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Action Research: Its foundations in open systems thinking and relationship to the scientific method[1]

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Abstract:

This paper considers those interpretations of action research that can be traced to Kurt Lewin at the Research Center for Group Dynamics at the University of Michigan, and the work in social ecology by Emery and Trist at the Tavistock Institute. It locates the logical basis of these interpretations in the philosophy of pragmatism, particularly as it relates to Peirce's inferential logic and inquiry system. Drawing on this argument, and on the significant developments in approaches to systemic thinking over the past 40-50 years, a normative set of criteria is established for action research. The paper concludes that both positivist science (which relates to closed systems thinking) and action research (which relates to open systems thinking) are essential to any complete scientific approach.

Key Words:

Action research; Open systems; Scientific method; Peirce; Pragmatism; Abductive inference.

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Introduction.

Reason and Bradbury (2001:3) observe that while many writers trace the origins of action research to "the social experiments of Kurt Lewin in the 1940s" and the "socio-technical experiments begun at the Tavistock Institute….there are others which deserve acknowledgement". Consequently Reason and Bradbury correctly observe:

> …..the term 'action research' has been used in so many different ways that the term has lost some of its original weight. Sometime it is used to describe positivist research in a 'field' context, or where there is a trade-off between the theoretical interests of the researchers and the practical interests of organization members; sometimes it is used to describe relatively uncritical organizational consulting based on information gathering and feedback… The action research family includes a whole range of approaches and practices, each grounded in different traditions, in different philosophical and psychological assumptions, pursuing different political commitments.

(Reason and Bradbury, 2001: xxiv).

This paper argues that the confusion implied in Reason and Bradbury's observation can be somewhat resolved by uncovering the fundamental logic associated with action research, that is, its *methodology*, and by understanding the manner in which the diversity of *methods* associated with the application of this logic, while complicating the field, add significant richness. This situation is further confounded by recognizing that each of the stages of action research is essentially recursive in its application of this logic[2].

To uncover the logic of action research we concentrate on those origins that are attributable to Kurt Lewin (1947, 1948) and the Tavistock Institute's transition from an emphasis on socio-technical systems (Trist and Murray, 1993) to the advent of socio-ecological systems (Trist et al, 1997). It is important to recognize that each of these approaches is informed by the traditions of Gestalt psychology; the natural precursor to the idea of a "system in environment" and subsequently, as distinct from Bertalanffy's biological view, the psychologists' view of an "open system", as a basis for understanding perception (Sternberg, 1999) and the systems concept. It is argued that this socio-ecological perspective best describes action research in the sense of Lewin and helps establish the link between action research and the pragmatist system of inquiry defined by C.S.Peirce (1877, 1878)[3]. Specifically, it is Peirce's articulation of three modes of inference; abduction (the formation of hypotheses), deduction, and induction, that provides a broader logic to the scientific method and opens the door to define action research as scientific method applicable to *open* systems. By contrast, positivist approaches to science are identified with the application of the scientific method to *closed* systems.

The paper argues that more recent developments in learning and systemic thinking have helped address the possible lack of objectivity and the ethical issues identified with Lewin's approach, and that many of the "soft" facilitation methods associated with action research are directed

[2] A similar observation was made regarding the evaluation stage by Dr Amanda Gregory at the recent ISSS 2009 conference.

[3] Despite his relative anonymity, Peirce is now widely recognised as a true polymath and the greatest ever American philosopher and is openly compared with Leibniz (Fisch, 1972, Nagel, 1982).

towards the elicitation of environmental data and the formation of hypotheses (the abductive stage), and to evaluation (the inductive stage). This leads to a proposal for a set of normative design principles for action research.

Finally, some further comparisons are made between positivist scientific method and action research.

Lewin's Action Research and Some Later Extensions.

Blum (1955) provides one of the most useful accounts of Lewin's practice of action research at the Research Centre for Group Dynamics, University of Michigan, in the period 1945–1955. Blum (1955: 1) defines Lewin's action research as meaning "diagnosis of a social problem with a view of helping improve the situation. All action research has, therefore two stages:

> (1) A diagnostic stage in which the problem is being analysed and hypotheses are being developed.
> (2) A therapeutic stage in which the hypotheses are tested by a consciously directed change experiment, preferably in a social "life" situation".

Blum argues that the inclusion of the second stage is the key differentiator from positivist science with fundamental consequences for the "overall research design, the methods and the techniques used".

Foremost amongst these implications is for the action researcher to develop a "mutual relationship" with stakeholders with possible consequences for objectivity and ethical behaviour. In the therapeutic stage "people take part in an experiment which is consciously directed towards the implementation of certain values" (p.2). Consequently, Blum argues that "ideally action research should be undertaken by a team small enough to function as a group but which is sufficiently large to represent different (a) personality types (b) social values and (c) talents" (p. 3).

Blum identifies the main objection "which the action researcher has to meet squarely is that he confuses his role as a scientist with his role as a human, social, political, and ultimately a religious being, that he ceases to do objective research as he becomes entangled with the world of values" (p. 40). But he proceeds to emphasise that positivist science is not immune from these issues: "values penetrate the whole conceptual framework since they affect such fundamental choices as between 'data' and 'variable'. They also determine the orientation of the whole structure of thought toward certain *problems* and hence the *meaning* of all theory" (p. 5).

As Midgley (2000: 118) explains, Lewin's advocacy for harnessing science in the interests of meeting human needs and desires was the basis of a "strong critique of 'pure science' in favour of action research. … Essentially, Lewin (1948) advocates the harnessing of science in the service of *intervention* rather than observation"; this awareness clearly motivating Midgley's considerable contribution to "intervention". But rather than see "observation" and "intervention" as separates (and Midgley is not advocating this), the real challenge is to adopt a wider, integrated appreciation of the scientific method and move away from a position that sees positivist science as "rigorous", where rigour is defined in somewhat circular terms

within the bounds of positivist science, which means that, by definition, action research is seen as not being rigorous.

Unfortunately, as Reason and Bradbury (2001) point out, there are many variants of action research, and not all involve the rigour involved in the processes developed by Lewin. In response to this situation Argyris et al (1985) introduced the term "Action Science" - a *science* of human action in an attempt to bring action research back to its integrative roots as described by Lewin. In particular, Argyris et al (1985) identified three objectives fundamental to Lewin's approach:

- Learning is the first and overarching objective.
- Any knowledge produced should be formulated into empirically disconfirmable propositions.
- Knowledge can be organized as theory.

In addition, they reinforced Blum's position by arguing that attempting to use "standard scientific research" in the social sciences may be "self limiting":

> We would be content to use the term "action research" if it was not for two factors. First, over the years action research has often been separated from theory building and testing. Leading social scientists distinguish action research from basic research by asserting that the intention of action research is to solve an important problem for a client and not necessarily to test features of a theory…. Second, many action researchers understandably conduct their empirical work by following the current ideas about standard scientific research. The dilemma is that some of the currently accepted ideas of rigorous research may be self-limiting.

(Argyris et al, 1985: x).

Argyris et al's (1985) attempt to address the issue of objectivity described by Blum is an elaboration of Argyris and Schön's theory-in-use models (I and II). Model 1 theory-in-use corresponds to a form of bounded rationality (Simon, 1964/1976) in which people impose their own meanings on action and become dogmatic about them. Consequently, it becomes difficult for them to openly reflect on their motivations and actions and they become defensive in conversation. Model 1 is also consistent with a closed-systems view of the world in which contexts and environments are locked out (Argyris, 1983: 120).

The capability of being able to reflect effectively on actions and motivations involves the adoption of Argyris and Schön's Model II. These two modes of learning have become popularised under the headings of single and double loop learning (Argyris and Schön (1974, 1978, and 1996). Argyris (1983) provides a succinct version of the action science perspective. Flood and Romm (1996) have added a third element of *critical* reflection that raises issues of power and systems of meaning and hence raises deep ethical considerations; triple loop learning. Checkland and Holwell (1998: 12) have further contributed to the development of Lewin's model by identifying from Argyris et al (1985) four "crucial elements in a research approach which works within a specific social situation:

- A collaborative process between researchers and people in the situation
- A process of critical inquiry
- A focus on social practice, and

- A deliberative process of reflective learning".

The important contribution that Checkland and Holwell make is the manner in which they articulate the difference between the traditional scientific method with its focus on the replication of results, and action research with its acknowledgement that, quoting from Keynes, social science is not dealing with phenomena that are "homogeneous through time". That is, in social science we are dealing with *open* systems.

Checkland and Holwell (1998) make this same point in their reference to the need for action researchers to increase their appreciation for a "declared epistemology and hence a recoverable research process" and make this explicit by defining action research as a process involving a framework (F) of ideas from which a methodology (M) is derived, and applied to an area of action (A). Significantly, Checkland's FMA framework provides a useful approach to undertaking Argyris and Schön's "double loop learning".

Acknowledging the influence of Chris Argyris, Peter Senge, Peter Reason, and Ken Wilber, Torbert and Associates (2004) provide an important synthesis of these developments in their exposition of "action inquiry", a transformational leadership skill. Torbert and Associates correlate single-loop feedback with behaviours/operations; double-loop feedback with strategy/structure/goals; and triple-loop feedback with attention/intention/vision (p. 19). At an even more fundamental level, Torbert and Associates (2004: 9) define action inquiry as seeking "to interweave subjective, intersubjective, and objective data- subjective data about our own intent for the future, intersubjective data about what is going on at present from the divergent points of view of different participants, and objective data about what has actually been produced with what qualities in the past"[4].

The Tavistock Approach- Emery's ecological learning model.

In an attempt to overcome a range of (closed system) issues associated with socio-technical systems theory and practice, Emery and Trist led the development of the field of "social ecology" (Trist et al, 1997). The critical development in this approach refines themes in Gestalt psychology from the 1930s and articulates the importance of information fields imbedded in a system's environment. The extant version of this is described by Merrelyn Emery as the "ecological learning model" (Emery, 1999).

Emery (1999: 54) points out that while approaches to learning such as those outlined above address questions such as "are we doing the right things right?" and is "rightness buttressed by power?" and espouse emancipatory practice, they do not adequately address the question of "learning from the environment". They are essentially assuming a closed system framework as distinct from the "ecological learning" approach that originates from contextualism and sits at the centre of the Emery Open System Model. This approach is best represented by Emery's open systems model (Emery, 1999; 2000), described in Figures 1 and 2.

There are two key aspects of this model that make it distinctive: it introduces a "causal texture" of relations in the system environment (L22); secondly, it emphasises that the agents operating in the system can influence this environment (L12). This model is very much about

[4] Donald Davidson (2001) distils these distinctions even further by arguing that objective data is what is *agreed* as the result of a subjective-intersubjective exchange.

the real time, co-evolution of the system and its environment. The relationships L11, L12, L21, L22 capture the dynamics of this co-evolution

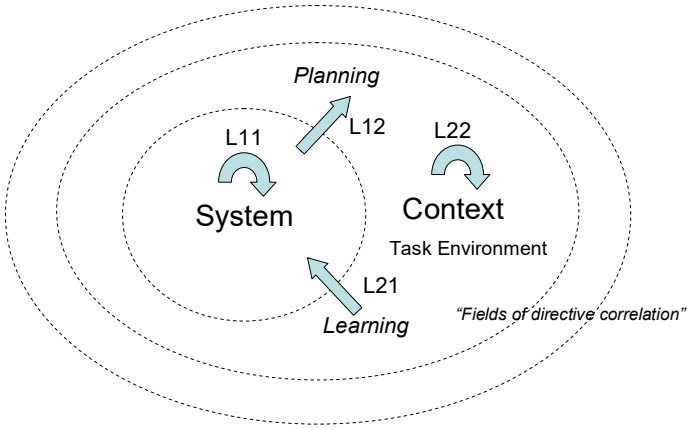

Figure 1. Emery's Open Systems Model- A Static View (Emery, 1999)

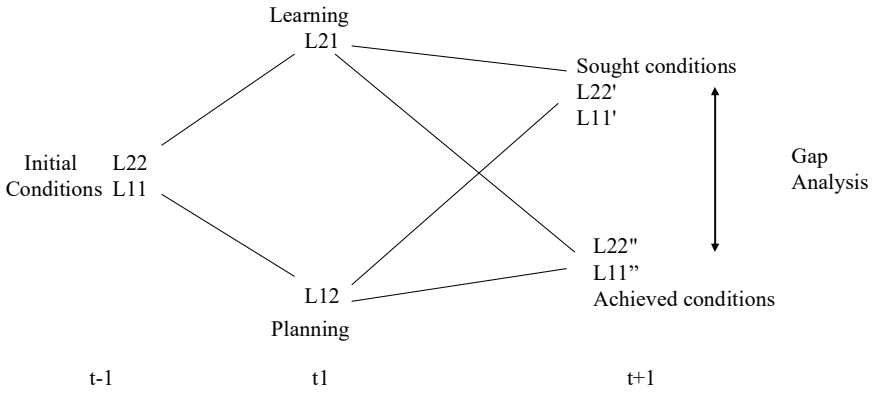

Figure 2. Emery's Open Systems Model- A Dynamic View (Emery, 1999).

Throughout, participants use their perceptions and experience as the data on which they describe desirable and possible futures. In data collection, participants collectively contribute changes they have seen; there is no other source other than their perceptions and experience on which to judge the significance of these changes. The ground rule is that "all perceptions are valid". This has multiple effects, not the least of which is that people begin to restore their confidence in the value of their perceptions. It also has the effect of preventing those with more formal status from devaluing the perceptions of those with less status. (Emery, 1999: 69).

The data collection stage of ecological learning corresponds to the stage of inquiry associated with forming a hypothesis. The process of continuous ecological and experiential learning continues in the action phases provided the organisation operates according to "Design

Principle 2"; redundancy of functions (Emery, 1999: 105–136). This structure provides an organisational context within which ecological learning can operate.

The relationship between social ecology and pragmatist philosophy was increasingly recognised by Fred and Merrelyn Emery over the 1980s and 90s (Emery and Emery, 1997); the principal way of making this connection being the identification of social ecology with Pepper's contextualist hypothesis (Pepper, 1942). Pepper established the contextualist hypothesis by identifying early American pragmatist philosophy with the contextualist root metaphor of an "historical event", that is, an "ongoing act in context" (Hayes et al, 1988).

As summarised in Stephens et al (this issue), contextualism is one of four world hypotheses identified by Pepper, the others being: formism (systems of classification); mechanism (mechanistic systems); and organicism (organic/ biological systems). While formism and mechanism are analytic in nature, organicism and contextualism are synthetic. Rather than seeing these characteristics as being irreconcilable, Kolb (1984) relates the tension that exists between them as being creative and a framework for learning through dialectic debate (Figure 3). Furthermore, and of significance when thinking about the learning structures within the context of the action research phases to be defined below, Pepper's system can be interpreted as operating within the context of a contextualist frame:

> (Pepper's) system is perhaps best treated in the framework of contextualism- as a set of hypotheses to be verified, as useful tools for examining knowledge structures in specific contexts.

(Kolb, 1984: 119).

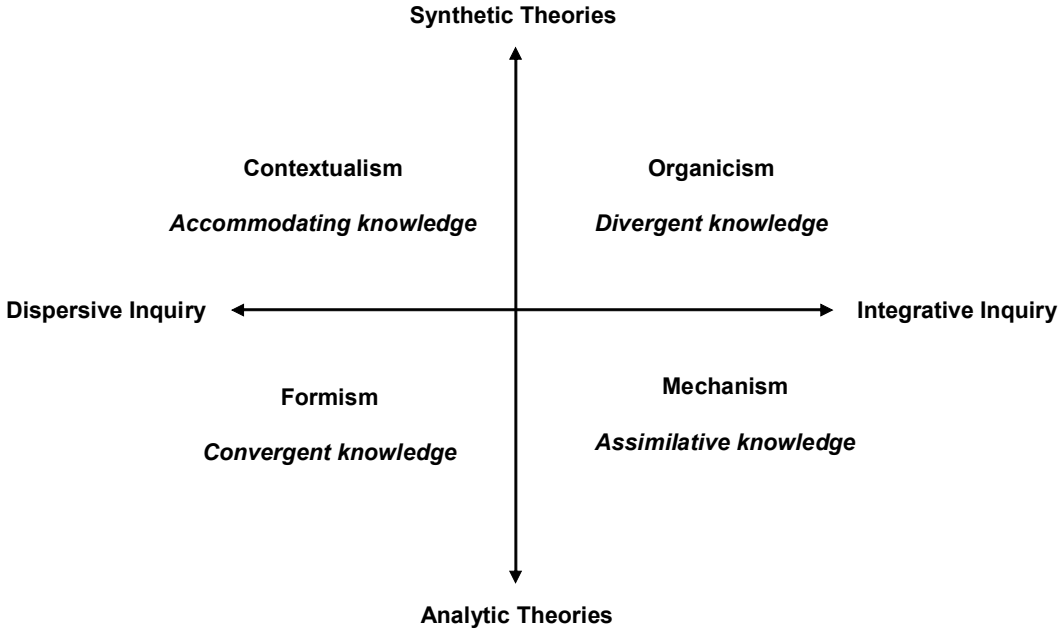

Figure 3. Pepper's System of World Hypotheses and the Structure of Learning (Adapted from Kolb, 1983 p.112

Hayes et al (1988) explain this in terms of the "pragmatic maxim", one of the characteristics of Peirce's pragmatist architectonic:

> The truth criterion of contextualism is successful working. Analyses are true only in terms of the accomplishment of particular goals….. A powerful implication of this truth criterion is that on contextualistic grounds one can adopt the analytic strategy of an alternative world view in a given situation if doing so is useful toward some end. For example, a philosophical contextualist might adopt a mechanistic theory because it is useful in identifying ways of "controlling" behavior….. The machine metaphor is merely used in the service of a contextualistic agenda; the truth of the analysis based on that usage is evaluated against a successful working criterion

(Hayes et al, 1988, 101).

These observations are consistent with a view that we form hypotheses using *closed* systems thinking that employs multiple metaphors (for example , using formist, mechanistic, or organicist metaphors) (Lawson, 2001).

Reframing the Scientific Method in terms of Open and Closed Systems; Pragmatism.

The socio-ecological approach highlights the use of the open-closed systems dichotomy and provides the opportunity to associate positivist science with closed systems thinking, and action research with open systems (Blaikie, 2004: 838). In this approach, the scientific process is interpreted as an analysis-synthesis dialectic in which hypotheses are framed in systemic terms, the most primary constructs being open and closed systems (Barton and Haslett, 2007). As outlined above, Pepper's (1942) four world hypotheses generate a hierarchy of corresponding systems approaches with increasing powers to frame complexity.

To take the next step in understanding the relationship of action research to the scientific method, we must turn to the philosophical basis of Pepper's contextualist world hypothesis: pragmatist philosophy. Although Pepper identified contextualism with the versions associated with Peirce, James, Bergson, Dewey, and Mead, it is sufficient for our purposes to concentrate on the pragmatist foundations established by Peirce.

The most referenced source of Peirce's early ideas is two key articles by Peirce[5]: "The Fixation of Belief", (Peirce, 1877), and "How to Make our Ideas Clear", (Peirce, 1878). Peirce emphasised that he wrote these articles for popular consumption and therefore they understated the significance and depth of the concepts involved. In fact, these papers were the first two in a series of five papers. In "Fixation", Peirce identified three modes of common sense thinking- tenacity, authority, and the a priori method and after demonstrating their inadequacies, advocates a "scientific" approach[6]. The second paper introduces the "pragmatic maxim" which defines meaning in terms of possible or actual consequences; the third introduces chance and probability; the fourth, introduces rules for calculating probabilities and explores the nature of probability in relation to synthetic and analytic reason[7]; the fifth

[5] The sole reference to these two papers belies the extent of Peirce's contributions to philosophy, science, mathematics, semiotics, and the arts

[6] This was used by Stafford Beer as the foundations to his "Decision and Control" (Beer, 1996).

[7] Hacking (2007) rates Peirce as "the greatest philosopher of probability whom we have known. … He was the first philosopher to understand one of the two viable approaches to learning from experience using probabilities. … We should see (Peirce) as a wild man, one of a handful who understood the philosophical events of his century and set out to cast his stamp upon them.

provides a critique of the argument that synthetic reasoning based on induction, "depends for its validity upon the uniformity of nature", and that "similarity" of events provides a "sufficient" reason for validity, and touches on the relationship between science and religion; the sixth and final paper provides a synthesis of the preceding arguments by summarising them in terms of three modes of inference: deduction, induction, and "hypothesis", that is, "abduction".

To appreciate Peirce's "method of science" it is necessary to understand something of his complete architectonic, of which several versions have been proposed (for example, Hausman, 1993; Rosenthal, 1994; Parker, 1998). In broad terms these each propose some point of emphasis ranging across Peirce's assumptions of continuity and fallibility, his theory of meaning (the pragmatic maxim), his phenomenology (semiotic), and his modes of inference. Anderson (1995) captures the relationship between these components by calling then "strands of system".

More significantly, Peirce's pragmatism itself needs to be understood as an "open system" (Feibleman, 1960). Emphasising this, Sandra Rosenthal interprets pragmatism as:

> … an open philosophical system or explanatory structure, giving rise to a view of explanation rooted in, rather than distortive of, the pervasive features of primordial experience, and to a view of systematic structure rooted in, rather than opposed to, a history of evolving change. Any philosophic system is inadequate if not grounded in the level of the full richness of lived experience.

Rosenthal (1986: 200).

Nevertheless, pragmatist philosophy, at least at the "popular" level is dogged by confusion between the colloquial use of the word "pragmatist" inferring dubious values associated with greed and success at any cost, and its technical meaning in philosophy. This is not without some justification because of William James's initial use of the term. In fact, Peirce introduced the term "pragmaticism" to dissociate himself from James' usage; and Dewey avoided this terminology all together by referring to "instrumentalism" and "experimentalism", the terminology adopted by Singer and Churchman. Sidney Hook (1974: 4) remarked that such an unfortunate interpretation of "pragmatism" as a philosophy "not only runs counter to what we know of the personalities of Peirce, James and Dewey, but is based upon a tendentious reading of their work".

Peirce's Inferential Logic.

In a significant departure from Kant's dichotomous treatment of deduction and induction, and their links to analysis and synthesis, Peirce returned to Greek dialectic involving three modes of inference: deduction, induction, and abduction.

In contrast to the more rigorous forms of inference (deduction and induction), abduction takes the form of making an observation about an outcome and proposing a cause for that outcome. In his early period, Peirce used the terms "abduction" and retroduction" interchangeably but later he reserved the term abduction for the formation of hypotheses and retroduction as the process of testing and refining hypotheses and their final selection (Rescher, 1978).

He did not succeed. He finished almost nothing, but he began almost everything"! (Hacking, 1983:61, quoted in Hacking, 2007: 44).

Peirce argued that abduction was the only form of inference that extends knowledge-deduction simply develops logical results from hypotheses, and induction uses data to quantify and test arguments. Abduction is now recognised as an essential part of the scientific method (Houser, 2005) and has a particular significance for management decision-making (Powell, 2002) and the field of artificial intelligence (Josephson and Josephson, 1994).

Haack summarises the importance of abduction:

> The method of science requires abduction. Scientific inquiry is creative; it requires imagination to come up with abductive hypotheses. But there are "trillions and trillions of hypotheses" that might be made, of which only one is true; we succeed as well as we do, Peirce suggests, because evolution has given human beings an instinct for guessing which "though it goes wrong oftener than right, yet the relative frequency with which it is right is ... the most wonderful thing in our constitution".

(Haack, 2006: 25).

Peirce uses these three modes of inference to define "logic of inquiry": abduction, deduction, and induction provide a cycle of inference in which experience is used to develop a small set of hypotheses from what may arguably be an infinite set of possibilities; deduction can be used to reformulate hypotheses into forms suitable for defining action and for testing using inductive inference (Figure 4). This gives rise to Peirce's experimentalism as the pragmatic basis for inquiry and the background to Dewey's instrumentalism. This process supports the analysis-synthesis dialectic described by Barton and Haslett (2007) and forms the logical basis to both action research and positivist science.

As noted above, Peirce's form of inquiry is the basis of Dewey's experiential learning model (Dewey, 1910) and its extant versions including, for example, Kolb (1984), Shewhart (1939) and Deming (1982), and Argyris et al's (1985) "Action Science".

Despite the emphasis on rigour, Peirce was aware that this process was subject to error (fallibility) and that all inferences were conditional. On this basis, we can differentiate between the logics of laboratory science and social science methods. In a laboratory science, and within reasonable limits, the conditionals (such as room temperature) can be identified, measured, and controlled. In systems terms, a "closed" system is created. In the social sciences, this is rarely possible: we are dealing with "open systems" in which not all conditionals are knowable, let alone controllable. In this sense, laboratory science is a "special case" of social science! The most important hedge against fallibility is to adopt a pluralist learning approach based on multiple perspectives as advocated by Lewin and Kolb.

Consequently, team processes are essential to the inquiry process and correspond to what Peirce termed "communities of inquiry", and as part of a process enabling ethical inquiry.

A Normative Model for Action Research?

The preceding discussion provides the basis for proposing a normative basis for the design and assessment of methods that claim to be "action research". Before defining this model, it is worth observing that many of the methods associated with action research relate to the abductive and evaluation phases. For example, many of the "soft" techniques including

brainstorming, mind-maps, narrative analysis, case analysis, and search conferences provide a rich variety of approaches for extracting stakeholder perceptions of information in complex situations, are part of the abductive phase of forming hypotheses (Emery and Emery, 1997). Reference has already been made to the richness of Tolbert and Associates' approach to evaluation

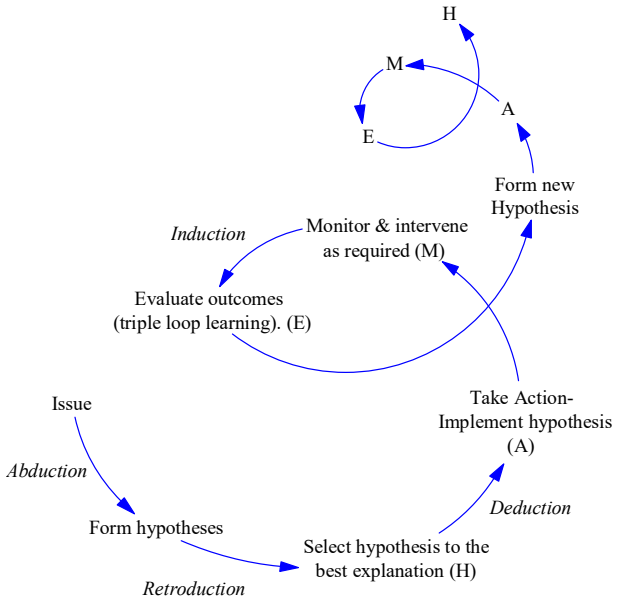

Figure 4. Inquiry Process Based on Peirce's Triadic Logic.

It is proposed that a methodology claiming to be "action research" needs to include the following:

1. The pursuit of social value framed within an open systems/ socio-ecological/ contextualist worldview.
2. Logical processes that can be easily identified with abductive, deductive, and inductive modes of inference.
3. Team processes that adopt multiple perspectives and pluralist values both as a hedge against fallible behaviour and as a platform for ethical practice.
4. Critical evaluation techniques that include single, double, and triple loop learning.
5. An operational basis in dialectic learning as a result, for example, of making critical comparisons between different systemic frames or perspectives.
6. Monitoring processes within action research cycles that inform (minor) corrections that can be made and recorded.
7. The possibility of considering each stage in the recursive terms of action research.

It is left to the reader to further refine these criteria and use them to assess their preferred methodology!

Does Action Research Constitute "Rigorous" Science?

There have been many attempts to establish the "scientific" credentials of action research. The usual approach is to first define a set of basic tenets of scientific research and then compare action research to them. In most instances this version of scientific research is synonymous

with one or more variations of positivist science. Blaikie (2004: 837) identifies three key variations- Comte's original version formulated in the first half of the 19th Century; logical positivism, formulated by the Vienna School in the 1920s; and a current "standard form" based on the tenet that phenomena must be explained as a specific case of a "covering law". In each case explanation are based on observations resulting from objective research and the formation and testing of refutable hypotheses.

Such an approach to comparison is doomed to fail from an action research perspective because the test is constructed from the relatively narrow view of positivist science; narrow because positivist science does not entertain taking action in the broader world and in doing so attempts to exclude the importance of values in science and the possibility of changing contexts.

Two contemporary examples illustrate the shortcomings of positivist science when action is taken or at least contemplated. The first relates to newspaper reports (The Weekend Australian, August 18-19, 2007) concerning calls for a review of Australia's system for monitoring widely used medications. This follows the withdrawal of a drug for the treatment of arthritis that has been linked to liver failure. This has occurred despite the development and trialing of the drug under the most stringent "scientific" conditions.

The second example relates to the call by NASA's top climate scientist, James Hansen, to take action on climate change before all the facts are agreed. Hanson (2007: 32) writes:

"… skepticism is at the heart of the scientific method and discovery. However, in a case such as ice-sheet instability and sea level rise, excessive caution also holds dangers".

In each case we observe that when faced with the practicalities of action, positivist science is inadequate and we find ourselves either taking action, or at least contemplating it, on the basis of "inference to the best explanation" (Lipton, 1991). That is, a "best" hypothesis is formed and corresponding action taken in the context of monitoring, intervention to make adjustments, and eventual evaluation. *However, note that positivist science is critical to establishing the "best" hypothesis.*

So, when we pose the question about action research and rigour in mainstream discussion, we are framing it in terms of a *received* position of positivist science. When posed in these terms, it is not surprising that, as Susman and Evered (1978) conclude, action research in its various guises, does not constitute "rigorous" science. As mentioned earlier, Checkland's response is that action research attempts to replicate *processes*, and in this sense we might suggest that the learning structures described by Argyris, Emery, Checkland and Holwell, Kolb and others represent particular cases of a "covering law" defined by Peirce's system of inquiry.

As Susman and Evered (1978) point out, and as has been mentioned previously, there are many deficiencies in positivist science. Social science and management in particular, is about action in open systems. Whether we are talking about positivist science, or action research, action is taken on the basis of a hypothesis that is always going to be conditional on circumstances relating to the system of knowledge of which the hypothesis is part. As discussed above, in the closed systems world of positivist science, we make the presumption that these conditionals are both known and controllable. In open systems, neither assumption is true. So we act on the basis of our best explanation- a decision which is value driven.

The critical fact that we must accept about positivist science is that it only confirms hypotheses under strict conditions. What happens when we act on these hypotheses in the

context of an open system? In the example cited earlier, what happens when a drug that has been extensively trialled under laboratory conditions is released into the open community? Do the hypotheses established by positivist research still hold? We never know, until we try! That is, we are acting on the basis of our hypothesis to the best explanation and have transitioned from a positivist research domain to an action research domain. In this sense the positivist research has simply been part of what Peirce's "retroduction". On the basis of the above, Table 1 provides a comparison between positivist research and action research.

Property	**Positivist Science**	**Action Research**
Systems frame	Closed	Open
Repeatability	Experimental result	Process
Conditionals on hypotheses	Known and controllable	Unknown and not controllable
Objectivity	Apparent independence of researcher but dependent on the norms of peers	Triple loop learning evaluation; dependent on values of the community of inquiry
Dominant mode of inference	Deduction	Abduction
Action based	No	Yes

Table 1. A Comparison of Action Research and Positivist Research.

Conclusions.

In summary, we have argued that action research and positivist science play complementary roles in the broader scope of the scientific method in which hypotheses are proposed, tested, and acted upon and that the logic underlying this process can be explained by reference to framing hypotheses in open and closed system contexts.

From the perspective of action research, Lewin's process has been made increasingly rigorous through a number of refinements and innovations. The problem of objectivity is addressed by Argyris and Schön's concept of single and double loop learning, which involves open reflection of processes. This process has itself been extended in two ways: by Flood and Romm's triple loop learning, and by Checkland and Howell's use of the FMA structure and its usefulness in guiding the double loop learning phase, and further refined through Torbert and Associates "action inquiry". However, as Fred and Merrelyn Emery have argued, these approaches fail to sufficiently emphasise the importance of the environment. Instead, they have provided an action learning approach rooted in theories of perception and "ecological learning" which help define the *dynamics* implicit in Lewin's model. In turn, the ecological approach is grounded in Pepper's (1942) contextualist world view which is based on early pragmatist thinking including Peirce's triadic logic of inquiry.

Scientific research and action research are not competing approaches to science, but complementary, albeit as Blum points out, where the design of the scientific method ideally needs to be influenced by the social objectives of the research.

The need for practical outcomes, place action research within a social context where interaction between the environment of the "experiment" and the experiment itself interact, and in which values place a critical role. Inevitably, this includes interactions between researcher and subjects, and context.

An attempt has been made to identify a normative set of criteria that can be used to design and assess action research and, in doing so represent action research as scientifically rigorous.

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