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Human beings develop in interaction with the environment (Keilhofner, 1980) (see figure 1). Out of this interaction, we establish our stock of knowledge. It is this stock of knowledge which links up human beings and their environment (Plotkin, 1995). Heuristics refer to the strategies for gaining knowledge. Human knowledge is founded on a 3-dimensional model of heuristics (Plotkin & Odling-Smee, 1982). The 3 dimensions are: (a) primary heuristics which operate at the genetical and developmental level and give rise to our sensori-motor knowledge; (b) secondary heuristic which operate at the social level and contribute to our intellectual knowledge; and (c) tertiary heuristics which operate at the cultural level and formulate our shared knowledge.



Figure 1: Human Development

We are not 'blank' when we come to the world. In fact, an infant possesses a series of primary  $(1^{\circ})$  heuristics which are 'hard-wired' into its biology. The 1° heuristics come in large part from genetical information which finds expression in a supportive environment. It is important to note that the 2° and 3° heuristics are built upon and under the direction of the 1° heuristics (figure 2). The 1° heuristic itself is the fundamental knowledge-gaining process which 'tells' the 2° and 3° heuristics, also knowledge-gaining processes, what to learn (Hinde and Stevenson-Hinde, 1973). We transmit our 1° heuristic from generation to generation by genes; but our 2° and 3° heuristics are passed on by training or education.



Figure 2: The Three Dimensional Model of Human Heuristics

Humanity

Humanity is collective term used to describe the 1° heuristics of human beings. It refers to the features which are inheritable, contributing to our overall functioning and distinguishing us from other animals. The driving force behind human activities is to make full use of our humanity. Through exercising the natural gifts of out humanity to the full, our ancestors created civilisation on the earth. The different elements of humanity can be categorised into (a) human attributes; (b) human qualities; and (c) underlying capacities (figure 3).

Human Attributes	Human Qualities	Underlying Capacities	
Bipedal walking	Self-conception	Intrinsic Drive	
Dextrous manipulation	Creativity	Problem solving ability	
Language	Sociality	Generalisation ability	
	Mastery of environment		
Figure 3: The Three Categories of Humanity			

The major human attributes are (a) bipedal walking; (b) dextrous manipulation; and (c) language. We are the only animals that are constantly walking on two legs with a vertical spine, the only animals with sufficient hand dexterity to make tools and the only animals to communicate which highly articulated language (Morgan, 1990).

Human qualities include (a) self-conception; (b) creativity; (c) sociality; and mastery of environment (Kondo, 1995). Self-conception refers to the ability to see oneself as an object differentiated from one's environment. Sociality refers to the ability for role-making and role-taking when interacting with others (Turner, 1994). By role-making, an individual gives information on how he or she is going to behave towards others. By role-taking, and individual takes the perspective of others and senses what they are likely to do. Creativity refers to the freedom to exercise one's own mental process; while mastery of environment refers to the desire to reconstruct the environment and makes it meaningful to oneself.

Human beings are born with an innate intention to learn from interacting with the environment. This intention to learn is built upon 3 hierarchical underlying capacities, namely; (a) intrinsic drive; (b) problem solving ability; and (c) generalisation ability (figure 4). Intrinsic drive can be subdivided into motivational drive and emotional drive. Motivational drive refers to the level of arousal of an individual when participating in a task. Emotional drive gives emotional coloration towards the task. Problem-solving refers to the innate ability to think out the situations, to vary the actions, to observe the results and to develop sense of responsibility towards one's own problems (Spivack et al, 1976). Generalisation refers to the innate ability to transfer the learned skills and concepts to novel situations (Schmidt, 1988). The hierarchical relationship indicates that the ability to solve problems is governed by the intrinsic drive, while the ability to generalise is governed by the level of the problem solving ability. These underlying capacities confer on us an intention to learn from interactions with the environment. By exercising our underlying capacities to the full, self-directed learning can be ensured.



Figure 4: The Three Hierarchical Underlying Capacities

## **Human Development**

Human development is not an automatic unfolding process which, once initiated, proceeds to the completed state of adulthood. Each individual is the unique outcome of an immensely complex series of interactions between the genetic constitution of that individual, its developing biology and its environment. Three lines of human development have been distinguished. They are the (a) biological; (b) social; and (c) cultural paths (figure 5). For normal children, the 3 lines of development take place simultaneously in parallel. Upon biological maturation, we continue to develop without limit along the social and cultural lines.



Figure 5: The Lines of Human Development

## The Biological Path

Development in the biological path directs the growth of humanity ( $1^{\circ}$  heuristics). Along this path, we obtain the basic life maintaining skills through the gradual unfolding of our humanity. Distinction among activities in the biological, social and cultural paths lies in the fact that the former refers to activities which are the accompaniment to, or a consequence of, normal internal bodily functions, while the latter two refer to activities which are directed towards effecting changes in the world outside the person. The same activity can be regarded as biological, social or cultural, depending on its purpose.

### The Social Path

Human intelligence ( $2^{\circ}$  heuristics) consists of 4 dimensions: learning, memory, reasoning and thought. Learning and memory are common to humans and quite a wide range of other animals. However, higher intellectual functions (i.e. reasoning and thought), are restricted to only a small number of species. The higher intellectual functions are developed from social interactions (Humphrey, 1976; Rieber and Carton, 1993). Human beings are predisposed by the sociality of our human quality ( $1^{\circ}$  heuristics) to be especially sensitive to the cost-benefit of social exchange (Cosmides, 1989). This lays a foundation to our sophisticated social world. Since  $2^{\circ}$  heuristics enrich themselves along the social path, the sophisticated social world contributes to us the powerful  $2^{\circ}$  heuristics which build up our vast intellectual knowledge.

#### The Cultural Path

The language ability of our human attribute  $(1^{\circ}$  heuristics) predisposed us to think and communicate by language. We think using language and hence manipulate our knowledge through language. Language facilitates our social interaction, but more important, it allows us to communicate our knowledge ( $3^{\circ}$  heuristics) to one another. By sharing of knowledge, we establish our culture.

Culture is defined as the sum total of all human creations (Singer, 1968). Functionally, it is defined as whatever knowledge one has to know or believe in order to operate in a manner acceptable to the members of a society (Plotkin, 1995). In fact, culture is learning about what others have learnt, created or invented in the population to which an individual belongs. A special feature of the shared knowledge is that it can be stored exosomatically, that is it can be represented outside our brains. The shared knowledge can be stored in books, on microfilms, on magnetic tapes, on computer disks or by other technologies.

Undoubtedly, culture is a constraint. Each of us behaves in the appropriate way according to the systems of language, technology, values, beliefs and norms of the population of which we are a member. Different subpopulations within a larger society often hold somewhat different beliefs or even different values. The wealthy, the holders of political power, are in a better position to impose their beliefs on, and to define the norms for other subpopulations (Mills, 1959). Persons with brain damage can be viewed as a subpopulation which shares the same beliefs and values with the general public. However, their language systems, the required technology and their norms are unique. It is most unfortunate that the general public and the government usually ignore the uniqueness of the disabled and tend to impose their own standards onto this subpopulation. The entire global culture does not cater for the needs of people with brain damage. They may have great difficulty to develop themselves along the cultural path.

#### The Brain Damage

In this paper, the term 'brain damaged' refers to clients who have suffered a non-progressive damage to their central nervous system before it matured. It includes both the cerebral palsied and the mentally retarded and the term 'client' applies to the infant child adolescence and adult the age groups.

Dysfunction

Clients with brain damage suffer from both motor cognitive deficits. These deficits may have different degree of detrimental effects on their humanity. It is believed that major cause of dysfunction of the brain damaged lies in the under- or mal- development of their underlying capacities which jeopardise their intention to learn. An insult to the brain also contributes to the under- or mal- development of the human attributes of its sufferer, making the existing habitat deviates more and more from his or her biological equipment. The lack of intention to learn is a key factor that hinders the clients with brain damage to overcome the limitations arisen from the changes in their biological equipment.

#### Orthofunctional Development

Orthofunction is defined as the utilisation of the  $2^{\circ}$  and  $3^{\circ}$  heuristics in accordance with the available humanity of person with brain damage. An orthofunctional stage is primarily founded on the existing level of humanity of the client and is attained through the utilisation of the corresponding  $2^{\circ}$  and  $3^{\circ}$  heuristics along the social and cultural paths respectively. When a spontaneous development of humanity occurs, a higher level of  $2^{\circ}$  and  $3^{\circ}$  heuristics will be

available for use, and a new orthofunctional stage at a higher level should be attained (figure 6). The humanity, once emerged, is continually present throughout the life span. During the spontaneous development of humanity, lower level does not disappear, but becomes integrated into a higher level.



Figure 6: Different Levels of Primary Heuristics and the Corresponding Secondary and Tertiary Heuristics at Different Orthofunctional Stages

## Habilitation for the Brain Damaged

We bring into this world the different elements of humanity by our genetic heritage. However, how this heritage is manifested is in a large part the result of our interactions with the environment. We are raised by our parents in an environment suited suited to our biological equipment; and our biological makeup will lead to the emergence of humanity under the nourishment of this supportive environment. If the environment does not suit our biological equipment, or if our biological makeup is disturbed by an insult to the brain, humanity does not emerges at a lower level. Both factors exist for the clients with brain damage. However, the remaining elements of humanity, at whatever level, may serve as an inner prompting which guides the clients towards the corresponding orthofunctional stage, provided that a suitable environment exists.

Upon biological maturation, we continue to develop ourselves in the social and cultural paths. Thus, human adult is very much a product of education and cultural training. It is therefore easy to assume that educational practice count for everything and that the level of the available 1° heuristics (humanity level) is insignificant. In the traditional educational approach, children are raised in the way the adults want, and the extent to which the children are biologically prepared through their humanity tends to be overlooked. For normal children, this educational approach may not cause serious problem, since they all have more or less the same level of humanity. For the clients with brain damage, their existing level of humanity should be taken into consideration in their education.

Due to the damage in brain and the lack of a suitable environment, the humanity of clients with brain damage may not be emerged at low level. The medical approach puts a high priority on the enhancement of their biological equipment with particular emphasis on their human attributes without much concern for their development in the social  $(2^{\circ} \text{ heuristics})$  and cultural  $(3^{\circ} \text{ heuristics})$  paths. However, the direct enhancement of the biological development in the medical approach may detach the clients from their social and cultural environments. By spending most of their time in the treatment room, the clients become more and more out of step with the society.

The contemporary habilitation of the brain damaged should not restrict itself to the client's intellect or physical abilities, but should appeal to the client organismically, as someone who acquires humanity and is active, sensual, expressive and emotionally alive. The success of habilitation should be evaluated not in terms of how efficiently it controls the disabled clients or make the clients adapt, but according to how well it supports and nourishes the 3 dimensions of heuristics of the brain damaged for self-directed learning.

### The Conductive Learning Model

The theory of the Conductive Learning System is known as the 'Conductive Learning Model'. The model combines the educational and medical approaches for the habilitation of clients with brain damage. In the Conductive Learning Model, we emphasise the spontaneous development of the humanity of the clients, upon the exploitation of their corresponding  $2^{\circ}$  and  $3^{\circ}$  heuristics in a structured environment which overcomes the limitations arisen from their humanity and, at the same time, facilitates its spontaneously development. Instead of instilling their humanity level as quickly as possible, we treat our clients as people with their own needs and own ways of learning.

While accepting the limitations of the available  $1^{\circ}$  heuristics of our clients, we are flexible enough to let them find their own balance for utilising and developing their  $2^{\circ}$  and  $3^{\circ}$  heuristics for the attainment of orthofunction at a particular stage. Since the  $2^{\circ}$  and  $3^{\circ}$  heuristics are nested under the  $1^{\circ}$  heuristics, the exploitation of the  $2^{\circ}$  and  $3^{\circ}$  heuristics may eventually lead to a spontaneous development of the  $1^{\circ}$  one.

#### The Fundamental Unit – Microgenesis

The fundamental unit of habilitation in the Conductive Learning Model is 'microgenesis'. In the Conductive learning Model, it is believed that an insult to a developing brain may lead to the under- or mal- development of the human attributes and the underlying capacities of its sufferer, but his or her human qualities are preserved. It is also believed that with the provision of a suitable environment, the human qualities can be emerged. The preserved human qualities can then be utilised to 'lead out' the under- or mal- underlying capacities that in turn contribute to the client's intention to learn. In Conductive Learning, various teaching methods and tools which employ the preserved human qualities to 'lead out' the underlying capacities have been designed. By exercising their underlying capacities, the learn to intend and self-direct their learning activities. Plenty of opportunities should then be given to encourage them to learn on their own and to develop their under- or mal- development human attributes. The enhanced human attributes will in turn reinforce the different elements of humanity. This cyclic process of interactions among the different elements of humanity and with the environment is known as microgenesis (figure 7).



Figure 7: The Cyclic Process of Microgenesis

Microgenesis is the fundamental process which underlies the biological, social and cultural activities of the clients with brain damage. The process of microgenesis is continually involved in their life. It refers to an internal process that occurs each time they confront a task in the 3 lines of human development.

#### **The Overall Structure**

Conductive Learning Model is built upon the 3-dimensional model of human heuristic. The Model is therefore a 3-dimensional model up of 3 component blocks, namely: (a) a longitudinal macroscopic perspective; (b) a transverse macroscopic perspective; and (c) a microscopic perspective of the habilitation process for the clients with brain damage (figure 8).



Figure 8: The Three Perspectives of the Conductive Learning Model

Figure 9 depicts the cross section of each block of the Conductive Learning Model. The 3 perspectives of the model are founded on an integration of the knowledge from information processing, teaching and learning, biomechanic and neurodevelopmental theories and is similar to the quadraphonic approach proposed by Abreu in 1992. The former two are current knowledge relate to our mind while the latter two relate to our body.

The longitudinal macroscopic perspective concerns the level of humanity of the clients with brain damage (figure. 9a). It emphasises their level of independence in work, self-care and play domains. The transverse macroscopic perspective concerns the group identity of the clients. It focuses on the interrelationship between the clients, the general public and the government (figure 9b). The microscopic perspective concerns the integrated development of the brain damaged. It stresses the interaction between the brain damaged and their physical and social environment (figure 9c).



Figure 9: The Cross Sections of the Perspectives of the Conductive Learning Model

The aim of the longitudinal macroscopic perspective of the Conductive Learning Model is upward mobility (figure 10). Upward mobility refers to the expansion of 'normalised' activities that the clients with brain damage can participates in accordance with their level of independence (Wan et al, 1997). It corresponds to the concept of 'normalisation' of the disable persons. The underlying mechanism for the upward mobility is the spontaneous development of the different elements of humanity of the clients in the biological path.



Figure 10: The Aims of Habilitation in the Three Perspective of the Conductive Learning Model

The aim of the transverse macroscopic perspective is integration into community (figure 10). Integration is defined as a mutual respect and understanding of the group identity between the brain damaged and the general public (Leung and Su, 1995a). The underlying mechanism for the community integration is image enhancement in the cultural path. Image enhancement involves not only active participation in a wide range of cultural activities, but also requires the community presence and community participation of the brain damaged.

The aim of the microscopic perspective is personality development of individual clients (figure 10). Personality development is facilitated through an integration of physical, cognitive, social and psychological experiences of the clients (Lam et al, 1997). The underlying mechanism for the personality development is the cultivation of self-concept and personal values of the clients in the social path.

In the Conductive Learning Model, an orthofunctional stage correspond to the attainment of an individual personality and the community integration in accordance with the existing level of independent of the brain damaged. At each stage of the upward mobility, orthofunctional development is practised through an integrated development along the social line of development and the group identity establishment along the cultural line of development (figure 6 and figure 10). As the clients climbing up the ladders of upward mobility, the corresponding level of humanity at each stage is expanding. At the top of the ladder, the corresponding humanity is similar, if not identical, to that of the general public. Thus, the spontaneous development of humanity corresponds to the process of 'normalisation' of the brain damaged.

# The Conductive Learning System

The Conductive Learning system has been implemented in the pre-school centres and the schools of the Spastic Association of Hong Kong for more than 2 decades. Recently, it has been extended to the adult service (Su, 1993). In this paper, the Conductive Learning system is described with particular reference to that of the adult service.

#### The Model of Practice: A Holistic Approach

To approach the problems of the brain damaged adequately, we should consider their individual personality, their levels of learning in different training elements and the environment in which they exist. In the Conductive Learning System, habilitation programmes are delivered by a transdisciplinary team which provides a holistic model of training under a structured environment. The transdisciplinary team requires the different disciplines of staff to establish common training goals for individual clients through a case meeting (Su, 1995). The Conductive Learning Model is adopted as a common philosophy which is shared by all staff members irrespective of their professional background. The Model serves as a common perspective from which training goals are established. Another feature of the transdisciplinary team approach is that the training programmes are no longer delivered with respect to the professional background of staff (e.g. physiotherapy, occupational therapy, etc). But instead, they are incorporated into the daily activities of the clients. The daily activities of a client can broadly be divided into 3 domains, namely: work, self-care and play (Kielhofner, 1980). The training programmes are planned by the team members according to the establishment common goals and the planned programmes can be implemented by any members of the programme planning group (figure 11).



Figure 11: The Transdisciplinary Team Approach

This transdisciplinary team makes every endeavour to establish a structured environment for the provision of a holistic model of training to the clients with brain damage (Su, 1995). The holistic model of training refers to an integration of physical, cognitive, social and psychological training elements in the training programmes. The structured environment is composed of a consistent and coherent atmosphere, a tailor made daily schedule together with the specially designed physical settings throughout the whole day of the clients.

In the Conductive Learning System, various teaching methods and tools which utilise the preserved human qualities of the clients have been designed. These teaching methods and tools are used to 'lead out' the maldeveloped or underlying capacities of the clients with brain damage (Leung and Su, 1995b). Three stages of learning have been distinguished namely, acquisition, retention and transfer stages. In our system, the acquisition of new skills and concepts are taught in a group format. On the other hand, retention and transfer of the acquired skills and concepts are taught individually by incorporating the training into the daily activities of the clients. Effective training for the brain damaged should be conducted in real-life situations, founded on their actual needs and is reinforced by the natural consequences of the participated activities.

## **The Overall Structure**

The Conductive Learning System is built upon the 3 perspectives of the Conductive Learning Model (figure 8). Brain damage is life-long disability, and therefore the habilitation process for the clients with brain damages should also be a life-long process. The whole system consists of a longitudinal subsystem, a transverse subsystem and a series of integrated curricula. The system is made up of a chain of building blocks which linked together to from the longitudinal subsystem. Attached to each block is the transverse subsystem and an integrated curriculum (figure 12).



Figure 12: The Overall Structure of the Conductive Learning System

The longitudinal macroscopic perspective of the Conductive Learning Model (figure 9a) is realised in the longitudinal subsystem (Fung and Su, 1995). In the adult service, the longitudinal subsystem comprises 3 routes, namely: the vocational, residential and recreational routes (figure 13). Each route is composed of centres at different levels. A higher level centre requires its clients to have a higher level of independence. The longitudinal subsystem provides ladders for the brain damaged to practice upward mobility through any of the 3 routes.

Open/Self Employment	Compassionate Rehousing	Sports
↑ Work Trial Placement	↑ Independent Home	$\uparrow$
1	1	Local Competitive Sports & Games Day
Supported Employment	Semi-independent Hostel	 ↑
1	1	Interests & Hobbies Development
Sheltered Workshop ↑	Large Hostel ↑	_ ↑
Training Centre	Care Centre	Social-rehabilitation Recreation
Vocational Route	Residential Route	Recreational Route
Figure 13: The St	ructure of the Longitudinal Subsyster	m in the Adult Service

The transverse macroscopic perspective of the model is realised in the transverse subsystem which is composed of day centres and residential centres. In the adult service, it mainly involves the coordination between sheltered workshops and hostels at different levels. (Leung and Su, 1995a). The workshop and hostel co-ordination is founded on the extracurricular activities, a thematic approach and the rotation of professional staff between the two centres. Extracurricular activities refer to the programmes which are conducted for the purpose of relaxation and fun. A thematic approach is employed in the extracurricular activities. A year plan of 'themes' are established at the beginning of each year and the sheltered workshops and hostels will share a common 'theme' during the same period of time. The established 'themes' should be chronologically ageappropriate to the clients and are founded on the principles of image enhancement. The design of the extracurricular activities is based on the established 'theme' and inter-centre extracurricular activities with community participation are highly encouraged. The professional staff of the sheltered workshop and its corresponding hostels are required to work shift between the 2 centres. They take the role of co-ordinating the two teams of staff in the 2 centres for ensuring consistency and continuity of training throughout the whole day of their clients.

The microscopic perspective is realised by a series of integrated curricular (Chan and Su, 1997). Unique curricula have been developed for the centres at different levels in the longitudinal subsystem. All training programmes from the integrated curriculum are designed specifically for the attainment of the common training goals that have been established for individual clients in the case meeting.

Basically, the curriculum is composed of 2 components, namely: daily routine training (DRT) and group training (GT) programmes (figure 14). DRT is the major component of the whole curriculum while GT serves as an adjunct to the DRT. GT programmes aim at the acquisition of new skills and concepts through blocked practice. On the other hand, the DRT programmes aim at the retention and transfer of the learned skills and concepts through random practice. Blocked practice refers to the repetition of the same task again and again in a single training activity while random practice refers to a varied ordering of different tasks in a single training activity.



Figure 14: The Structure of the Integrated Curriculum in Sheltered Workshops and Large Hostels

In line with the 3 domains of activities of an adult, DRT is subdivided into work, self-care and plat domains. The DRT programmes are conducted in a real-life environment, founded on the actual needs of the clients and reinforced by the natural consequences of the participated activities. GT is subdivided into motor and social task series. The GT programmes utilise group dynamic and are given to a group of homogeneous clients with similar potentials and common needs. The motor task series aim at the development of skills which equip the clients with the abilities to interact with the physical environment. They focus mainly on integrating the physical and cognitive experiences of the clients (figure 15). On the other hand, the social task series aim at the differentiation of roles in different social contexts. They equip the clients with the abilities to interact with the social environment and focus mainly on integrating their social and psychological experiences (figure 15). The underlying capacities are involved in the learning process during the motor and social task series. Various teaching methods and tools are used in the GT and DRT programmes in order to 'lead out' the underlying capacities of the clients.



Figure 15: Training Elements and Objectives of the Motor and Social Task Series in the Group Training Programmes

The skills and roles evolved from the motor and social task series in GT contribute the cultivation of a positive self-concept to the clients (Lam et la, 1997). The practice of skills in DRT gives rise to experience in life while the practice of roles in DRT contributes to the evolution of attitude towards the external world. The evolved experience and attitude in turn leading to the establishment of personal values. The discrepancy between self-concept and personal values serves as a measure of the client's quality of life. It lays foundation for the personality development of the clients with brain damage. Again, the underlying capacities are involved in the learning process in both the GT and DRT programmes (figure 16).

For each homogeneous group of clients, GT and DRT programmes are linked together by a daily schedule which is tailor-made for the group members. The daily schedule serves to ensure that sufficient opportunities in the DRT have been given to the clients for practising the skills and concepts learnt in the GT.



Figure 16: Training Elements and Objectives of the Group Training and Daily Routine Training

# Conclusion

Habilitation of the clients with brain damage is a life-long process. The cause of dysfunction of the brain damaged lies in the under- or mal- development of their underlying capacities making them unable to learn from their interactions with the environment. The Conductive Learning Model focuses heavily on the parallel exploitation of the  $2^{\circ}$  and  $3^{\circ}$  heuristics which are built upon the cyclic process of microgenesis of the available  $1^{\circ}$  heuristics (humanity) of the clients. The utilisation of the  $2^{\circ}$  and  $3^{\circ}$  heuristics in the social and cultural paths under a supportive environment, in turn, contributes to the spontaneous development of the humanity of the clients. It is important to emphasise that the development of the  $1^{\circ}$  heuristics is always a spontaneous process. It is also stressed that learning is a process of active discovery and should be geared to the

existing level of humanity of the clients. The exploitation of the  $2^{\circ}$  and  $3^{\circ}$  heuristics according to the available humanity for the attainment of a healthy personality and the community integration constitutes what we called the orthofunctional development of the brain damaged.

The Conductive Learning System is a habilitation system which is constructed upon the Conductive Learning Model. The system is delivered by a transdisciplinary team which provides a holistic model of training under a structured environment so as to 'lead out' the underlying capacities of the brain damaged. Microscopically, it aims at the personality development of individual clients through a series of integrated curricula. Macroscopically, it aims at their upward mobility for an independent life through a longitudinal subsystem and at integrating them as far as possible into the community through a treatment subsystem at each level of the upward mobility.

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