Nonlinear dynamics provides a conceptual tool to explain how the mind works. Human cognition could be conceptualised as an intentional self-organising process, in which patterns of brain activity and neural organisation evolve based on prior knowledge and experiences (Lazzarini 2005). Occupations and the experiences of daily life activities are unique and especially meaningful to each individual (Pierce 1997). Consequently, occupations embedded in the individual’s emotional and personal meanings are part and parcel of what he or she becomes privately and publicly. When looking at occupation from such a variable and nonlinear perspective, one can easily propose the ubiquitous power of occupation as a vehicle for change in therapeutic interventions (Lazzarini 2004). According to nonlinear dynamics systems theory, human beings are conceptualised as self-organising complex dynamical systems, who interact with the environment through their occupations, for the purpose of creating, changing and adapting to achieve optimal performance (Lazzarini 2005).

Traditionally, in the realm of occupational therapy education, theoreticians and educators have proposed occupation as either a process or a means to an end or as both (Trombly 1995, Crabtree 1998, Royeen 2002). Clinicians and practice placement educators, on the other hand, view occupation as the dynamic engagement in life’s activities that reveals the person-environment interaction (Dunn et al 1994). However, with the latter view, questions arise. How does finding meaning in occupation create change for the individual and at what levels do changes occur? Does occupation play a role in shaping brain function?

Neuro-occupation, a blending of neuroscience and occupation, provides a structure based on nonlinear dynamics and chaos theory to suggest approaches for treatment (Royeen 2002, Lazzarini 2004). Neuro-occupation also provides nontraditional ways of looking at occupation, affording a path for research and the provision of therapy in the field. One of the key concepts founded in nonlinear dynamics theory is that humans create meaning through their choice of occupations, which are habitual routines that intricately develop highly complex patterns of brain activity, which in turn shape and develop brain function (Royeen 2002, Lazzarini 2004). Nonlinear dynamics allows occupational therapists scientifically to reframe...
their understanding of interrelationships among the infinite variables of human occupations, ranging from the microscopic – the human body functioning as a complex dynamic-homeostatically regulated physiological system – to the macroscopic levels observed in the survival and maintenance of families, communities and societies as highly complex social and cultural systems (Rowles 2000, Lazzarini 2004). Consequently, nonlinear dynamics is a framework for providing a deeper understanding of how habits are formed and manifested in human systems.

Linear and nonlinear models

Linear model

Traditional evidence-based practice follows a linear thinking paradigm, employing cause and effect relationships. The main problem with linear models is that the effect can never reshape the cause. A linear system is a well-behaved system, for which the principle of superposition governs the interrelationship between its inputs and outputs. This simply means that if stimulus S1 elicits response R1 and stimulus S2 produces response R2, then the sum of stimuli S1+S2 brings about the sum of responses R1+R2. Any multiple of S1 and S2, namely [k (S1+S2)], produces [k (R1+R2)]. In simpler words, the magnitude of the response is proportional to the strength of the stimulus. This translates into the simple idea that there is a direct cause and effect relationship between inputs and outputs: small changes cause small effects and large changes cause large and striking effects (Goldberger 1996). This view, there is no way for the effect to reshape the cause.

Nonlinear model

A dynamical system is a system that changes over time (Kelso 1999, Ott 2002). For nonlinear dynamical systems, proportionality does not hold: small changes can have dramatic and unanticipated effects (Briggs and Peat 1989, Goldberger 1996). Complex nonlinear dynamical systems are composed of multiple subunits and cannot be understood by analysing these components individually (Goldberger 1996). This strategy fails because the components of a nonlinear dynamical system are interacting continuously, expressing the interdependency of the system. In other words, the system is coupled.

A coupled system refers to a system guided by influences as opposed to control. Any two parts of a system that are considered to be related through transmission, receptions, storage, retrieval or material resource exchange are coupled together (Eoyang 2004). The ‘cross-talk’ of pacemaker cells in the heart or of neurons in the brain are two examples. Their nonlinear coupling generates behaviours that defy explanation using traditional (linear) models (Goldberger 1999).

A related and noteworthy property of nonlinear dynamics is referred to as universality. An important and universal class of abrupt, nonlinear transitions is called a bifurcation. This term describes situations where a very small increase or decrease in the value of some parameter controlling the system causes it to change abruptly from one type of behaviour to another. The output of the same system may suddenly go from being wildly irregular to a highly periodic behaviour, or vice versa. A universal class of bifurcations occurring in a wide variety of nonlinear systems is the sudden appearance of regular oscillations or fluctuations that alternate between two values.

Nonlinear dynamical systems are also highly sensitive to initial conditions. This means that small or subtle changes can produce large effects (Goldberger 1996). This is in stark contrast to a linear system, in which small changes cause small effects and large changes cause large effects. In nonlinear dynamical systems, circular causality and feedback interconnections at all levels govern the emergence of the self-organising behaviour of the system.

Many life sciences and traditional clinical practices, including occupational therapy, may assume the linear worldview (as is done in many physical sciences and engineering disciplines to make problems more tractable and find simplified solutions to complex problems), in which individuals are perceived as highly deterministic, predictable and passive directionless systems, most likely incapable of producing any kind of self-organisation. This assumption and adoption of a linear model for an individual places a tremendous burden on a profession like occupational therapy, which deals with human habitual activities. The approach is counterproductive to service delivery, programme planning and implementation, and most importantly to the sustainability of realistic occupational therapy outcomes.

The main difficulty arises from the consistent use of theoretical models that metaphorically imply a holistic approach to therapeutic exchanges, although lacking a coherent and fully integrative picture of living systems. An insight into and an understanding of the concepts of nonlinear dynamics, namely self-organisation and pattern formation, are essential to occupational therapy practice. Such scientific concepts are quintessential not only to validate the holistic perspective claimed by the profession but also to provide robust theoretical models. The concepts of pattern formation and self-organisation not only provide a clear scientific sense for human habitual activity but, in addition, irrefutably validate the philosophical and scientific premise of occupational therapy practice. For example, theoretical models explaining human action from a narrowed ‘information processing’ perspective suffer from the brain-as-a-computer metaphor, attempting to explain in purely mechanistic and deterministic terms the brain’s unique capacity for adaptive behaviour.

Human beings, however, are highly nonlinear, self-organised, adaptive complex systems, whose behaviours create unique experiences in a dynamic fashion (Royeen 2003, Lazzarini 2004). As these actions evolve from highly complex interactions, nonlinear dynamics provides a powerful and more realistic description and understanding of such actions at all levels of organisation (molecular, cellular, tissue, organ, system, individual, group and community).
Edge of chaos

It is now established that nonlinear adaptive systems are capable of exhibiting self-organising behaviour that fluctuates between three stages:

1. **Stasis**, state of complete order or fixed point with no apparent change
2. **Chaos**, state of complete disorder
3. **Edge of chaos**, or in-between state (see Fig. 1).

The edge of chaos, or bistability, is the state of creation and adaptation (Peak and Frame 1994, Sullis and Combs 1996, Lazzarini 2004). This state is of particular interest to occupational therapists, because this is where occupations can be reshaped and new ideas with unexpected and surprising outcomes in human performance can be observed.

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**Fig. 1. Behavioural modes of nonlinear dynamical systems: nonlinear adaptive systems can exhibit three different types of self-organising behaviour.**

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The edge of chaos represents a dynamic instability within a system. Dynamic instability, as it pertains to human behaviour, represents a critical period in a spatiotemporal event, where sudden and abrupt behavioural adaptation takes place. Living organisms are thermodynamically open systems while at the same time being organisationally closed, that is, they are in a state of permanent flux, continuously exchanging energy and matter with their environment; however, the latter does not dictate the specificity of the changes that occur within the system.

Living systems as energetically open are characterised by a complex organisation, which results from a vast network of molecular, cellular, tissue, organ and system interactions involving a high degree of nonlinearity. Under appropriate conditions, the combination of these two features, openness and nonlinearity, enables complex systems to exhibit properties that are emergent self-organising. In physical and biological systems (at their lowest organisational levels) alike, such properties may express themselves through the spontaneous formation, from random molecular interactions, of long-range correlated, macroscopic dynamical patterns in space and time – the process of self-organisation. The dynamical states that result from self-organising processes may have features such as excitability, bistability, periodicity, chaos or spatiotemporal pattern formation, and all of these can be observed in biological systems.

Emergent or self-organised properties can be defined as properties that are possessed by a dynamical system as a whole, but not by its constituent parts. In this sense, the whole is more than the sum of its parts. Put in different terms, they are emergent phenomena that are expressed at the higher levels of organisation in the system but not at the lower levels. One attempt to help to visualise the concept of self-organisation is the sketch in Fig. 2, which shows the dynamical interdependence between the molecular interactions at the microscopic level and the emerging global structure at the macroscopic level. The upward arrows indicate that, under non-equilibrium constraints, molecular interactions tend spontaneously to synchronise their behaviour, which initiates the beginnings of a collective, macroscopically ordered state. At the same time, as indicated by the downward arrows, the newly forming macroscopic state acts upon the microscopic interactions to force further synchronisation. Through the continuing, energy-driven interplay between microscopic and macroscopic processes, the emergent, self-organising structure is then stabilised and maintained actively.

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**Fig. 2. Dynamic interdependence: the dynamical interdependence between microscopic molecular interactions and the emerging global structure at the macroscopic level. The system under consideration is open to the flow of matter and energy. The upward arrows indicate that, under non-equilibrium constraints, molecular interactions tend spontaneously to synchronise their behaviour, which initiates the beginnings of a collective, macroscopically ordered state. As indicated by the downward arrows, this newly forming state acts upon the microscopic interactions to force further synchronisations. Through the continuing, energy-driven interplay between microscopic and macroscopic processes, the emergent, self-organising structure is stabilised and actively maintained.**
Among the earlier examples of this behaviour in a simple physical system is the spontaneous organisation of long-range correlated macroscopic structures; that is, of convection cells (Bénard instability) in a horizontal water layer with a thermal gradient (Chandrasekhar 1961, Lazzarini 2005). In this well-known case of hydrodynamic self-organisation, the size of the emergent, global structures – the spatiotemporal hexagonal patterns of the order of millimetres – is greater by many orders of magnitude than the size of the interacting water molecules. This implies that, when the thermal gradient has reached a critical value or edge of chaos, the initially uncorrelated, random motions of billions of molecules have synchronised spontaneously without any external instructions; hence, the arising of a new self-organised state of behaviour. This argument elucidates and provides validation to the actualising states of human performance in response to experiences, forming new patterns of brain activity, meaning and behaviour.

The evolution of self-organised behaviour is sensitive to initial conditions, meaning that a new experience perturbs the system; it initiates growth in the system and the change facilitates adaptation of the system as a whole. Even the smallest perturbances to the system have the potential to produce large modifications to the system’s behaviour (Briggs and Peat 1989, Blackerby 1998). Clearly, the change, in turn, influences the cause, which serves as a new initial condition for further evolution of the system.

In nonlinear thinking acquired through the application of the theory base, the process of causality is circular (Lazzarini 2004). Cause is seen to produce an effect, which in turn serves as a new initial condition for further evolution of the behaviour of the system. Under this analysis, occupation then emerges directly as a self-organising vehicle of change (Lazzarini 2004). Using this method of thinking, occupational therapists have been able to identify the adaptation process of how individuals as dynamical complex systems self-organise their intentional states in response to changes in the internal and external environment (Lazzarini 2005). To understand self-organisation, one must look at the individual’s history of prior experiences, levels of arousal and attention; the intentionality of the individual’s typical responses to stimuli that lead to the formation of goals; and the derivation of meanings attributed to occupation (Lazzarini 2004).

The Neuro-occupation (IMP) model

This paper proposes that through a Neuro-occupation perspective, which exemplifies the nonlinear dynamics of human occupations, therapists can deepen their understanding of occupation by considering the views of intention, meaning and perception (IMP) proposed by Lazzarini (2004).

In this model, the microscopic (intentional) state demonstrates a linear causality that disappears at the mesoscopic (meaning) state by the formation of wave packets (Freeman 1999, 2002b). Wave packets are the results of microscopic sensory stimuli that are pervasive throughout the hemisphere. Self-organised patterns of neural activity largely broadcast through the forebrain. Wave packets form when sensory-driven input destabilises the primary receiving areas by local state transitions and are the precursors of awareness. Wave packets constrain the cortex at the macroscopic state (perceptual), ultimately actualising old experiences and sending the new sensory consequences of actions back to the microscopic state in a circular causality fashion (Lazzarini 2004).

Macroscopic activity involving the whole forebrain is expressed by the observable actions and behaviours that reflect the key state of awareness. Mesoscopic activity bridges the gap between microscopic and macroscopic in a nonlinear fashion by the formation of wave packets. The key state of mesoscopic activity is the formation of meaning. Microscopic activity is sensory and intentional, expressed by action potentials. Sensory-driven action potentials condense into mesoscopic wave packets, like molecules forming raindrops from vapour, which reflects the key state of self-organisation (Lazzarini 2004).

To assist with understanding this process, William’s case is presented as an example. At the time of interaction with the occupational therapist, William was a middle-aged male with alcoholism, who was attending an outpatient programme at a psychiatric hospital. William’s behaviour is analysed from two points of view. His behaviour is compared and contrasted according to the traditional
linear model, and the newly developed nonlinear model, to provide the reader with a fresh approach to explaining adaptation and to stimulate a better appreciation of the uniqueness of the individual.

William’s name is fictitious and aspects of his story have been changed to preserve confidentiality. Psychiatric hospital guidelines do not allow for release of the names of family; therefore, the authors were unable to find retrospective consent, since William is deceased. The authors have considered the risk of identification carefully and made every effort to provide anonymity, due to the circumstances.

Case study: William

After losing his job to alcohol abuse, William became severely depressed and his drinking increased. He was picked up as Driving Under the Influence and had court-ordered treatment in an outpatient substance abuse programme. William’s history included 15 previous inpatient psychiatric hospitalisations for alcoholism. He had a prestigious and highly responsible job with a telecommunications company, where he supervised 2,000 mid-level managers, monitoring employees laying cable networks throughout the United States. At the time of treatment, William was self-employed and lacked enthusiasm for his new job, where he stocked cigarette machines weekly at truck stops within a radius of 200 miles of his home. He was constantly far from home and isolated while he performed what he considered to be meaningless tasks.

On his first visit, the occupational therapist learned that William had put off dealing with some major issues, which had led to complications in his life. William was able to generate a 28-item list of tasks that he had avoided. For example, he had not paid his taxes for 5 years. Although buying large quantities of cigarettes yielded William opportunities to redeem coupons, he had accumulated uncashed coupons totalling $8,000. The occupational therapist could see that William’s chemical addiction was affecting his behaviour and his life roles as husband, father and work supervisor.

Linear approach

Using a linear thinking model, the occupational therapist determined that William was experiencing fears associated with task avoidance: a fear of disapproval, a fear of accepting responsibility, a fear of exposing his inadequacies, a fear of embarrassment and a fear of failure. He had feelings of guilt associated with not reacting promptly to demands, had trouble making decisions at work, and felt that his current job was meaningless. At the same time, the occupational therapist noticed that William’s former work as a supervisor had met his needs to influence others, be in charge, be a role model and feel respected by others as an authority figure. Obviously, William’s new work role could not meet the same needs as had his previous job.

Nonlinear approach

A different way to reflect about this case would be to consider the nonlinear dynamics of self-organised complex systems. Using this approach, the occupational therapist acknowledged that the development of behavioural patterns and the formation of new habits had a strong basis on intentional state (influenced by past experiences, historical essence, long-term constructed meanings and cultural as well as social contexts). Rather than talking about William’s guilt or avoidance of tasks, the therapist would focus on the strong new behavioural mode where behaviours converge to a stable state (a basin of attraction, using complexity theory jargon), which forms the new habitual patterns. William’s repeated struggle to overcome alcoholism was unsuccessful because his intentional state was not accounted for or determined during his 15 inpatient hospitalisations.

Self-organising systems are not merely affected by traditional generalised rehabilitation methods and, regardless of their degree of illness, individuals are profoundly influenced by their intentional states. Recognising this premise, the therapist perturbed William’s perception by advising him to employ a secretary to supervise and organise his work (Fig. 4). To perturb a system is to challenge the system and assess how quickly the system can go back to its habitual pattern or stable state (basin of attraction). Perturbation is a term that indicates how complex and unpredictable results (new habits) can be formed in systems that have a highly sensitive dependence on initial conditions (Peak and Frame 1994, Blackerby 1998, Lazzarini 2004).

Fig. 4. Perturbation to the system: the occupational therapist perturbed William’s perceptions by suggesting the hiring of a secretary to accomplish work that William avoided for many years.

<table>
<thead>
<tr>
<th>Macroscopic: Perception</th>
<th>Mesoscopic: Meaning</th>
<th>Microscopic: Intention</th>
</tr>
</thead>
<tbody>
<tr>
<td>William’s belief: ‘I can’t file my taxes. I cannot face my challenges. I am a failure.’</td>
<td>William’s belief: ‘There is no meaning in my job. I do not want to think about what I have lost.’</td>
<td>Accumulated previous experiences; historical essence, lifetime of constructed meanings. Subcortical emotions at the limbic level. Chemical changes to the brain resulting from alcohol.</td>
</tr>
<tr>
<td>External and internal influences</td>
<td>Formation of patterns of brain activity in response to the meaning of the stimulus</td>
<td>Contextual influences, external and internal</td>
</tr>
</tbody>
</table>

At the time of treatment, William was determined during his 15 inpatient hospitalisations. Although buying large quantities of cigarettes yielded William opportunities to redeem coupons, he had accumulated uncashed coupons totalling $8,000. The occupational therapist could see that William’s chemical addiction was affecting his behaviour and his life roles as husband, father and work supervisor.
Consider how this small perturbation altered William's intention, meaning and perception (IMP) through the Neuro-occupation model created by Lazzarini (2004) and shown in Fig. 3. Lazzarini (2004) clarified that intention is not the same as meaning, although they are used interchangeably in the literature. Intention occurs at a limbic system level, allowing the individual to make choices in moving towards goals, and is derived from the accumulation of experiences that are self-organised and built upon changes that develop from feedback to the system.

Meaning takes place following the destabilisation of the sensory cortices. Destabilisation of the sensory cortices refers to an explosive jump from a preexisting state, expressed in amplitude modulation of brain activity, to a new state that is expressed in a different spatial pattern … This process is indeed a dynamical action pattern that creates and carries the meanings of sensory stimuli for the individual (Lazzarini 2004, p345 [Freeman 1998, 1999, 2000a, 2000b, 2000c, 2000d]).

Perception is then the organisation of sensations and the simultaneous construction of meaning (Freeman 1998, 1999, Lazzarini 2004). Perception is to be differentiated between cognition occurring in the forebrain, as a self-organised process within the context of initial conditions of the limbic system, and all sensory input with musculoskeletal and autonomies experience (Kelso 1999). Fig. 5 shows sensitivity to initial conditions and circular causality, that is, how perturbation by the occupational therapist influences the system to change.

Fig. 5 also illustrates how perturbation introduced at the perception level enabled William to change his behaviour by setting new goals, which helped him to actualise his potential, move his life experiences in a new direction and utilise the feedback to create a new initial condition. Had the occupational therapist’s perturbation not had an impact, William would have continued his habitual course of behaviour, which would have perpetuated his behaviour even further.

The 15 hospitalisation attempts for the treatment of William’s alcoholism were ineffective because, during these attempts, William's intentional state was not perturbed. He could not change his behaviour by finding meaning in setting new goals while going through each detoxification experience. As a consequence of linear thinking, the professionals assumed that with more detoxification attempts and treatments, the outcome would be better! William continued his habitual drinking behaviour during this treatment period because detoxification did not alter his intentional state.

Addiction research performed on rats may help to identify why humans take a varying amount of time to develop habits and have difficulty with cessation. Graybiel (2002) showed how learning routine behaviour occurs in ‘chunks’ (clusters), which originate in the basal ganglia in the forebrain and connect to the cerebellum. ‘Templates’ are stored routines that occur automatically and are triggered by an event. Graybiel’s (2003) research in addictions focuses on ‘dysregulation of behavioural patterns’ as result of substance dependence. Her theory is that a ‘switch’ becomes turned on, providing a ‘massive reward’ to the brain that turns habit into a chemical addiction.

William began to make changes in his life habits because of his new perceptual state as to how to meet his needs better. By employing a secretary, William was able to delegate unpleasant tasks to her and return to his habituation at a new level. He returned to his former supervisory mode, but at a new level of perception. Shortly afterwards, he decided to volunteer as the construction supervisor for an important housing programme, which built houses in his community for the poor (return to habituation at a new level). By acknowledging his emotions that prevented his action, William found meaning in new roles and his positive goal-directed energy emerged (intention). Sixteen years later, William continued to supervise home construction as an avocation, and owned his own cable television company. At that time, he supervised 225 employees. William became active in the Alcoholic Anonymous community and mentored newly recovering alcoholics for more than a decade.

William’s case helps occupational therapists to appreciate the power of human occupation. The case also assisted his occupational therapist to underscore the following observations from the perspective of Neuro-occupation and its nonlinear dynamical concepts: the occupational therapist realised that she was mainly...
a facilitator and could not impose a change on the self-organising system of a human being, but could use the concepts of the IMP model to influence the system and thus instigate change in the client.

The human system is a self-organised, interdependent system. Owing to the existence of feedback loops of circular causality when the occupational therapist affects one part of the system by perturbing it, all parts of the system will be affected. The change in William’s perception created a new basin of attraction or homeostatic state, upon which growth and adaptation occurred. By returning to habitual patterns of occupation, old and new meaningful patterns were conflated, finally contributing to a new level of self-perception for William. The prediction of outcomes is not possible in dynamical complex systems. Those subscribing to linear systems thinking believe that prediction is possible, but in self-organising systems one has no control over outcome. One can only influence the system by setting in motion those initial conditions that are necessary for change.

As traditional occupational therapists have been trained to look at an individual’s problems in component parts, nonlinear dynamic systems theory helps them to refocus on the relationships and interdependence among parts of the human system, thus giving rise to an understanding of the complex, collective behaviours of the client and the relationship of the client to the environment. Occupational therapists can look at how interactions lead to patterns of behaviour (emergence), and describe their interdependence (indirect effects) and evolution into self-organising patterns that occur independent of manipulation by others (Kelso 1999).

Ikiugu (2004a, 2004b) has developed a nonlinear dynamics model of practice called Instrumentalism, where he sets up guidelines for occupational therapy practice that acknowledge the complexity of the human system. He proposes a three-phase feedback loop, which establishes the clarity of the beliefs that guide human actions and designs activities that strengthen the constructs of beliefs and the commitment of the individual to complete the actions, and the individual evaluates the consequence of behaviour against the expectations.

In this case, the occupational therapist perturbed William, after which he self-organised to determine how his beliefs and thoughts led to non-action and stymied his productivity (Ikiugu 2004a). Having a purpose or a mission leads to meeting the search for meaning in life. With the loss of his job, William had lost his sense of mission and his actions were meaningless and uninspiring. As goals are future reference points that act as attractors to draw the system’s movement towards that direction, the clarification of one’s goals informs purpose, gives inspiration and direction to the lives of individuals, and counteracts the stagnation that begins in the mind as maladaptive thought patterns upon which maladaptive actions are based (Ikiugu 2004a, 2004b).

**Discussion**

This paper has proposed that individuals are complex nonlinear dynamical systems and has explained the concepts of Neuro-occupation. Three levels of an alcoholic person’s actions – microscopic (intention), mesoscopic (meaning) and macroscopic (perception) – which operationalise the connection between brain dynamics and occupation, were recognised in the case study using the IMP model. This case study illustrates and embellishes the occupational therapist’s understanding of how intervention at one level of the IMP can affect the whole system at all levels, due to the existence of feedback loops of circular causality.

Neuro-occupation is a tool that allows occupational therapists to understand the interaction between occupational therapists and their clients, and between clients and other human systems, in order to understand the complexity of the dynamic human system and the interplay of the environment. This tool has the potential to take occupational therapists away from the mechanistic thinking of linear approaches, which they have been taught to use to evaluate their clients (Royeen 2002). Nonlinear dynamics may challenge occupational therapists to be open to the broad range of human experience at multiple levels (Royeen 2002).

Creek (2003) has enlightened occupational therapists by defining occupational therapy as a complex intervention that dynamically integrates five interactive levels. These levels are:

1. The occupational therapist as an independent self-organising system, with all the beliefs, values, skills, tools, knowledge, abilities and culture that he or she brings to the interaction
2. The client, also as an independent self-organising system, with all of his or her history, experience at all levels and contexts, coupled with values, health care beliefs, needs, problems, issues, personal goals, occupations, abilities, skills, attitudes and interests
3. The context
4. The environment
5. The occupational therapist’s actions.

Creek (2003) describes how the mature occupational therapist interchanges perspectives at each hierarchical level, while engaging in the occupational therapy process with a client. The occupational therapist would adjust the focus of his or her attention ‘from occupation to activity to task to skill and back again’ (Creek et al 2005, p283) throughout a treatment session. Creek (2003) reflects that therapy is an active partnership between occupational therapist and client, which facilitates the client’s autonomy and guides his or her care.

These authors suggest that as the occupational therapist uses the client-centred approach to engage the client in goal setting and activity planning, he or she does a continuous assessment of the client’s actions, which provides the therapist with an ongoing feedback loop regarding his or her interactions. By providing perturbation
at the perception level at the edge of chaos, the occupational therapist evaluates client progress towards goals and attends to client needs at various levels. Occupational therapy is a complex intervention because the individuals that therapists serve are complex self-organised systems, who interact with complex self-organised therapists. It is through understanding the complexity of those relationships that one can understand the uniqueness of the profession (Creek et al. 2005).

It would be advantageous for the occupational therapist to invest proper time to study the literature on chaos, nonlinear dynamics and complexity, which provides the basis of Neuro-occupation theory. Several authors have explored the value of the relationship of occupation to the nervous system, since Neuro-occupation theory has been articulated. Walloch (1998) demonstrated how the Neuro-occupation framework helped to design interventions to manage the sensory and affective aspects of chronic pain and to reconstruct goals for the continuation of meaningful occupations. A most intriguing application of Neuro-occupation theory at the intentional level was presented by Howell (1999), who worked with the reticular activity system (RAS) of comatose clients by using the habit strength of self-care activities to provide sensory input to the RAS. Way (1999) explored the role of the autonomic nervous system in relation to play. Gutman and Biel (2001) prepared a theoretical discussion of how occupation has an impact on the neurological substrates and neurochemistry that underlie the emotional states of depression. Lohman and Royeen (2002) examined the behaviour of people with traumatic hand injuries experiencing post-traumatic stress disorder, which was shown to affect normal cognitive function.

Butler (2004) recognised the need for research into the complexity of the occupational therapy process and practice. She suggested longitudinal research with experimental time-series analysis to support the qualitative analyses of complex interventions. Recent research by Ikiguu and Rosso (2003) presents a mixed method study of complexity, evaluating the daily habits and routines of occupational therapy college students by looking at their life trajectories through the collection of activity inventories. The authors concluded that human occupations could be understood in terms of concepts from chaos theory, such as fractality, sensitivity to initial conditions and basins of attraction. In another pilot study, Ikiguu and Ciaravino (2006) evaluated Ikigu’s model of Instrumentalism in Occupational Therapy (IOT), guided by complexity theory, as an effective intervention for assisting emotionally and behaviourally disordered adolescents to challenge their maladaptive life behaviour patterns.

**Implications for future practice**

Keeping up with other health-related professions is essential in modern-day practice. Occupational therapists must expand their thinking to understand the concepts of nonlinear dynamics as they apply to the blending of neuroscience and occupation. Although it takes a while to comprehend the new terminology and understand the concept of humans as nonlinear dynamical adaptive systems, the Neuro-occupation model furthers the professional claim that occupational therapists look at the whole person.

It behoves occupational therapists to understand the role of habit and routine in forming occupation and adapting to change. Occupational therapists can use their boundless creativity to create strategies to build on the habitual routines established in brain dynamics. Clearly, the reinstatement of habits is sensitive to initial conditions and the person develops new levels of habits, never returning to old routines. Although what occupational therapists do best seems mundane at times, ‘… recognising the ordinary can lead to extraordinary outcomes … [for clients]’ (Rowles 2000, p65S). Clarifying the value of treatment and the theory supporting it is an endless task that has been addressed by clinicians since occupational therapy was a fledgling profession. Neuro-occupation validates the essence of that for which occupational therapy exists.

**References**


COT Forum for OTs with a disability

www.cot.org.uk/forum/intro.php