abandon them if the facts do not bear out his predictions. If a series of observations, designed to verify certain predictions, force us to abandon our theory, then we look for a new and improved theory.*"

This definitive expression of the scientific methodology also depicts a *four stage, continuous and iterative learning cycle* which is consistent with many AR learning frameworks. For example Dewey (1943), Deming (1982), and Flood (1999) base their action-learning frameworks on the "cyclic" method described by Einstein. However as Walsh (1992:142) explains, the study of man and society is different from the study of planets and electrons because human reality becomes largely known *through participation in it*. We clearly acknowledge the disparities between systems science and systemic intervention research practices, and the necessity of taking into account multiple standpoints on perceptions of reality. Using the root metaphors of Pepper's (1942) *World Hypotheses,* we have thus associated the time of the Greeks with *Formism* and Newtonian science with the *Mechanism*. We now associate the third of Pepper's root metaphors *Organicism* with the *Modern era* worldview to look at the formalization of Systems Thinking and the development of the Organizational Behavior (OB) and AR intellectual streams.

Formism and *Mechanism* have not disappeared during the *modern era.* Whereas the mechanistic view had claimed that analysis and reductionism could explain all objects and events, Vitalists were among those biologically minded who queried the capacity of *Mechanism* and/or *Formism* to sufficiently explain behavior in complex entities where intrinsic properties could not be derived merely from an understanding of their parts. In describing *equifinality* as a mechanism whereby a system has a specified goal, or final state which it may reach in different ways from different working conditions - the goal is equifinal, we agree with Beer's (1959: 168-9) inference that Von Bertalanffy's (1950) proof that closed systems cannot behave equifinally effectively rebutted Vitalism.

In the *modern era*, von Bertalanffy's (1968) General Systems Theory (GST) and the biological metaphor underpinned methods that explored complex systems including then embryonic organizations and laid the claims of the Vitalists to rest. Our views on organizations and thinking in the *modern era* are however strongly influenced by Systems Thinking with its foundations in the both biological and mechanistic metaphors. The concept of inherent feedback systems was fundamental to knowledge about the functionality of organizational systems. Systems Thinking is now strongly endorsed (Simon 1979; Senge and Sterman 1992; Park 1999) as a valid approach for securing of knowledge about functionality in organizational systems. Our belief is that the enhanced systemicity of the 1990's introduced new ways of thinking to people concerned about understanding through Kant's *a priori* knowledge.

Our line of thinking suggests that some discontentment with mechanistic thinking led to the formalisation of Systems Thinking around the middle of the 20th century. From that time, OB has progressed to become a justifiable way of securing knowledge about management practices in complex organizational systems. However some disappointment with some of the OB methods, basically generated through the analysis-synthesis dialectic then germinated a different but not unrelated interest in knowledge created *in and of* organizations, rather than that created by the application of static prescriptions *onto* them. Hence AR, a different stream of thinking, was founded.

Restating that there is no simple answer to the question 'What is AR?' (Checkland and Holwell 1998a; Reason and Bradbury 2001), it is broadly agreed that AR was founded by Kurt Lewin (1946; 1947; 1951). We think of Lewin's founding work in Sarton's (1952) terms as a particular "cut" in social history where an interconnection of Systems Thinking, OB and AR gave substance to a paradigm shift about how research might be conducted in and about organizations.

As Midgley (2003: xviii) puts it "by drawing upon the full variety of systems ideas, we should be able to produce a more rounded understanding of people, organizations, societies and the world we live in, than could emerge from any of the traditional (*deterministic*) scientific disciplines" [*our emphasis*]. Here, Midgley (2007) means that the traditional scientific approaches are useful but limited unless integrated into a more systemic perspective. Scientific methods can become part of a systems thinker's toolkit, but whether those purposes are appropriate needs to be assessed systemically. This view emphasizes a potential shift in thinking as research is conducted *in and by* rather than *on* organizations.

We have now presented a Western philosophical view on the development of belief systems and theory-based methods in the light of recognized worldviews. That view is grounded on our core belief that knowledge may be developed through an analysis-synthesis dialectic. In promoting Systems Thinking, OB and AR as meaningful "new" ways of producing knowledge, our view is that Pepper's *Organicism* root metaphor has been influential in the development of knowledge. It is also our belief that Pepper's fourth root metaphor, *Contextualism* grows in importance, particularly for emerging worldviews such as *Post-modernism.*

Barton and Haslett (2007) argue that the scientific method and the development of knowledge can be described in terms of the analysis-synthesis dialectic and that this process can be used to describe both the "grand" developments in science and "micro" developments at the organizational and personal levels. When supported by the system of inferential logic described the 19th Century pragmatist philosopher, Charles Sanders Peirce (Peirce, 1878), this process also

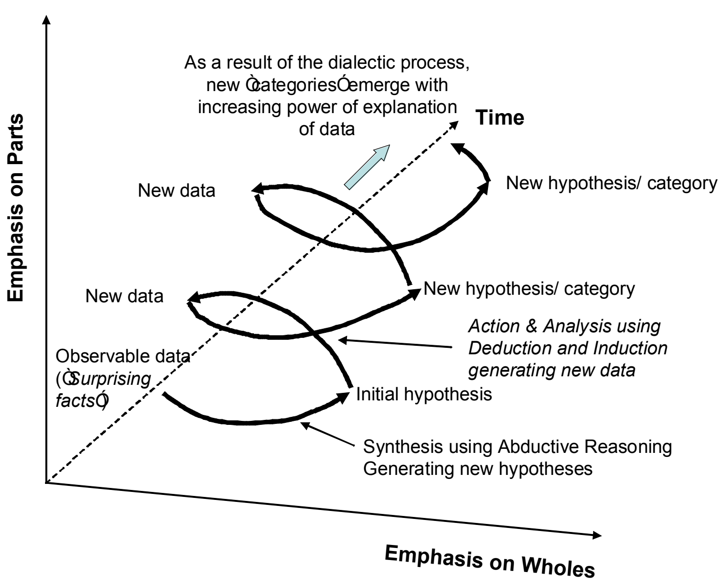

Figure 1 *The Scientific Method as Analysis and Synthesis Dialectic*

provides a rigorous framework for defining both AR and Positivist Research and demonstrates that they are complementary processes.

The process is described in Figure 1. It starts with the observation of a number of events for which there is no obvious and immediate explanation and for which there is a desire to gain a coherent explanation. In Ackoff's terms these situations are described as "messes" (Checkland, 1981). Peirce describes these as "surprising facts".

A new synthesis of these "facts" occurs which provides a primary "thesis". Analysis, experimentation, and/or action taken on the basis this thesis leads to differences between the explanatory powers of the thesis and observation.

This leads to the development of an "antithesis" and so the dialectic is established. The resolution of this dialectic results in a new synthesis or hypothesis, which becomes the thesis for the next cycle of dialectic. The concept of the cycle of dialectic is central to scientific method in the same way that the process of cyclic reflection is important to Action Research. The essential distinction is between an open and closed system of enquiry. Traditionally scientific enquiry takes place in a closed system where the influence of the environment is minimized whereas in Action Research the influence of the environment is part of the experiment.

Senge (1990) identified "five disciplines" that define a set of capabilities for any organization aspiring to become a "learning organization". Importantly, in each case these factors form part of a coherent, systemic framework, which can be used to explain what initially appears as an ill-defined and largely intuitive set of observations and ideas. In each case, a number of "surprising facts" are synthesized into a systemic framework in the sense that they describe an integrative framework based on an organizing principle- the systems principle (Emery etc). Over time, these frameworks will be tested and compared with other possible frameworks leading to the emergence of new frameworks and theories. For example, Senge's learning framework can be compared and tested against Nonaka's (1991, 1994) knowledge creation construct based on a tacit knowledge-explicit knowledge dialectic (Takeuchi, 2004). What is significant is that each of these frames is "systemic".

Einstein identifies a similar process in physics (Figure 2) as the jump from the observed facts to the set of "Axioms of Fundamental Principle"- Speculative leap based on hunch, conjecture, inspiration, and guesswork…. We are dealing, after all, with the private process of theory construction or innovation, the phase not open to inspection by others and indeed perhaps little understood by the originator himself. But the leap to the top of the schema symbolizes precisely the precious moment of great energy, the response to the motivation of "wonder" and the "passion of comprehension" (Holton, 1998a, p. 31).

In summary, each cycle of dialectic described in Figure 1 can be described as a learning process starting with "surprising facts" which lead to the formation of a systemic framing of the ideas; that is, an the explanatory hypothesis. Barton and Haslett (2007) argue that this is describes the role of the systems concept in science- the framing of explanatory hypotheses.

There is a close similarity between this description of the scientific process with that identified by Peirce as being analogous to Cuvier's evolutionary

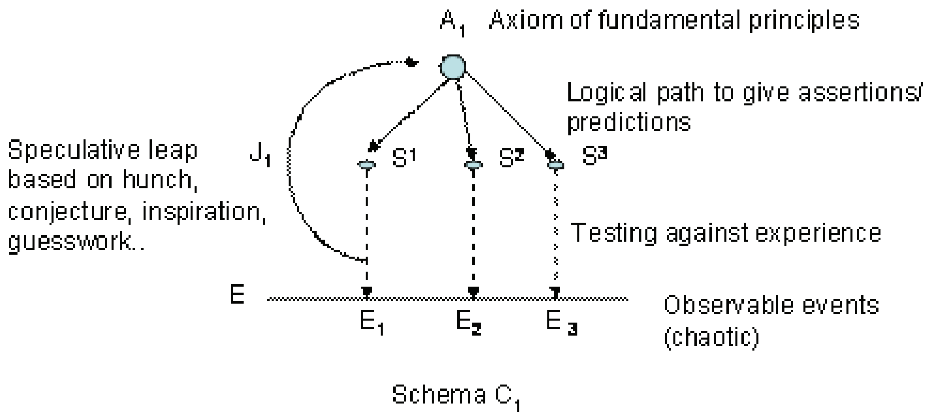

Figure 2 *Einstein's Model for Constructing a Scientific Theory (Holton, 1998)*

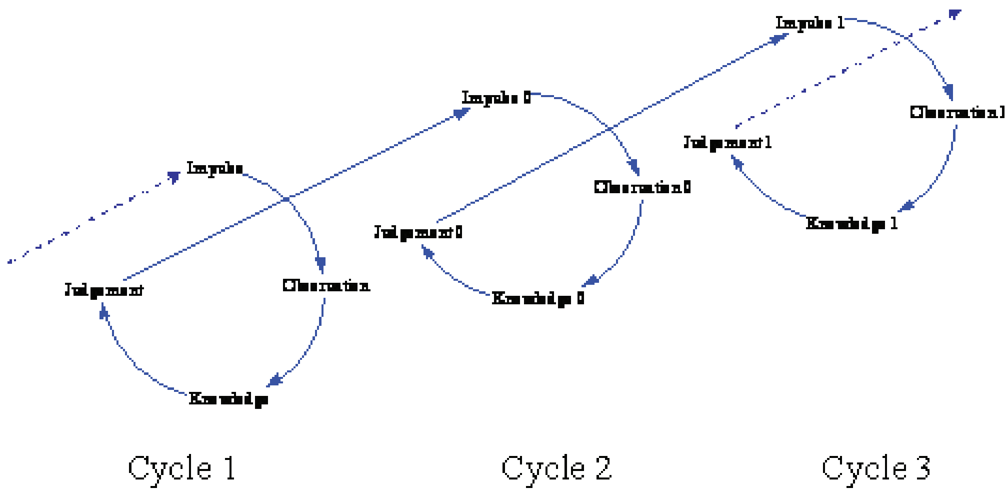

Figure 3 *Dewey's Experiential Learning Cycle (Kolb, 1984)*

process. This process emphasizes that science advances in leaps, compared to the more stable evolutionary processes identified with Darwin and Lamarck (Sharpe, 1970; Tuomi, 1992). (It is this type of "speculative leap that sets abduction apart from induction- see below).

To relate this dialectic version of the scientific method to Action Research, it is necessary to relate it to experiential learning theory. In particular, the process described in Figure 1 can be related to Dewey's "Spiral of Learning" (Figure 3).

But to make this connection explicit, it is necessary to articulate the role of inferential logic in this process, and abductive inference in particular. Dewey's experiential logic is drawn from Peirce's notion of the continuity of inquiry supported by his description of inferential logic (Dewey, 1938).

Conclusions

The development of knowledge comes through an analysis-synthesis dialectic. While scientific enquiry takes place in a closed system where the influence of the environment is minimized, Action Research recognizes and integrates the influence of the environment into the enquiry process. This places Action Research in an open, rather than a closed, systems context. It is thus able to integrate learning into the scientific and organizational process.

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