

THE GROUP DEVELOPMENT PROCESS

SEEN THROUGH THE LENS OF COMPLEXITY THEORY 1

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Abstract

Complexity theory is used to develop a model of group development based on earlier research with social groups such as Tuckman and Jensen's stages of forming, storming, norming, performing and adjourning (1977). The model shows how these stages correspond to Wolfram's four attractor classes of *order* (point and periodic), *chaos* (strange) and *complexity*, and transitions among them. Kauffman's NK models suggests several ways of moving networks among the attractor regions (1995). The theory was tested on data derived from observations by a Facilitator, and feedback from participants, who participated in a series of training workshops for other facilitators, and for members of a labour union.

The results confirmed that these training groups made three clearly identifiable transitions among the regions of complexity theory. Initially, the Facilitator breaks down expectations of order, while establishing a multitude of interactions among group members to help the group make the transition from order into the realm of chaos. The result is great uncertainty and unpredictability for both the participants and the Facilitator.

Later, through the establishment of goals and simple rules, the group begins to focus, uncertainty decreases, and the group makes a second transition from chaos to complexity, just within the region of order, at the 'edge of chaos'. Complex groups resemble sports teams in the Zone during peak experiences. They are very creative and require little input from the Facilitator. Finally, in the third transition, the Facilitator prepares participants to move from complexity back to more orderly organizations and institutions.

The paper concludes with a discussion of how complexity theory can organize earlier research and theory on group development, and offers suggestion for more quantitative research using these ideas. The paper should be of interest to those who wish to apply models of complexity theory to social change in all social systems.

Key Words: *chaos, complexity, order, stages of group development, facilitating, social change*

INTRODUCTION

The theory we are using in this paper has been called by various names as it has developed

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over the past decade. Chaos theory, nonlinear dynamics, complexity science, complexity studies, the lens of complexity, complex adaptive systems theory, are only a few of the names used. We have chosen the term, *complexity theory*, which seems to be the most recent, all-encompassing term. Complexity theory emerged from a variety of approaches in the physical sciences, including cybernetics, general systems theory, and catastrophe theory (Ashby, 1966; Bertalanffy, 1968; Thom, 1975). The theory became more widely known after the publication of Gleick's (1987) and Waldrop's (1993) descriptions of the social dynamics among the scientists who developed respectively, chaos and complexity theory. The recent comprehensive examination of complexity by Wolfram (2002) has further developed our basic understanding of this whole area.

Not surprisingly, given the nonlinear nature of human interaction, the insights of complexity theory were soon applied to social systems. Eve et al. (1997) remains one of the best introductions to the relationship between complexity theory and the social sciences, along with a sampling of case studies using the approach in a variety of social systems.

Another excellent introduction to complexity theory in the social sciences is Eidelson (1997). He shows how social systems are *complex adaptive systems*, that is, systems which are nonlinear and evolving (p. 62). In his exhaustive review of the literature he covers almost every concept in complexity theory, and almost every type of system from biological to political. Although Eidelson is a psychologist and his paper is published in a journal of psychology, most of the material is relevant to sociology.

Most other applications of complexity theory to social systems have been in the field of organisational management. The new journal, *Emergence*, is almost exclusively concerned with organisational applications, primarily business enterprises. Volume I (1999), available to anyone online, has a good selection of papers and book reviews on this burgeoning sub-discipline. The editor of *Emergence*, Michael Lissack, has also co-edited a collection of papers (1999) from a conference in 1998 which brought together many practitioners in this new field. Much of the debate in the management literature on complexity theory centres around the question of whether the approach is, indeed a theory, merely a metaphor, or simply a new way to package management consulting. In some ways, the unpredictability of complex systems has fed into its use as a model for consultants—*some* of the recommendation are bound to work *some* of the time!

There have been many fewer application of complexity theory to research on groups. Formal research on groups began with the Hawthorne experimental studies of small work groups in an electrical factory, started during the economic boom of the twenties, and concluding at the height of the Depression in the thirties (Roethlisberger & Dickson, 1939). The goal was to discover changes in working conditions which would lead to increased productivity. The results were confusing, partly because of a bad research design but, also because of the difficulty of making predictions about complex, nonlinear processes.

In the early stages of the Hawthorne research, workers mostly ignored changes in their working condition, and refused to increase productivity, probably in order to protect their jobs. When the experiment was moved into a separate room, and the workers gradually became friends with the experimenters, they sometimes increased production even when conditions, such as the amount of lighting, were reversed and made worse. It was an early discovery that groups can develop their own social norms independent of the external environment (Arrow, McGrath, & Berdahl, 2000: 17). This led to the human relations school of management, as practitioners interpreted the Hawthorne results to show that if management took a personal interest in workers,

they would respond by producing more.

Later reanalysis of the Hawthorne data discovered several flaws in the experiment, including the discarding of some workers who were perceived as not cooperating with the researchers (Carey, 1967). Of course, the ongoing economic depression encouraged the remaining workers to cooperate with the researchers. The point is that the group itself has the power to self-organize and develop in unpredictable ways because of the complex interaction of so many variables.

Just before the Second World War, Lewin and others designed more controlled experiments to test the effects of leadership style on group behaviour (1939). They found that different styles of leadership—authoritarian, democratic or laissez-faire—generated different group cultures, independent of characteristics of the members. The research team used the same groups and rotated the same leaders among them. The independent variable, the only one which changed, was that the leaders systematically changed their style of leadership.

Each different style of leadership produced quite different behaviours and quite different group cohesion and morale. Authoritarian leaders, who put the most emphasis on order, generated the most production as long as the procedures and outcome were repetitive. However, individual morale was very low, although group cohesion was high as members united against the dictatorial leader. Laissez faire leaders had the least organised groups, quite chaotic, and all three dependent variables—production, morale and cohesion—were very low. Democratic leaders, situated midway between the other two leadership styles, had a slightly lower output but the highest cohesion and morale. Most significant for our study, the products of the democratically-led groups were more creative.

The implication of both the Hawthorne studies and the Lewin et al. ones, was that while outside leaders could influence group culture indirectly, no one could directly force groups to obey, without negative consequences. In particular, creativity could not be forced, only encouraged under special conditions.

Later research on groups after the War focused on this self-organisation ability of groups. At several laboratories, including Bales' at Harvard (1950) and at the National Training Laboratory in Bethel, Maine (Moreland, 1996), researchers used either no leader or very laissez faire facilitators and discovered similarities among all groups, especially their transition through similar stages of development, from expectations of structure, to anxiety over its absence, to, usually, a transition into very cohesive, creative groups.

Practitioners applied these findings on group development to two types of groups. T-Groups, as both types came to be called, for Training or Therapy, are still widely used for both the training of teams in organisations, and for clinical group therapy (Arrow et al., 2000: 21-22; Rubinfeld, 2001). The goal for both types of groups is to encourage the group to develop autonomously as much as possible, beginning with expectations of order, passing through chaos into the third stage of creativity, ideal for learning how groups work, or for personal therapy. Although on the surface, these applications might seem to use linear cause and effect—use this type of leadership and you will get these results—they are actually treating groups as nonlinear systems which evolve naturally in unexpected ways.

Since that research in the fifties and sixties, there has been a precipitous decline in all research on groups. McGrath argues strongly that it is necessary to view groups as examples of complex adaptive systems in order to explain earlier research and spark new interest in this field

(McGrath, 1997: 14ff).

So far, there is little use of complexity theory in research on groups. The special millennium issue of *Group Dynamics*, commemorating the past one hundred years of group research, makes almost no mention of complexity theory. Yet the editor's introduction bemoans the fact that groups are too complex to be 'studied scientifically', and that 'the great complexity of small group behaviour...the interrelations among the many parts of the group and the variables that influence group process almost defy comprehension (Forsyth, 2000: 3, 6).

McGrath, in his plea for complexity theory, begins with a review of earlier research, dividing it into three approaches, each identified with three American universities: (i) the Michigan school, which specialised in what influences group behaviour, (ii) the Harvard school, which was concerned with patterns of interaction, and (iii) the Illinois school, where McGrath is located, applied results from more theoretical research to the performance of work groups (1997: 8-10). He analyses the weaknesses of each approach, both theoretically and methodologically, and then argues for the broader approach of complexity theory to revitalise research on groups.

In a later book, McGrath, along with Arrow and Berdahl, attempt to outline in more detail, what a complexity model of small group research might look like (Arrow et al., 2000). Most of the material in Arrow, McGrath, and Berdahl's book describes more stable, orderly groups. Their comment on chaotic groups is that

...the requirement for precision, resolution, and volume of data points needed to distinguish between chaotic dynamics and random behaviour make us sceptical about the value of searching for chaos in the groups research domain. Thus, we have focused instead on the simpler patterns that match extant theorizing on group development (p. 155).

Still, they do recognize that there are a limited number of patterns—what they and we will call 'attractors'—that are available for groups, and they refer to various stages of development (pp. 133, 229ff). They also describe a possible final stage of *metamorphosis*, caused by disruptive outside events. The results of this disturbance may be i) no change at all, ii) a switch to an alternative structure—a new attractor, iii) a transformation into a new group with radically different structure and behaviour, or iv) dissolution of the group (pp. 233ff).

Their description of the effects of negative and positive feedback suggest one way to guide groups from stage to stage Arrow et al. (p. 202ff). In systems theory, the terms for the two kinds of feedback have a slightly different meaning from the way the terms are commonly used. *Negative* feedback refers to any information fed back to the system which causes it to keep its output variety constant. *Positive* feedback is information which makes the output increase in variety. The example used by Arrow et al. concerns groups of flight attendants. In one case, after a member was fired, the effect was to keep the remaining members at the same level of performance for years, hence the firing acted as negative feedback. For another group, responding successfully to a crisis encouraged the group to be more willing to experiment with new procedures, demonstrating a process of positive feedback.

Positive feedback for nonlinear systems may have unexpected and devastating effects, according to Arrow et al. Since variety is increasing under positive feedback, the continued iteration of such feedback will eventually destabilise the group, and make it chaotic. Eventually, the group may collapse if it becomes too unstable. On the other hand, with the proper amount of positive feedback, the group will become very creative. Negative feedback may constrain the group so much that it does nothing except what it is told to do, as in the case of Lewin's groups

with authoritarian leadership. Alternatively, just enough negative feedback, ensures that there are fewer errors, and the work is predictable, especially important for repetitive work.

A second book by McClure (1998), presents another approach to group phenomena using complexity theory. McClure's book is a somewhat quixotic incorporation of complexity theory ideas into the author's personal experience as a teacher of group dynamics. Two recent reviewers criticized him for misunderstanding many of the concepts of complexity theory (Trofimova & Sulis, 2002: 287). Part of McClure's problem is that he is still using chaos theory, an early version of complexity theory. For example, his only use of the term complexity is simply incorrect—he speaks of the 'edge of complexity' as that 'stillpoint' state where any perturbation is likely to push the group into chaos (p. 128). Most theorists would describe this condition as the realm of chaos itself. We now use the term 'edge of *chaos*' to refer to the region of complexity, just within the ordered realm, where evolution and adaptation take place without the extreme sensitivity of chaos.

McClure is on safer ground when he describes the stages through which T-Groups pass (pp. 33ff). His model proposes that all groups begin in a *preforming* stage when members bring certain expectations and 'themes' from earlier experiences (pp. 41-42). The next stage, which he names somewhat misleadingly, *unity*, is characterised by a common sense of ambiguity when the leader refuses to give directions. This leads directly into a third stage of *frustration* and *anger*, a fourth stage of *confrontation*, and a fifth stage of *disharmony* as members become aware of the diversity among participants. Once the members work through stages 3, 4 and 5, they emerge, usually, into a stage 6 of *harmony*, as they experience relief, euphoria and a sense of pride in what they have become. Finally, in stage 7, *performing*, the group becomes productive, and learning or healing generates 'peak experiences'.

Again, Trofimova & Sulis criticize him for being "metaphysical rather than scientific" (2002: 287) especially when he describes groups at the higher stages (McClure, 1998: 183ff). The fact is, groups at certain stages are experienced by members in surrealistic ways which seem to demand a metaphysical explanation. Suffice to say, while McClure may not use complexity terms in quite the same way we do now, we believe that he is on the right track in his use of complexity theory for an explanation of group development.

Rubinfeld, in a very recent paper, is somewhat more successful in the application of complexity theory to explain what happens in group therapy (2001). He uses a wide range of terms from complexity theory, including edge of chaos, emergence, level, bifurcation, catastrophe, fractals, fitness landscape, order, self-organization, co-evolution, to describe what happens when a group of people with a common problem are guided by the therapist into stages where healing can take place. Perhaps influenced by the explicit emphasis on change in therapy groups, Rubinfeld is more interested in the realm of chaos than in the orderly regions where most work groups operate. Although he calls therapy groups examples of *complexity systems*, they appear to be mostly chaotic in their sensitivity to initial conditions, frequent bifurcations as the group advances and regresses between two ways of behaving, and sudden catastrophic changes in response to perturbations (pp. 450-1).

Rubinfeld notes that one problem for therapists is that there always exist what he calls a *pre-existing group*, made up of earlier experiences of members, including the therapist's own views and practices. Gradually groups tend to settle into a distinctive 'microculture' and the group and therapist need to work at co-evolving back into instability for successful therapy (p.452). Therapy groups seem to be most helpful when they operate on the verge of equilibrium, the edge

of chaos, where they can quickly adapt to the changing need of the members. Eventually, a therapy group may evolve into a higher level of organisation, what Rubinfeld, quoting Bak (1996) calls a phase transition (452-3).

Rubinfeld's description of what happens in therapy groups seems to fall at one end of the spectrum of group behaviour, compared to the more stable, predictable work groups of Arrow et al. (2000). McClure's (1998) teaching groups seem to cover the whole range of group patterns, and all of the stages of group development. In general, however, their descriptions of group development seem remarkably consistent. In new groups, participants try to retain the order they have found elsewhere in society. There follows a period—extensive or brief—when there seems to be great disarray as members search for an appropriate structure. There may be much experimentation and anxiety as the search goes on. Successful groups find their way out of this chaotic pattern into a realm where they can constructively evolve into the best form for their purpose. They may stay there only a short time, in the case of work groups, or most of the time, in the case of therapy groups. Eventually, groups tend to become more ordered if the tasks become more routine. Over time, the cycle may be repeated many times.

In the next section we will use complexity theory to identify each of the patterns associated with the developmental stages of social groups, along with suggestions for making transitions among them.

COMPLEXITY THEORY

What initially interested people in the ideas which eventually became complexity theory was how orderly patterns could emerge from disorderly ones, a process which seemed to contradict the Second Law of thermodynamics which predicts increasing disorder—not order—over time. The process of moving from disorder to order has several names—autopoiesis, self-organisation, autocatalysis, adaptation—depending upon the field of study.

There is more agreement over the names of the patterns themselves, ranging from the extreme unpredictability of *randomness*, through the instability of *chaos* to the extreme predictability of *order*. Between chaos and order there is a particularly interesting area at the edge of chaos, now known as the region of complexity, where living systems especially are most likely to adapt and evolve into higher level systems.

In an abstract sense, randomness is a very difficult concept to define (Wolfram, 2002: 223ff) however, along with most people who study social systems, we are not very concerned with completely random arrangements. In any case, the social groups we study seem to exhibit patterns of either being somewhat chaotic or of being somewhat orderly, or, at their most creative, complex when they are in the region between.. Our interest for this paper is how and why groups move among these three patterns.

Experimenters have used a variety of models to simulate the transitions from pattern to pattern. The models range from mathematical models of dripping faucets (Gleick, 1987) to computer simulations of sandpiles, to computer simulations of connected light bulbs (Kauffman, 1995). None of the models exactly mimics the messiness of real social systems but they do suggest a common terminology for discussing what happens when social systems move among patterns.

The model of connected light bulbs we will use here, the so-called NK model, was developed by Stuart Kauffman of the Santa Fe Institute as a computer simulation of a network

based on K connections among N lights. Similar models, especially the discrete systems known as cellular automata, have also been studied in great detail by Wolfram (2002) and others. (For an extensive discussion of cellular automata see Flake, 1999: 231-259).

Although Kauffman's model simulates a network of interconnected light bulbs which are turning on and off, it is mathematically equivalent to K connections among N people in a social system. For a group of people, a *connection* between person A and person B means that they are able to talk to each other. An individual is 'on' when s/he is speaking; 'off' when not talking. The beauty of Kauffman's computer model is that one can visually observe the flashing of coloured lights on a computer screen, where, for example, red lights signify an 'off' light and green lights signify 'on'. Thus, one can literally see networks as they move among the various patterns.

The resultant patterns are analogous to the four classes of attractors which Wolfram defined for cellular automata (Waldrop, 1993: 225ff; Wolfram, 2002: 231-252). In Class I, point attractors, the pattern is fixed and does not change over time. In Class II, periodic attractors, at least some of the lights flash through repeated cycles. Both Class I and Class II attractors are deep into the *ordered* realm, where small perturbations or disturbances have only local effects. Visually, the Class I and Class II patterns on a computer screen remain constant even when a few lights are 'perturbed', that is, arbitrarily changed from 'off' to 'on'. Disturbances have only a local effect in orderly systems.

Class III, strange attractors, have outer bounds but within those boundaries the behaviour is completely chaotic and unpredictable, and, hence, termed the *chaotic* realm. Chaotic systems are extremely sensitive to initial conditions, and the slightest perturbation throws them into a new path, the so-called butterfly effect (Kauffman, 1995: 79). Each new trajectory follows such a wide range of behaviours that it seems completely unpredictable. To use Kauffman's term, the basin of attraction is very shallow, so that systems are easily thrown out of one basin into another. For a Class III chaotic attractor, any local change rapidly permeates throughout the entire system, another example of its great sensitivity to initial conditions. Since it is almost impossible to keep conditions constant in any real system, in chaotic systems the visual patterns are constantly changing in unexpected ways.

Finally, there is the region of Wolfram's Class IV systems, where the network of lights evolves relatively slowly into new patterns. These new patterns may be generated by the system itself or may be a response to outside influences (Waldrop, 1993: 225ff). Hence, while a part of the system may seem quite chaotic, other parts will be quite orderly so that the overall system avoids the wild trajectories of the chaotic realm.

Each new pattern, fixed or periodic, may remain for awhile on the computer screen, until the next disturbance, when it shifts slightly into a new pattern. Patterns evolve slowly as local change spreads throughout the entire system. In an environment which selects for survival, Class IV systems are, by their nature, the most adaptable, and are typical of, although not confined to, living systems (Flake, 1999: 4; Holland, 1998: 5).

Langton named this fascinating region, in the ordered realm but close to chaos, *the edge of chaos* (Waldrop, 1993: 230). Hock uses the term '*chaordic*', to describe organisations which are between CHAos and ORDer, a structure which 'harmoniously blends characteristics of both chaos and order...competition and cooperation', and which, Hock argues, is the most adaptable to change, and, hence, the best able to survive changes in the environment (Hock, 1999, 2000; See also Marion, 1999: 23-38).

Wolfram describes this midway region as the most complex, by which he means that there is ‘no short description that can be found by any of our standard processes of visual perception’ (2002: 559). To put it another way, there appear to be several layers of meaning, a merged variety of patterns, some of which are obvious but others of which are more subtle and gradually changing. In any case, the edge of chaos has taken on the name *complexity* itself. To quote Kauffman,

Just between [order and chaos], just near this phase transition, just at the edge of chaos, the most complex behaviour can occur—orderly enough to ensure stability, yet full of flexibility and surprise. Indeed, this is what we mean by complexity (1995: 87).

He goes on to argue that it is in the ‘regime’ of complexity that evolution takes place (1995: 90). It might be expected, then, that groups in the region of complexity will be the most creative.

One way to model NK networks on the computer is to use Boolean networks, a well studied model used by Kauffman and others. In the simplest form of a Boolean network, the state of each light, either ‘on’ or ‘off’, is determined by a set of rules related to the state of those lights to which it is connected. For example, one rule might be that a bulb turns ‘off’ if it is connected to two ‘on’ lights, but turns ‘on’ if it is connected to only one ‘on’ light. The combination of connections and rules, over time, produces a variety of state-cycles for the entire network. More detailed descriptions of these systems can be found in Kauffman’s books (1993: 40ff; 1995: 74ff).

Most of the patterns generated by Kauffman with his computer programme were Class III types, chaotic. Yet it turns out that there are a few special conditions which will move the network into the other Classes. For example, ordered systems, Class I and Class II, occur very quickly when $K = 2$, each light having only two links to another light.

In addition, it is possible to tune or bias the parameters governing the rules of the network so that an ‘on’ outcome is more likely than an ‘off’. Langton called his parameter, lambda, based on the probability of cells in cellular automata living or dying (Waldrop, 1993:227ff). Kauffman used a similar parameter named P (1995:84ff). Without the bias, $P = 0.5$, so that there is an equal likelihood of a light being ‘off’ or ‘on’, according to a particular set of rules and connections. With P approaching the value of one, the light is more likely, say, to stay on. As the bias increases, the network moves from chaos to order, even with $K > 2$, perhaps as high as $K = 5$. At a certain critical value of P, the network becomes Class IV, just at the edge of chaos, in the region of greatest complexity.

Kauffman also speculates that it is the nature of evolution to gradually ‘tune’ systems so that they converge toward complexity (Kauffman, 1994; 1995: 90). We believe that skilled group facilitators, without being aware of complexity theory but through experience, can take advantage of this natural tendency of social systems to converge toward complexity. Through the use of a variety of techniques, such as controlling the links among members (K), and by using simple rules to control the bias (P), the group can be guided among the three regions of order, complexity and chaos. It is important to note that the facilitator cannot control what the group does, especially in the regions of complexity and chaos; only guide it into a region where the group becomes either ordered, complex or chaotic. Rubinfeld, quoting Gleick, (1987) explains how in nonlinear systems outcomes may be determined yet not predictable.

“You cannot assign a constant importance to friction because its importance depends on speed. Speed, in turn, depends on friction. That twisted changeability makes nonlinearity hard to calculate, but it also creates rich kinds

of behaviour that never occur in linear systems” (Rubinfeld, 2001: 449).

Wolfram, in his studies of complex systems, shows that they cannot be described or computed with a model that is shorter than the actual system and therefore prediction is severely limited. All you can do is use simple rules to generate complex behaviour; the results are not computable.

Although all systems share certain characteristics derived from complexity theory, the types of transitions differ among physical, biological and social processes. Kauffman’s models of physical processes, because of the large number of variables and subsystems, are generally in the region of chaos, and are moved out of chaos with great difficulty. Kauffman speculates that biological systems, as a result of evolution, tend to be already in the region of complexity, at the edge of chaos.

Most social systems, perhaps because they are the most highly evolved, tend to operate further into the region of orderly arrangements. Before significant changes can be produced, we hypothesize that orderly systems need rather large perturbations to shake them out of order and into a chaotic attractor. Only then is it possible to guide them back into the creative realm of complexity. Eventually, most ongoing social systems need to become more ordered, to conform to the expectations of the real world.

Thus, we would expect that people entering training groups come from orderly organisations, so that it is necessary to move them through three transitions: (i) an introductory transition where participants are moved from order into chaos, (ii) a second transition, where the group is moved back into complexity where it can be the most creative, and a final transition, (iii) where participants are prepared for a return to the more ordered world of modern society.

With this theoretical background in mind, we set out to examine an actual series of training workshops to see if a skilled facilitator operated according to the predictions of complexity theory.

METHODOLOGY

One of the authors has been the Facilitator for workshops aimed at people who are themselves facilitators already engaged in a variety of group related training activities. He has also facilitated workshops using a similar design, to help unionised workers increase their communication skills, over twenty workshops in total. In both types of workshops, the Facilitator’s goal is to encourage the group itself to develop new skills, as well as encouraging members to teach each other. The emphasis, then, is on moving groups into the edge of chaos where ‘co-creation’ and co-evolution can occur, in which members work harmoniously with each other and with the Facilitator.

Three years ago the Facilitator became a member of a study group on complexity theory. He speculated that his workshops might be explained by this new approach, and joined with two other members of the study group—a sociologist who has studied organisational change, and a researcher in the application of complexity theory to chemical processes—to describe and analyse his experiences through the lens of complexity theory. He had already written up his experiences in the form of a manual containing the handouts he uses in the workshops, along with general instructions for other group facilitators (Campbell, n.d.). He used excerpts from this manuscript and from his experiences, to prepare the material in the next section.

After we finished the first draft of the paper in 2001, he administered a questionnaire to

participants of his next three groups to add additional data about group development. The questionnaires contained both open and closed questions. Details are available on request. We will also refer to the recent studies on group development and complexity theory.

Our results remain closer to qualitative than quantitative research, reflecting the early stage of our research (Palys, 1997). On the other hand, many researchers, not just those doing social research, are realising that the research process itself is complex, involving cycles of iteration and reflexivity as theory is tested against results, the process changing both the theory and the system being studied (Flynn, forthcoming). Few scientists believe it is possible, nor, perhaps, even desirable to approach research as a one way, linear analysis of cause and effect, as earlier laboratory experiments attempted to do.

CREATIVE FACILITATING WORKSHOPS

Creative Facilitating Workshops have taken place almost every year since 1987 at St. Francis Xavier University (SFX) in Antigonish, Nova Scotia, Canada.

The inspiration for the SFX sessions is the belief that it would be interesting and useful to gather together facilitators, teachers, and trainers—persons who worked with others in learning situations—and have them share their best ideas, methods and techniques, exercises, and experiments. During each session, one essential objective is to facilitate a process which will create a learning atmosphere in which this sharing can take place.

The Workshop begins with a two-hour session on Sunday evening, and continues for six hours a day on Monday, Tuesday, Wednesday, and Thursday. The program concludes on Friday between noon and 1:00 p.m. During the week-long session, the group, under the guidance of the Facilitator, seems to pass through three transitions: i) order to chaos, ii) chaos to complexity, and iii) preparations for a return to order.

Transition 1: From Order to Chaos

By far the greatest problem in the Workshops is the transition for most participants from fairly structured and orderly environments—including their earlier experiences with training groups—into this Workshop environment which is much less structured. This seems to require a kind of overshoot into chaos. In complexity terms, this means moving from deep order into the realm of chaos.

Initial contact with people coming from the ordered phase

Almost all of the participants come from organisations or situations where there is an expectation that group workshops will be quite structured, a kind of “pre-existing group culture” (Rubinfeld, 2001: 452) or ‘preforming’ (McClure, 1998: 41-42). The initial contact with applicants attempts to deal with these expectations by preparing them to experience much less order than they would normally expect. When the administrators at the host university receive a participant’s registration form, they forward the usual package of material containing campus information, along with a letter from the Facilitator of the Creative Facilitating Workshop which contains the following:

- 125 questions related to what a participant might want to achieve during the week.
- a request to think of a symbol which will depict what kind of a facilitator they want to be.

- accompanying these requests is a statement that no one will be asked to do or say anything during the week that they do not wish to do or say, i.e., that their personal choice will hold a high priority during the week.

In addition, participants are encouraged to bring to the session, personally meaningful materials such as musical instrument(s), poetry, drawings, songs, dances, audio and video tapes, favourite writing (books, articles, quotations), Internet resources, favourite stories (their own and others) or myths. They are informed that resource tables will be set up in the classroom so that these resources can be shared with others.

Defining an uncertain reality by breaking down order

The first and most important task during the early sessions of the Workshop is to break down expectations of order by helping participants become comfortable with an unstructured environment. Initially, however, the participants and even the Facilitator feel great uncertainty about what is going to happen next, typical of the early stages of group development (McClure, 1998: 42).

The participants are greeted with a brief welcome after they take their seats on chairs arranged in a horseshoe, with a flipchart at the open end. Then the Facilitator explains that the first exercise will be to list words or phrases which describe the atmosphere in which they learn best. The Facilitator begins this process by putting the words 'co-creation' and 'choice' on the flipchart and explaining their significance. Written handouts on the two terms are also provided. Thus, participants are aware at the very beginning of the session that they have wide control over what they do and say in these sessions.

Participants then share for a few minutes, in groups of two or three, those words and phrases that describe the atmosphere in which they learn best. After this subgroup sharing, the large group reconvenes and participants are invited to write their words on the flipchart. Many words and considerable discussion are forthcoming. The Facilitator says a few words about other concepts, such as 'laughter' and 'a positive approach', which help produce an atmosphere conducive to creative learning, a process which Rubinfeld call, 'cogniforming' (2001: 457).

It is important that the Facilitator speaks only briefly so that the limelight is left to others and to respect the principle of co-creation from the outset. Usually some group members will find ways of testing what is going on, to determine whether or not the principles which are being discussed are indeed going to be respected in the sessions.

It is essential that this exercise not be rushed since it takes time to establish safety and trust. However, these elements tend to build rapidly when co-creation, choice, laughter, and a positive approach begin to take hold. Words such as confidential, knowledge, authentic, substantial, challenging, respectful, and caring, are suggested by the participants. The learning of names of fellow participants follows immediately.

These opening exercises are dynamic, interactive and fun. During these exercises, the many and varied interactions may seem to be going nowhere but their very lack of structure helps move the members out of the ordered systems of their previous experience into the realm of chaos.

As well as giving first priority to establishing a positive learning atmosphere, these exercises are a gentle way of introducing group guidelines, a step necessary for the future when

the group begins to move away from chaos. They establish a few simple rules such as choice, staying positive, and co-creating, which will eventually form the basis of the group's behaviour at the edge of chaos. Rubinfeld describes this as the facilitator's role in establishing and maintaining boundaries "to help preserve the self-organising character of the group" (2001: 458).

Occasionally, there are obstacles to this process, in addition to the pervasive organisational scripts people bring with them, such as attempts by some participants to impose order on the group, challenges from difficult individuals who might intimidate others, or from people who have supervisory capacities in relation to other individuals in the group. In some cases the challenges are aimed at the Facilitator's unwillingness to impose more structure. McClure's explanation for such behaviour is that

Attacks on the leadership are over issues of power and control and dependency and independence, and are often based on transference. Group members confront their capacity for governance while attacking the leader's early group role as parent and protector (McClure, 1998: 45-46)

On these occasions, the Facilitator must find ways to loosen up the group by introducing such core principles as equality, staying positive, and protecting each person's right to do what s/he wants. All of these principles seem necessary to move the group temporarily into a state of chaos, paving the way for later creative and complex options.

Chaos, however, is experienced as a state of uncertainty and can be quite upsetting for everyone, including the Facilitator.

Uncertainty during the experiencing of chaos

Since the most difficult part of the Creative Facilitating sessions for both facilitator and participants is the element of uncertainty, some elaboration seems appropriate. Most people are uncomfortable with uncertainty, and the uncertainty at the beginning of the Creative Facilitating week can be intense. Participants, even though they are trainers and teachers, and, by and large, experienced, are not accustomed to being put in a position of not knowing what is going to happen next. The Facilitator must be prepared to stand in the uncertainty, and to hold to the simple guidelines during the first two days. In those initial days it is difficult for the Facilitator to relax, even though it is known from experience that the group will eventually—usually—cross over into a more comfortable zone. As McClure suggests, referring to these early stages of confrontation and anxiety, "The road to freedom is through the fire, not around it" (1998: 46)

During the uncertainty of the first twenty-four hours, there is a sense of a critical mass building as more and more people become comfortable with the uncertainty and begin to see the development of the simple rules which will, eventually, generate a safe, free and enjoyable environment. This is similar to what Bak refers to as 'self-organised criticality', occurring just before the transition into a new region of complexity (1996). Even after the critical mass has moved the group out of chaos and back into a more ordered situation at the edge of chaos, the uncertainty continues, albeit a different kind of uncertainty. Although it does not relieve completely the anxiety that accompanies the uncertainty, it can be a great consolation that uncertainty is normal, that it seems to be a natural part of a process accompanying the development of complex groups.

Here are some responses from participants in recent workshops describing their sense of uncertainty. SFX refers to the Creative Facilitating Workshop at St. Francis Xavier University; USA refers to the United Steel Workers of America.

It never entered my mind that this is something crazy, but I did wonder what was going on. Even the description of the course left uncertainty, but I think that also added inner excitement as well...I felt like a fish out of water, not sure whether or not I belonged...I felt some anxiety—like it may be a very long week! (Workshop, SFX, 2002). I expected a much more regimented format, yet I enjoyed this experience much more...[I] only [had] uncertainty in myself (Workshop USA, 2002).

A Complexity Theory Interpretation of Transition 1: From Order to Chaos

Kauffman discovered that increasing K beyond two connections quickly generates chaos in a set of randomly connected units. Hence, one would expect chaos among a new group of people chatting randomly with many others. In the Creative Facilitating Workshops, however, the tendency seems to be for the group to begin in a more organised state, because of the high order in the institutions from which they come, and because of previous experiences in training workshops. Instead of $P = 0.5$, then, there is a bias toward order already in place.

It is not surprising, then, that during the first day or so of the Creative Facilitating Workshop, there are expectations of order and routine, and that members put pressure on the Facilitator to provide more structure. Before a complex group can emerge, however, it seems necessary to cause such large perturbations that the members overshoot from their normal orderly pattern, into a chaotic one.

Moving from order to chaos

How can people be moved from order into chaos? To keep people's expectations of order from structuring the group into old ways of operating, the Facilitator, in the initial exercises, deliberately encourages many interactions among people so that the value of K increases. According to Kauffman's experiments, when $K > 2$, chaos is likely. For example, participants are asked, initially, to trade and share resources they bring with them, and this interaction usually generates a multitude of connections, essential if a system is to move out of the ordered phase and into the chaotic realm. Soon, everyone tends to be loosely connected to everyone else, so $K = 10$ to 20.

Secondly, the P parameter bias is moved away from 1 (order) back toward 0.5 by making the rules governing interactions among people more varied through the use of various novel exercises. New behaviour and reactions are produced under rules which encourage a range of choices. If the Facilitator is successful, the group becomes chaotic, an uneasy state for most of us.

Chaos

People become quite edgy as they find themselves moving into the chaotic phase. The group may split into those who want more structure and those who are happy to go with the flow. As long as the Facilitator is patient and resists the urge to intervene and impose his own structure, the group will become chaotic. Because of its inherent uncertainty, however, the state of chaos is very disorienting for everyone, including the Facilitator. The butterfly effect, great sensitivity to perturbations, means that the slightest disturbance can send the group wildly off in a new direction.

The tricky part is to prevent chaos from degenerating into too much conflict and mayhem, and to know when to set the right conditions for a return to a new ordered state just on the edge of chaos. The skill of the Facilitator is to set up conditions to limit what is essentially uncontrollable,

to gradually guide people back into complexity.

McClure also emphasises the importance of timing. His interpretation is that the group must be able to challenge the leader, and, ultimately overcome him or her, a kind of mythical killing of the Royal Metaphor. Only then can the group develop its own identity. On the other hand, if the process gets out of hand, people may simply leave the group, or, in their fear of attacking the leader fall back into uncreative order and obedience (1998: 46-47).

In the following section we examine the second transition, from chaotic uncertainty into complexity at the edge of chaos.

Transition 2: From Chaos to Complexity

The trick with group work is to move gradually out of chaos back into the realm of order—through the development of a few simple rules—without going too deeply back into order. In this section we describe how this is done in the Creative Facilitating Workshops. It begins with the identification of personal and group objectives, and the setting of some basic rules. If successful, there may be a sudden transformation of the group into complexity, a feeling akin to what sports people call the Zone. We begin with the identification of individual objectives, based on the list requested during the initial contact with new participants at the time of registration.

Identifying personal objectives

In Creative Facilitating, when working with the principle of co-creation, one of the basic assumptions is that everyone in the group is a teacher. Consequently, it is vital that everybody knows the wants of the other participants if s/he is going to give feedback regarding progress relating to those wants. The ‘I Want’ exercise is designed to ensure that each participant knows the personal objectives of everyone else in the group, that is, to the extent that a participant wishes to disclose those objectives.

Participants are asked to finalize their personal list of wants, which they have been working on since they registered, share the list with another person if they wish, list their wants on a sheet of newsprint, adding symbol and name, and posting their newsprint on the wall, reading others’ lists of wants before returning to their seat.

The result is a beginning of an understanding of why others in the group have come to the Workshop. After a discussion related to what this exercise has achieved, participants are invited to come to the front of the room and speak about their list of wants to the group. As part of this presentation, participants are asked to incorporate other aspects of their lives if they wish. For example, they can tell the group where they live and they are encouraged to talk about their symbol. They are invited to tell the group any other relevant things about themselves—especially their positive accomplishments in their home life, their work, and in their community. It is emphasized that the most important part of this presentation is the telling of the persons’ goals—for themselves and for others, in the family, at work, and in the community.

Time is taken to inform participants that from this point each person’s presentations will be videotaped unless s/he expressly indicates that they do not want a particular performance to be taped. A video tape has been provided for each participant. In this way, the rule of feedback is introduced. More direct feedback comes from other people who are encouraged to give the speaker constructive feedback relating to the presentation. They are also told that critical feedback is not permitted, a reinforcement of the feedback rule which is followed throughout the

Workshop.

Usually speakers are willing to receive encouraging feedback but occasionally a speaker will exercise his or her option not to receive any feedback. Crisp feedback is useful at this stage so that lengthy, detailed feedback does not interfere with the flow of the session which has, as its main objective, the sharing of participants goals in a fairly unstructured way. To facilitate feedback, large presentation boards are placed at the front of the room. These boards have pasted on them numerous examples of appropriate, brief, encouraging comments which group members can use as triggers for positive statements about the presentations. The Facilitator models these crisp comments.

When everybody who wants to do this exercise has done it, there is a general discussion about what has transpired during the introductory presentations. Final comments and questions conclude the session. Participants are invited to remain afterward to view their video tapes by themselves, with friends, or with the Facilitator, at which time they may ask for additional constructive feedback.

Through the sharing of personal wants with the whole group, as well as the invitation to share other personal things—symbols, positive accomplishments, constructive comments related to other participants—communication shifts to a deeper place, below that surface level from which most more structured group communication emanates. This is perhaps the most important rule, for as more participants share from that deeper place, interaction becomes more focussed, although, typical of behaviour near chaos, the way this happens cannot be completely predicted. Nevertheless, at this point the group has begun to move back from chaos into the region of complexity.

Identifying group objectives on the way into complexity

Although we have arbitrarily separated the stages of group development into several phases, the actual process is fluid and unexpected. At any moment, the group can reverse direction and move back into chaos, or suddenly become quite structured as it shifts too deeply into order. It is during the intermediate stage, however, the complexity stage at the edge of chaos, in which the most creativity occurs. The following exercise, designed to come to some consensus on what the group wants to achieve, helps move the group from chaos into complexity.

Group objectives, in this instance, are the facilitation topics which are most important to the group members as a whole, and which form the basis of the remainder of the Workshop. The Facilitator establishes these group objectives by compiling from the participants' 'I Want' lists described in the previous section, a summary of wants, ranging from most-requested to least-requested topics. After the topics which are most important to the group have been established, the participants are again divided into subgroups. The number of subgroups will depend upon the number of topics most requested by participants.

Flexibility is important when setting up these smaller groups. For example, some individuals may choose to gather together to explore a topic which has not ranked high on the priority list. Most of the subgroups, however, will choose to deal with one of the most requested topics. Members then self-select, choosing the subgroup which holds the most interest for them. Members may choose a particular subgroup because they have expertise in that area, or, they may choose the one which will help them with a specific topic. Members in the smaller groups are asked to discuss their chosen topic and to find specific ways through which all participants in the

program might achieve the objectives related to their topic. The next step is to have each subgroup report their findings to the large group, outlining methods which might be used to achieve the group objectives which have been established. The exercise often uncovers an abundance of participant resources.

The 'Identifying Group Objectives' exercise is not always required. Sometimes at the end of the 'I Want' exercise, or during the period immediately following that exercise, the group is already at the complexity stage. Such groups want to move in their own way, and will be impatient with any more formal efforts to establish goals. When the Facilitator senses that he is in the way of the group moving at its own rhythm, he may decide to discard the 'Identifying Group Objectives' exercise.

With the completion of the group objectives task, the overall program shapes up like this. At the individual level, each participant has clarified his or her personal goals and has been invited to pursue those in their own time and at their own discretion. Group members have been informed of each other's goals, have been invited to share ways in which all goals might be met, and have been encouraged to give encouraging feedback when appropriate.

At the group level the group has established priorities regarding what things it would like to learn, and it has suggested specific things that can be done in the group to facilitate that learning. Now the group is invited to concentrate all its energy on achieving these individual and group objectives.

Achieving personal and group objectives at the edge of chaos

As members begin to work together to achieve personal and mutual goals, they become a highly cohesive group which, we believe, is operating in the region of complexity. At this point the Facilitator withdraws somewhat from direct participation in the activities of the group. In the Workshops there is a basic assumption that individuals attracted to these sessions will know, better than anybody else, what will work best for them to achieve their goals, although they may need help to uncover that knowledge and they may need resources and acknowledgment which will serve as supports as they move toward their objectives. Part of the Facilitator's task is to provide materials—numerous handouts, books, video and audio tapes, Internet access, art supplies, musical instruments, toys, easels, newsprint—anything within reason which will assist participants in their work. As well, the Facilitator continually offers options, alternatives, suggestions—anything from his knowledge and experience that he thinks will be helpful. Ultimately, however, it is the participant's use of their own creativity and energy to meet their own ends that brings results.

The Facilitator invites the group to do presentations, stories, subgroup work, talks, experiments, thinking-on-your-feet exercises, anything which will help them achieve their goals. When participants respond, the program has moved into its most exciting stage. Participants make individual efforts to meet their personal goals, and small subgroups facilitate exercises which are addressed to achieving the group objectives which were set earlier. Feedback constitutes an important part of these individual and subgroup efforts. Constructive feedback in the presence of the whole group comes immediately after the presentations. Constructive suggestions may also come from viewing the video tapes privately with acquaintances and friends, or with the Facilitator. Additional constructive feedback comes also from the Facilitator and other participants during breaks, at meals, and during the evening in residence if the program is held in

a residential setting. While these participant presentations and experiments proceed, the Facilitator fills in any spaces with useful presentations and exercises.

The tools and ideas emerging in the group can cover a range of topics, for example, opening groups, setting objectives, building confidence, coming to consensus, mediating, promoting discussion, ice-breakers and warm-ups, enhancing laughter and fun, evaluating the work done, staying positive, energizing groups, building trust, storytelling, reading to a group, using metaphor, enhancing concentration and focus, dealing with difficult people, stress reduction and relaxation, aspects of art and music, demonstrations involving dance and movement, and closing groups.

When the group is working well as a complex system, participants feel as though they are in a space which can be compared to the state of being in the Zone when one is participating in a sports event.

Groups in the Zone

Although the Zone phenomenon has not been studied systematically, an overwhelming body of anecdotal evidence indicates that the Zone experience is real. The following are some comparisons between the personal experience of an athlete in the Zone and the experience of being in an emerging group at the edge of chaos.

Just as the athlete experiences a relatively effortless flow, and a quality of lightness in his or her movements, the group flows in a natural and easy manner from moment to moment, as if it were being carried along by a friendly current in a mysterious river. The group can be entirely engaged in its interactions, like an athlete who is totally immersed in the game. Afterward, both athlete and group may be reluctant to take full credit for what has transpired when in the Zone. They have a sense that, during the time in the Zone, they were both doing something and being done to. To the athlete, sometimes perceptions are altered when in the Zone. In basketball, the basket seems as big as a lake; in soccer, players can see the whole field and the exact location of each player. Similarly, in the group, members do not have to think about problems; they seem to know exactly what to do, without a moment's hesitation.

Those participating in this work in the Zone, experience a different sense of time. Sometimes, these phenomena may be accompanied by a sense that time has slowed down. When the session is flowing in a natural way from segment to segment, sometimes in an uncanny way, blocks of time will pass rapidly. Before they know it, the time had come to close the session. Again, often, although a session might be spontaneous, unrehearsed, and creative, it will come to a coincidental or serendipitous finish at precisely the time that the formal schedule indicated the session should end.

Another shift in time sometimes experienced in Creative Facilitating sessions are what we might call 'synchronous' occurrences. Synchronicity is the connecting principle, when cause and effect are eliminated by the impossibility of any rational explanation, between our psyches and an external event, in which we feel an uncanny sense of inner and outer being linked. In the experience of a synchronistic event, instead of feeling ourselves to be separated and isolated entities in a vast world, we feel the connection to others and to the universe at a deep and genuine level (Bolen, 1979).

In Creative Facilitating sessions an inordinate number of things occur in an unexpected manner. For example, people who, at the beginning of the sessions, seemed least likely to

contribute anything substantial to the group, invariably contribute to the group and to the Facilitator in significant ways. Participants are cautioned to watch for events happening in most unexpected and surprising ways.

Perhaps the most exciting part of the group's working in the Zone, is not knowing what is going to happen next. Sometimes, presentations spin off one another as if they were planned. At other times, the process seems jerky and awkward. Sometimes a smooth-flowing process will stop abruptly. At other times, a session that has been somewhat stagnant will come to life suddenly. Sometimes the Facilitator is in the background, inconspicuous, guiding gently. At other times, he becomes very visible, filling in with presentations and offering other techniques. As individuals pursue personal and group objectives, the ebbs and flows, the mountains and valleys, the comings and goings, take on an unpredictable character typical of the mode of complexity.

Here are some comments from the participants in recent Workshops which communicate their perception of what is like to be in the realm of complexity. Again, SFX refers to the Workshops at St. Francis Xavier University; USA to the Workshops with the United Steelworkers of America.

Sense of Time: Time did not exist...It is amazing to never look at your watch, and, if you did, realize the disappointment of only a few minutes left...I feel as if I have escaped the real world and entered another time zone...completely present in flow (Workshop, SFX, 2002). Time flew by; before you realized, day was over...Sometimes the discussions were so interesting that it seemed like time is flying (Workshop, USA, 2001). You would get lost in time due to the fun we had, or the interest and concentration on what was going on in class (Workshop USA, 2002).

The Zone: We became a group with a common purpose....I couldn't believe it. I just 'was' (Workshop, SFX, 2002). I was very relaxed as if I had known these people all my life...Found when the topic became personal or deep, that's when the Zone happened...Everybody blended together and culture differences did not matter...The group as a whole seemed to be coming into a Zone at end of week (Workshop, USA, 2001).

The Unexpected: Lots of surprises...Some people have so much depth within them that I was delighted by their hidden gifts (Workshop, SFX, 2002). I connected with opposites...One person really surprised me...At first I may have been not so open to some members but by the end I had connected (Workshop, USA, 2001). I was different than I expected to be and it surprised me (Workshop USA, 2002).

Serendipity: The whole week!...I had many revelations revealed through symbols this week. It was eerie at times. There were many profound moments, quotes, that spoke to me (Workshop, SFX, 2002). This class lulled me into a magical environment (Workshop, USA, 2001). I know this sounds stupid, but I call it the undercurrents (Workshop USA, 2002).

Synchronicity: It was so awe-some that only a greater connection would have made this

happen... Yes, there were times when I felt we were all tapped into a special place. A different state of being. For awhile I didn't want to leave. I didn't want to return to reality (Workshop, SFX, 2002). I sometimes floated above the classroom (Workshop USA, 2002).

This process continues until the last hour of the program when the group participates in closing exercises. Sometimes the closing itself consists of exercises suggested by one of the participants.

A Complexity Theory Interpretation of Transition 2: From Chaos to Complexity

It turns out that it takes only a few simple rules to guide a system out of the chaotic realm into complexity. In fact, there is recent evidence in Kauffman's studies which hint that systems tend to evolve into the edge of chaos on their own, whether they begin in an ordered or a chaotic state (Kauffman, 1994: 156). So, in the case of the Creative Facilitating Workshops, as long as the groups are allowed freely to change connections—to mutate—they might evolve eventually toward complexity on their own. The rules may simply speed up the movement.

Moving toward complexity at the edge of chaos

It was noted earlier that external constraints tend to keep systems such as small groups within the ordered phase. Since the Creative Facilitating Workshops are fairly isolated from external constraints, the constraints introduced by the Facilitator are internal. Internal constraints refer to the way the coupling of lower level subsystems moves the system—a group here—into complexity, although the way this happens cannot be completely known (Flake, 1999: 449-450; Hayles, 1991: 45; Holland, 1998: 8-9). There are, however, some suggestions about the manner in which these internal constraints operate in the Creative Facilitating Workshops.

In the first place, the Workshops are kept fairly small, so N is low. Workshops which are unable to move out of the chaotic phase often have too many participants. As well, the range of behaviour permitted for each individual is limited, for example, by coming to a consensus on shared wants.

Still, it would seem that in a group of 10 to 20 people, even with limits on interaction, the number of connections for each member, K , would still be too high since, according to Kauffman, complexity emerges usually between $K = 2$ and $K = 4$. Adding a bias to the rules, however, can greatly affect the process. In the Workshops, a cultural bias is introduced during the middle part of the Workshop so that the P parameter is biased toward moving the group slightly into the ordered realm but not too far. For example, allowing supportive comments and forbidding critical remarks helps to create such a culture. The conversations become more focused but not locked into any given position, thus permitting the development of attractors which are slightly more stable, compared to those in the chaotic region. Of course, individuals are more than just on/off switches but it appears that within these Workshops there is a bias toward the 'on' position of encouraging communication which moves the group, in spite of the multiple connections, from chaos into complexity.

An even more direct way to move the group toward order, even with multiple connections, is to use a technique called canalisation (Kauffman, 1995:103-106). Canalisation can occur if several connected individuals happen to have the same Boolean rule. An example of canalisation

would be a feedback loop connecting, say, 6 elements so that the 6th element is connected to the first. In such a loop, if all 6 elements are guided by the rule, “If either one or the other of my inputs is ‘on’ then I will be ‘on’”, then once one element is turned on, all will be turned on. Canalising is rare in theoretical Boolean systems, especially as K increases, but common in biological systems. It is as though living systems have evolved to favour canalising. In practice, this means that several people in the group must share a willingness to have the group move in a certain direction. Once a certain suggestion is spoken, the entire group will seem to catch fire and evolve in that direction.

The subdivision into small subgroups to work on areas of common interest generates canalisation and also limits the range of person to person interactions. As K is reduced through the use of subgroups, the density of connections is decreased and, for each individual, reduces the number of links to other people. Throughout the early stages of the Workshop, the P parameter is biased toward agreement, what the Facilitator calls ‘co-creation’. Combined, these actions move each subgroup closer to the ordered realm. Later, allowing connections and trading of ideas among the several subgroups encourages them to co-evolve as complex subsystems systems, and prevent too much order (Kauffman, 1995:217).

Rubinfeld also uses the term *canalisation*, although in a slightly different sense (2001: 457). He puts more emphasis on the role of the therapist to interpret what is happening in order to connect events with awareness, especially events of “unconscious actions”. The effect is the same, however, when at least some of the group is ‘turned on’ simultaneously as a result of some trigger.

Direct internal feedback is another technique used by the Facilitator to help the group evolve into complexity. Members are able to observe their own behaviour through the use of video tape and comments from the Facilitator. These comments encourage both experimentation and convergence, typical of complex systems at the edge of chaos. Every time this happens, the group is energized and begins to operate at an even more intense, synchronous level. The feedback also inhibits discouraging comments so that eventually any member of the group will notice and discourage such criticism. Soon, it may disappear altogether. This internal feedback loop helps the group modify its own behaviour in ways which brings group members closer together, and intensifies its development. Many of the early exercises of the Facilitator were designed to establish these internal feedback loops.

Again, feedback must be used judiciously. Feedback which discourages the group from experimenting is negative feedback (Arrow et al., 2000: 202) and tends to move the group too far into the region of order. Supporting too much bizarre behaviour might be too much positive feedback and drive the group back into chaotic, wildly unstable behaviour which might lead to people leaving and the group collapsing (Arrow et al., 2000:204-203). Finding the right balance keeps the group at the edge of chaos—complex and creative.

In effect, complexity at the edge of chaos can be reached by several routes, but there needs to be enough time, especially in the beginning, for group interaction and for internal constraints to have a chance to develop in this direction. Of course, as is characteristic of complexity, the processes of change and development are not uniform nor linear. Each day new patterns emerge and each Workshop evolves in a different way.

Complex Social Groups

Once into the edge of chaos, new complex systems appear, generated by a few simple

rules. A lot of the experimental work with networks and computers on complexity, by necessity, must specify these rules of emergence precisely. Much of Holland's work described in his book, *Emergence*, describes examples of simple rules, what he calls *constrained generating procedures*, he and others have used to generate complex systems such as cellular automata (Holland, 1998:129ff). An example of a complex system is the now-famous computer program, *Boids*, invented by Craig Reynolds, which uses three simple rules to simulate the complex flocking behaviour of birds as they fly around obstacles while remaining a connected system (Flake, 1999: 270ff; Waldrop, 1993: 241-242). Similarly, Kauffman's computer-generated NK networks follow a few specific rules (1995: 76-77).

Now, while the 'shape' of complex patterns may be similar, they are not identical. Furthermore, the specific complex processes which go on as individual parts interact at the edge of chaos, are extremely complicated and essentially not analysable in terms of lower level processes (Bak, 1996: 6). So, while we can suggest the rules which the Facilitator uses to generate complex groups, and while such groups may resemble each other superficially as they enter the Zone, the exact nature of what happens within such groups is always different and always unpredictable.

Unlike carefully organised groups within larger organisation, the Creative Facilitating Workshops remain a bottom-up model. Rather than being engineered by a master planner, work in complex systems is designed and takes place at the level of participants (Johnson, 2001: 73ff). The role of the Facilitator is to set up the right conditions for the appearance of complexity, without controlling the results. Unlike many physical models of social processes, models of complexity do not involve simple causality, where a change in A leads to a predictable change in B. Rather, a change in A generates a new system and a new process which, while it may be described in general terms, does not produce determined outcomes.

It is important to note also that complex systems, in general, consist of both chaos and order. Thus, within complex social groups, we observe individuals freely interacting with each other, forming smaller, temporary subgroups, which break up quickly, reforming into different patterns. The group, although it is somewhat united, remains fluid. It is both a dynamic group and a group perfectly synchronized, operating with a different sense of time, a group in the Zone.

Another remarkable effect noted by Rubinfeld, is that each subgroup and each individual of a complex larger group is also a complex system, mimicking the overall behaviour, a phenomenon known as the fractal effect in complexity theory (2001: 450, 453). Rubinfeld's uses the example of an arguments between two people which may reflect conflict occurring in the whole group. For the Creative Facilitating Workshops, the way in which the entire group operates, encouraging exploration of new techniques for facilitating, is reflected in the way each subgroup approaches problem solving.

Rubinfeld uses other terms to describe complex groups such as *resonance* (p. 454), *synergy* (p. 456) and *catalysis* (p. 458) all ways to name what happens when participants in a complex group begin to feed on and stimulate each other's behaviour in nonlinear, unified, yet unpredictable ways.

Although McClure claims that what he calls the 'stage of harmony' is short, at least in his teaching groups (1998: 48), his descriptions of this stage and the next stage of 'performing' match the Facilitator's experience of being at the edge of chaos in the Creative Facilitating Workshops. There is a great 'we' feeling of high cohesion and a strong sense of bonding. Member are more

likely to interact with each other than with the leader, and to “share leadership responsibilities”. Members trust their own judgements. They are more likely to “disclose hidden aspects of themselves” (pp. 48-49).

Later, when McClure is talking about the emergence of a group mind in very developed groups, he, along with the Facilitator, does not hesitate to borrow the idea of *synchronicity* from Jung, who referred to events which coincide in surprising ways (p. 191). Jung’s example was the sudden appearance of a flying beetle similar to one his patient was describing from a dream. In the Creative Facilitating Workshops, people who seemed least likely to contribute would suddenly make a statement which exactly captured the moment. Perhaps such occurrences take place all the time. Only under conditions of complexity do such events seem to come together.

Both the Facilitator and Rubinfeld refer to the element of surprise when there are sudden shifts in the direction of the group during complexity.

...nothing happens in a group therapy session quite as the therapist might predict. This reflects the element of surprise in group analysis [he gives two examples]...Both of these illustrate spontaneous self-organising qualities of a group system and its nonlinear determinism (2001: 450).

With respect to changing impressions of time reported by the Facilitator, Rubinfeld notes that “Group process is no respecter of chronological time...” (p. 450). The group seems to move suddenly forward. At other times, “Events also propagate backwards” (p. 455) as events in the group trigger a reinterpretation of events which took place earlier in the group process or even long before in the life of a member.

McClure, like the Facilitator, also refers to the experience of athletes during peak experiences, an experience now usually called, ‘being in the Zone’. Bill Russell, playing for the Boston Celtics basketball team, writes in his autobiography that during such moments time seems to slow down.

Every so often a Celtic game would heat up so that it became more than a physical or mental game...the feeling is difficult to describe...my play would rise to a new level...all sorts of odd things happened...the game would move so fast...but it was as if we were playing in slow motion (p. 65).

McClure goes on to note that “Sports are replete with such examples as Russell’s”. He describes this experience as an example of ‘phase-locking’ in groups.

Eventually, the entire system may settle down and move into a stable equilibrium away from complexity and into a new pattern of order, a new system level. The groups in the Creative Facilitating Workshops, meeting for less than a week before dispersing, do not have time to evolve into a stable system level. To observe such a phenomenon would require observations of groups in a somewhat stable environment over an extended period of time. On the other hand, most members of the Workshops do return to fairly structured environments and organisations. One function of the final closure exercises is to help individuals leave the heady euphoria at the edge of chaos and return to more structured systems deeper within the realm of order. This preparation for the third transition, from complexity back to order, needs to start several days before the actual closing, through the preparation of a Tool Kit, described below.

Transition 3: Preparations for a Return to Order

As the group is working to achieve its objectives during the main part of the Workshop, at an appropriate time participants are invited to reflect on the fact that within two or three days they

will be going home.

The Tool Kit for moving back to order

From time to time during the last part of the course, the contents of the handouts, ‘The Tool Kit’ and ‘Carrying New Ways of Being into One’s Community’ are discussed. It is hoped that these discussions will ensure that, when the time comes to depart for home, participants will be able to return to the more orderly world.

These discussions and handouts have three purposes: i) to outline the numerous environmental influences which may affect participants efforts to initiate personal, workplace, and community change, ii) to provide information regarding positive ways to re-enter home, work, and community environments, and iii) to emphasize the necessity for participants to develop a daily program—a Tool Kit—unique to themselves, which will provide individual readings, techniques, affirmations, visualizations, music, exercises and guidelines to maintain and strengthen those elements of the training program which that individual values.

The Tool Kit is meant to ease the participant’s descent from the mountain top experiences of being in the Zone, while at the same time suggesting that some of that experience is portable. It recognises the reality that individuals are returning to their own networks of friends, family and the organisation itself, networks which are usually more structured and ordered than the complex group of the Workshops. At the same time, when successful, the Workshop has expanded the abilities and enhanced the confidence of the participants, and some of those skills and abilities may, in turn, influence the home networks. For example, people are returning to organisations which often, perhaps by necessity, encourage a culture of competition among co-workers, and conflict with outsiders. Participants returning from the Workshops may be able to introduce some elements of co-operation and co-creativity, typical of complex systems, which can help organisations respond more innovatively to changing environments.

Here is a sample of how recent participants experienced this preparation for the third transition, from complexity back into more order.

I gave a lot of hard thought to my shield—this was difficult for me...John stretched our comfort zone again and again and at this moment there is no finish line (Workshop USA, 2002)...I have more energy to try different options because I know someone will respond and appreciate...I will answer by quoting Benjamin Netanyahu, “Leadership is where vision and reality meet” (Workshop, SFX,2002). I feel a lot of new and exciting options are just around the corner...I am a totally different person now. Full of confidence (Workshop, USA, 2001). Feel more empowered and confident to be able to speak in public...I have an energy I can’t explain (Workshop USA, 2002).

A Complexity Theory Interpretation of Transition 3: Return to Order

Orderly systems such as organisations are not necessarily bad. Such systems are highly productive and efficient, especially if the output needs to be repetitive and predictable, a necessary condition for much of modern society. There is a kind of peaceful, rather elegant calm for individuals working within an organisation, in contrast to the intense interaction of complex systems at the edge of chaos. There is accumulating evidence that the ordered realm may be the condition of most advanced evolutionary systems, when the environment is relatively calm.

Kauffman defines order as a state of homeostasis. No matter where the system starts each day, it ends up in the same state because it is in a deep basin of attraction (Kauffman, 1995: 81-

83). Hence, orderly systems are resistant to small perturbations, and lose their sensitivity to initial conditions. To put it another way, because they are more linear and predictable in their behaviour, they can be modelled in simpler terms, are more predictable and can more easily be controlled. As Eves et al. argue, we live under physical and social laws, which, although they may have evolved from processes of complexity, are now ordered and predictable (Eve et al., 1997: xvii).

Thus, the Tool Kit, which participants are encouraged to modify for themselves, is a way to appreciate what real organisations are like, while at the same time preserving some of the excitement experienced in the Creative Facilitating Workshops during the stage of complexity.

Producing Order

What amazed early complexity theorists was how order seemed to emerge spontaneously from apparent chaos. The term negentropy is sometime used to describe this characteristic of biological evolution which seems to go against the overall trend of increasing entropy described by the Second Law of thermodynamics. Even very complicated systems may become orderly in a remarkably short time. Kauffman describes again and again how stunned he was in the mid-sixties when he discovered that even in huge networks with many light bulbs (N very high), the magic $K=2$ number (two inputs for each light bulb), produced order in a fraction of a second, every time (1995: 83).

$K = 2$ would describe an extreme hierarchical structure where each individual receives input from one supervisor, and communicates information to one other person. With this restricted interaction pattern, these very narrow hierarchies quickly become a fairly rigid structure. Even with a slightly larger K , the bias P may encourage people to agree with superiors, and discourage new ideas and disagreement. For example, many organisational meetings are very ordered, usually intentionally. Even with many (high N) participants there may be a very strong organisational bias, especially during corporation information meetings, which increases the P bias toward agreement, and thus maintains order. Other factors which can take the group far into the ordered realm are powerful individuals or subgroups which force others to conform.

The point is, it may be quite difficult for returning participants from the Creative Facilitating Workshops to change what almost seems inevitable, order and predictability. Still, they can learn from their week of experiences the possibility of complexity. Furthermore, many organisations, partly under the influence of complexity theory, are themselves experimenting with moving at least closer to the edge of chaos, so that participants may find more encouragement than they might have even a few years ago.

What are some of the conditions which foster complexity? Keeping N small—using small work groups; keeping K larger—sitting in a circle, encouraging cross-communication through groups representing several functional areas, E-Mails; using more positive feedback which feeds new ideas back into the organisation. It is unlikely that most organisations will choose to go into chaos but major perturbations, such as a stock market crash, a hostile takeover, may be the right context in which to guide the organisation into the realm of complexity where new, more adaptable forms can evolve.

CONCLUSION

Early researchers learned about the developmental stages of groups through observations of groups in laboratory settings. Building upon this knowledge, skilled group facilitators learned

through experience how to guide groups to become healthy and helpful. The lens of complexity theory helps us explain both the research and experiential findings on group development. As well, complexity theory promises more precise ways to measure and produce the effects we want.

The model of complexity theory we use is derived from Kauffman's research with computer simulations of N subsystems connected in K ways to each other. The NK model not only explains group development but identifies how skilled facilitators guide training and therapy groups. Researchers in group dynamics have identified several stages of group development, to which they give a variety of names and descriptions. We related these stages to three transitions in complexity theory—order to chaos, chaos to complexity, and complexity to order. As well, Kauffman's studies suggest several ways to guide the systems from stage to stage.

In the second half of our paper we report the experiences and observations of one group facilitator who learned, through trial and error, to apply many complexity theory techniques in his Creative Facilitating Workshops in order to move a group through the three transitions. His findings for all of the groups are consistent with complexity theory, and also with some recent applications of complexity theory to stages of group development (Arrow et al., 2000; McClure, 1998; Rubinfeld, 2001).

The first stage, *order*, is marked by predictability. Patterns of interactions are structured and controlled. Innovations and disturbances by individuals or subgroups have little effect on the overall behaviour of the group. To use the jargon of complexity theory, local effects are not converted into global behaviour. Groups already embedded in larger organisational systems are quite orderly.

Authoritarian leaders, as Lewin's research revealed, control members by discouraging innovation, and using negative feedback—squelching variety and constraining output to a narrow range (1939). In terms of Kauffman's NK models, authoritarian leaders keep new information out, limit links among subsystems, and bias the system toward order. The predictability of orderly groups, as researchers discovered, ensures high, repetitious output, with fewer errors, better for early industrial factories than for modern ones where machines do most of the repetitive work and people need to be able to problem solve.

The Facilitator of the Creative Facilitating Workshops found order even in new groups, because participants brought with them, and imposed certain expectations, cultures, and habits of order upon the group. He tried to discourage this pre-existing bias toward order through material he sent to participants in advance but invariably, even with experienced facilitators, there was an initial push for order.

The second stage of *chaos*, is dramatically unpredictable and very sensitive to any disturbance anywhere in the system, producing sudden and unexpected changes in behaviour. It occurs when groups are freed from authoritarian leadership and structure, or when they are put into an isolated and unconstrained setting, or when placed under *laissez faire* leadership—or when their institutional context is subjected to great disturbances, such as war or an economic downturn. Even the most structured groups may suddenly become unstable, begin to fall apart, and become unpredictable.

Especially in new, isolated training and therapy groups, the second chaotic stage of conflict, struggle and testing seems to be a necessary intermediate stage before healthy groups can evolve. Chaotic systems appeared quickly for Kauffman when he added links among subsystems, when he changed the bias away from order, and when he introduced large perturbations at several

places in the system. In general, positive feedback, anything which amplifies change, makes the system spiral out of control.

In the Creative Facilitating Workshops, the Facilitator used a variety of handouts and structured experiences to shake the group out of its early order, into the realm of chaos. When the group became chaotic, participants were disturbed by feelings of anxiety and uncertainty. The Facilitator himself had the same uncertainty even after many years of facilitating. There is no guarantee that the group may not remain in this stage where they will learn little, and where there is even the risk of people leaving to escape the uncertainty.

The third stage, *complexity*, happens when the group moves away from chaos to a place just within the ordered realm, on the edge of chaos. Systems tend to move toward complexity naturally in biological and social systems, perhaps a characteristic of higher evolution, since this region is best for adaptation and evolution (Kauffman, 1995). Complexity appears more quickly, however, with the introduction of a few simple rules from a democratic leader, by restricting the links among participants through the use of subgroups, and by tuning the system culture slightly toward order. In this region at the edge of chaos, just within the orderly realm, innovative and creative ideas and structures evolve best, but it is not easy to keep systems on the knife edge between chaos and too much order.

Again, we discovered that the experienced Facilitator had developed over the years a set of exercises, and simple rules, such as no destructive, critical feedback, to gently move the group into the realm of complexity. When it happened, he compared the experience to being in the Zone, where athletic teams perform together to generate the peak performances. For the Creative Facilitating Workshop participants, this was the time when the most creative ideas were produced and practised.

Over time, all systems tend to become more organised and, once again, orderly. So the fourth stage is like the first, as the cycle is completed. When members of a training group move back into a structured environment, they find that limits are put on links among workers, that new inputs of information are restricted, that negative feedback processes discourage change, that the culture is biased toward order, all ensuring that groups become more structured and predictable again.

To keep some of the creativity of the stage of complexity, then, the Facilitator of the Creative Facilitating Workshops introduced through a Tool Kit ways to resist these tendencies toward order. In addition, he suggested ways to keep up multiple links and dialogue, to disseminate new information. It is difficult, of course, for one or two individuals who have returned from the Creative Facilitating Workshops to change the culture of an organisation. Ultimately, what is required is that the organisation itself use some positive feedback to encourage innovation, and use some of the findings from complexity theory to move itself closer to the region of complexity. The risk, of course, is that complex systems are less predictable—and controllable—and that under unstable conditions, may become chaotic. The benefit to organisations which encourage creative innovation is that the whole system is more adaptable in a changing environment.

DISCUSSION

What does a complexity theory model of group development add to our understanding of group development? We'll first look briefly at some earlier alternative models. These are well summarised in the Arrow et al. book, (2000).

Because their book essentially focuses on work groups within more organised systems, and, therefore, discounts chaotic patterns and does not even mention complex systems, most of the models of development Arrow et al. cite are much narrower than the one we have used in this paper. These earlier models either converge upon a single equilibrium or oscillate among several equilibria. Regardless, in both cases, the models predict transitions to order. Nevertheless, Arrow et al. also include some models which resemble more the complex groups we encountered in the Creative Facilitating Workshops.

We should point out that by collapsing many case studies and models into a relatively few categories, both Arrow et al. and we have glossed over many of the finer points of differences found in the literature. Arrow et al. have a miscellaneous category for models of development which do not fit the general patterns—*contingency* models describe changes in groups which are caused by idiosyncratic factors (2000: 133). For the most part, however, groups do seem to follow a limited number of paths. One of the contributions of complexity theory is that it provides a good conceptual scheme for abstracting out patterns which may be overlooked in the details of earlier studies.

We'll begin with the most orderly models of development, then move into more complex cycles.

Class I Point Attractors

Models of *robust equilibrium*, to use Arrow et al.'s term (2000: 151) describe ongoing work groups which, "after a relatively short, initial period of change", settle down to their task. One can imagine this happening when a team is assigned a new task and needs to work out what is required before getting on with it. This is normal development deep within the region of order, as the system oscillates briefly before converging on a point attractor.

Class II Periodic Attractors

Several of the models cited by Arrow et al. meet Wolfram's criterion for systems which oscillate between two or more patterns. They name these *alternative equilibria* or *multiple attractors*. *Adaptive response* models move between point attractors in response to preset triggers (p. 153). For example, fire fighters go from normal to crisis procedures in response to a fire bell. Another term for such transitions is *catastrophic* models (Arrow et al., 2000: 154). As Arrow et al. point out, the term *catastrophic bifurcations* refers to the emergence of new attractors, and is better placed in the complex models below. When the term *catastrophic* is used alone, the implication is that that when some control parameter is altered, the system will alternate back and forth among patterns. A study of postal workers in Australia (2000) showed how two types of local rules appear suddenly in response to a single global rule, depending upon the amount of mail to be sorted (Haslett, Moss, Osborne, & Ramm, 2000).

Class III Chaotic Attractors

Although Arrow et al. explicitly reject chaotic systems, we will argue that some of the models of development they review do imply chaos. This becomes clearer as we discuss in the next section, models which incorporate complexity.

Class IV Complex Attractors

Many of the group development models described by Arrow et al. (2000) are really a mixture of order and complexity, with occasional forays into chaos, as groups make transitions from region to region.

The most classic and oldest model of group development is the famous, rhyming model of Tuckman and Jensen (1977): ‘forming, storming, norming, performing, and adjourning’. Arrow et al. call it the *life cycle model* (p. 152), since it roughly corresponds to the life course of a human being who is formed at birth, is stormily socialised into following socially acceptable norms, then performs certain social roles, before adjourning at the end of life. Later, Arrow et al. use the term *progressive stage model* (p. 229) for the Tuckman and Jensen chronology.

This matches what happens in the Creative Facilitating Workshops, not surprisingly, since Tuckman and Jensen’s model is derived from research on relatively autonomous groups. So, *forming* corresponds to what happens at the beginning of the Workshops when the participants bring in an earlier history of order; *storming* represents a pattern of chaos; *norming* signifies the introduction of simple rules which guide the transition from chaos to complexity; *performing* is what the groups do in the creative Zone, and *adjourning*, for temporary training groups, refers to the transition back into the world of order. Depending upon the group and the context, the time spent in the chaotic, complex and orderly regions may vary, but the underlying idea of transitions is clearly implied in the Tuckman and Jensen model.

Gersick’s original model of *punctuated equilibrium*, emphasised the contrast between period of relative stability, punctuated by initial and midpoint periods of instability, change and even transformation into new patterns (Arrow et al., 2000: 230). At the beginning, and midway, the group is much more open to outside influence, hence much more unstable. Later, the model was generalised to cover alternating periods of ‘stasis and transformation’, a clear analogy to order and complexity.

A variation of punctuated equilibrium is Worchel’s *cyclical stage model*, based on the observation that groups pass through repeated cycles of conflict and cooperation, reflecting the tension between individual and group needs (Arrow et al. 2000: 230-232). For both punctuated equilibrium and cyclical stage models, we would say in terms of complexity theory that the group is likely moving between order and complexity, with the ever present possibility that either external inputs (punctuated equilibrium models) or internal conflict (cyclical stage models) may push the group over the line into chaos with the risk of dissolution.

Bales’ *interaction model*, based on his observations that autonomous groups alternate between instrumental/task oriented and expressive/socio-emotional behaviour, is also a cyclical stage model. At time groups become orderly and work on getting the task done, until problems of group maintenance push them into the complex realm of group evolution, before they return again to task achievement as a more capable group.

Yet another variation on how groups alternate between patterns is the *group socialisation model* of Moreland and Levine (Arrow et al., 2000: 232-233). These describe groups which add

new members from time to time. Each new person throws the group back into complexity until the newbie is socialised into conforming to existing group norms of behaviour.

Combining all of these models produces a more complete, more complicated and more complex model more like a spiral than a simple cycle. That is, long lasting groups, as they pass through each cycle of order/complexity, evolve into new forms, become *transformed* (Arrow et al., 2000: 216-218). They have adapted so that they become more fit to deal with similar problems in the future. At this point they have gone through system *emergence*, rather than mere transitions from one stage to another (Arrow et al., 2000: 175-176).

Although the groups in the Creative Facilitating Workshops are quite temporary, frequently there may be repeated cycles as the groups sometime cross back into the realm of chaos, as the result of what Worchel calls 'precipitating events'. The groups in the Creative Facilitating Workshops, are, after all, made up of real human beings, who, from time to time, may feel ignored, insulted in ways which trigger a need for individual recognition. In the process of solving these individual problems, the group evolves into new shapes. We would argue that the complexity theory approach makes it much easier to understand these various processes.

Perhaps the time has come to stop debating whether or not complexity theory provides useful models for social systems and, in particular, for social groups and their development. Organisational theory successfully incorporated traditional psychological models of individual motivation and morale, and produced its own concepts of structure and change. In a similar way, chaos theory explained more satisfactorily such concepts of organisational theory as conflict, systems and boundaries, along with new ideas of attractors, nonlinear, and unpredictability. There remained, however, a gap between the two theories, papered over with such terms as 'self-organization' and 'autopoiesis'.

Now we have complexity theory which literally and conceptually explains how the two theories are interconnected. It is as pointless to say that complexity theory is a metaphor for highly cohesive, creative group behaviour as to say that the term organisation or system is a metaphor for business enterprises. When a few people interact face to face, over time, they develop system patterns which are sometimes orderly, sometimes chaotic and sometimes complex, and the cycle of development tends to follow the kind of path we have presented here.

The next stage of research on small groups needs to focus on how to identify each region, orderly, chaotic or complex, and how to guide transitions from one region to the other. The final section of this discussion will suggest some approaches to future research on social groups.

Future Research

In some ways the best measuring instrument to identify what region a social group is in, is to ask the participants. We have, after all, evolved personally into entities which are quite sensitive to nonlinear dynamics. We know when our group is more orderly and focused on a task. Similarly, we can sense when our group is chaotic and unpredictable. The interviews with participants in the Creative Facilitating Workshops confirm that they also knew when they were operating in the Zone, the region of complexity.

Very experienced facilitators and therapists have also learned through trial and error how to guide groups out of too much order, through rebirth into chaos, to the learning region of

complexity. We have reported some of the techniques used by skilled group leaders to make those significant transitions.

Still, it would be useful to have measuring instruments which are somewhat more objective; less art and more science. Arrow et al. (2000: 249ff) have a good general discussion of future research on groups using complexity theory, using standard research methods in the social sciences. As well, they suggest six 'global variables' to measure change, derived from traditional research on groups—interaction between individuals and the group, tasks, structure, information processing, conflict/consensus, and control of members (pp135-147). We would add to their suggestions some additional methods which come from more recent research in complexity theory.

There is a specialised body of research in complexity theory which uses conversational analysis to identify the three regions of order, chaos and complexity. Dillon (1993) measured the amount of complexity in written arguments from debates over abortion. Coders ranked the levels of differentiation and integration on a seven point scale, where high complexity is indicated by a greater variety of ideas, conceptually linked into higher level concepts. Ideological arguments tend to be less complex—fewer ideas linked with simpler concepts, and, therefore more ordered. Although Dillon did not use the term chaos, one would assume that a chaotic publication would have a high variety of ideas not integrated. These are indirect measures of order, chaos and complexity, and it would be interesting, for example, to see if groups such as the Creative Facilitating Workshops, generated a greater variety of ideas, linked with more creative concepts when they were in the complexity region.

Guastello et al. (1998) analysed conversations among student groups playing simulation games in a laboratory. Guastello et al. also used several measures of variety and integration, including Shannon and topological entropy, and Lyapunov dimensionality, to identify when the groups were focusing on the task (more ordered) as opposed to generating other ideas (more chaotic). Again, statements were first coded to see if the conversation could be condensed into smaller pieces of information. The more information required to reproduce the conversation, the more chaotic it is. Hence, conversations could be ranked from very high order (easily condensed) to very chaotic (difficult to summarize). They do not define intermediate conversations which are complex.

Pincus (2001) use a similar approach to study conversations among family members, again measuring Shannon entropy and Lyapunov dimensionality. Dysfunctional families tend to have very orderly conversations with not much variety—in other words, they tend to repeat the same scripts. More healthy families generate more variety, although Pincus argues that there needs to be a central core of beliefs to give some coherence to the conversations.

All of the techniques of conversational analysis require data from the coding of at least a sample of communication in a social group. These measurement techniques may point the way to more quantitative analyses of group development.

The recent publication of Wolfram's work with cellular automata, related to Kauffman's NK models, provides a another way of understanding complexity (2002). In particular, he defines complexity more precisely and develops many of its properties. The application of his methods to social groups offers additional opportunities for exploration of group development.

For example, it would be interesting to apply to group development, Wolfram's conclusion that there is only one level of complexity, and that more and more complex input does not seem to

increase the degree of complexity (p. 351ff). This idea is related to his finding for cellular automata that complexity is the result of initial rules and conditions, and that the degree of complexity cannot be greatly changed by adding more constraints on later system development. Perhaps this is why once the groups of Creative Facilitating Workshops are in the Zone, they seem to operate independently as a complex system, not changing their basic operating mode in response to later inputs by participants or the facilitator.

Perhaps the search for the applicable rules, which Wolfram's book reports in great detail, will become an essential part of complexity theory research into group development. The Facilitator's simple rules, which we have related to Kauffman's research into NK models, may provide a start.

While our paper is based upon the experience of one type of group, that found in relatively short term training workshops, it does suggest the possibility of more controlled, experimental studies of group formation. A refinement of our study would be computer simulations of the models we have described. Using the techniques developed by Kauffman and Wolfram, it should be possible to simulate what we have found in the operation of actual groups.

There are many different kinds of groups. They exist and prosper according to the needs of individual members and whether or not the whole group achieves its goals. We believe that the ideas proposed here would be applicable in many group situations, even to groups embedded within hierarchical structures of higher level systems constrained by expectations of order.

The use of techniques such as the generation of uncertainty in order to develop chaos, and then the development of a few simple rules to guide the group back to complexity at the edge of chaos, may be helpful tools for all leaders to consider. As we point out, skilled group facilitators have learned by experience that such transitions are essential for healthy change and development, for individual satisfaction and a sense of group satisfaction. Our paper should reassure already successful facilitators while also offering new techniques.

We emphasize again that these techniques do not force groups into specific behaviours and outcomes, and, in fact, chaotic and complex groups are quite unpredictable. The guiding techniques simply allow and encourage the group to develop in the most natural way.

Since complexity theory applies to all systems, it would also be interesting to observe conditions under which larger, higher level social systems such as organisations and even societies shift between the three phases of order, chaos and complexity.¹ We are convinced, based upon our research, that all social systems need to be flexible to survive successfully, that it is unhealthy for members and the group itself to remain locked deep in the phase of order or, for that matter, to persist at the other extreme, in a state of chaos. We argue, then, that all social systems need to move, from time to time, away from order into chaos so that they can return to the Zone of complexity. Complex systems are more creative, a characteristic essential for long term adaptability in a shifting environment.

We hope that our paper stimulates refinements in the model we have developed, along with suggestions for creative new uses of complexity theory in the study of social systems.

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¹ An attendee at the Sociocybernetics Research Group meetings in Brisbane suggested that similar transitions among order, chaos and complexity, can be generated in the brain with the right stimulation.