

The Importance of a Sensorial Grounding of Intelligence from the Beginning of Life

By Lynne Lawrence

Lynne Lawrence is the Executive Director of Association Montessori Internationale and Director of Training and Schools at the Maria Montessori Institute, London, the AMI International Training Centre in Britain. The MMI also runs three Children's Houses and an Elementary school and Lynne oversees the running of these schools in addition to running the MMI courses. Lynne took the AMI training course in London in 1974, training under Hilla Patell and worked with Muriel Dwyer on the 'Help the Children' project in Kenya between 1978 and 1985. Since 1990 Lynne has been Director of Training of the 3-6 AMI Course at the MMI.



This paper was originally presented at the 2001 Paris Congress. Reprinted here with the kind permission of the Congress Committee and Lynne Lawrence.

The importance of sensory stimulation in the formation of our intelligence cannot be underestimated. We know that, from birth, the quantity and quality of sensory experiences has a direct influence on the creation of our higher order thinking and processing skills. A direct influence on the creation of the human being that we will become. Dr Montessori described the first six years of life as a period of rapid psychical growth and the first three years in particular as the period of the 'psychic embryo'. A period which mirrored the physical growth of the embryonic period. Because of the enormous role that the senses play in this early period of life children are inwardly directed towards a detailed observation of their environment.

Development of the human being thus begins with taking in the world around us. With our observation of that world that surrounds us, the living world.

Have you ever been at a noisy dinner party, apparently engaged deep in conversation with your neighbour? Suddenly, from the other end of the table you hear your name. You find that amongst all the conversation that surrounded you and that you were apparently not giving attention to, you were, without knowing, filtering it! You are now engaged upon the difficult task of trying to continue your original conversation whilst eavesdropping on the other! This is apparently called by psychologists the 'cocktail party' effect.

Dr Steven Rose in his book, *Lifelines*, says, 'We are constantly being bombarded with sensory stimulation from the world around us: sounds, sights, feels, smells. Most of this bombardment, for most of the time, doesn't get past our perceptual filters. And we even ignore most of the small fraction that does. Yet the fact that one can respond to the sound of one's own name spoken unexpectedly in the midst of the hubbub says that there must be some continuous monitoring process going on in the brain, observing and classifying the incoming data beneath the level of conscious awareness.'¹

Rose continues by giving us the following example: 'It is October, and I am walking in the beech woods with a Russian friend. Idly, I scan the tans, golds and purples of the fallen leaves. My friend Kostya is also focused on the leaves, but less idly. He darts forward, bends down and plucks from the variegated brown background an equally brown and to me hitherto invisible mushroom—a perfect boletus. In fact, until I met Kostya I wouldn't have known that it was edible, or indeed what to look for. Edible fungi hunting, pursued avidly by Russians, is a relatively rare sport in England. But once he has pointed out the boletus to me I soon match him as a hunter, spotting my prey where previously I would have seen only the myriad fallen leaves.'²

As adults, our interests, based on previous knowledge and the people

we have become, help us to select, filter and interpret the information that we receive from the outside world through our senses. Not one of us, not even the new-born baby observes neutrally, innocent of preconceptions about the outside world. From birth children are absorbing the world directly into their being and their experiences will create a mind whose structure is unique to them.

From the beginning of life and particularly within the first plane of development (0-6) children are guided in their interactions with the world by strong vital forces. As Montessori teachers we have names for some of them, the hormone, the human tendencies, the sensitive periods, studied on Montessori courses, but sadly, often irrelevant to us in our daily work with the children.

It is essential to understand these vital forces if we wish to collaborate with the child in his great task of self-construction. Children bring with them the power to focus on what is required; what to pay attention to and when; the possibility of incarnating their experiences into their very soul. They have a cosmic plan. It is our responsibility to help.

Experiences we have never had cannot play a part in framing our personalities. From the beginning of our lives we are learning how to observe and what to observe, being guided from within as to what to define as object or foreground and what is field or background.

At birth the mind is equipped with approximately 100 billion neurons all needing to connect up in some way. The more connections that are made amongst the neurons the better functioning the brain will be. Brain wiring needs stimulation from the outside world. Connections are made as the body receives information, through the senses, from the outside world. As experiences are translated into chemical impulses they stimulate the growth of dendrites (the main connections between neurons) and increase the number of synapses (the place of information exchange).

The brain is constantly rewiring itself extending and modifying its structure and this complexity in the circuitry depends deeply on experience.

In the book *How Babies Think*, it says, 'Experience changes the brain from the very beginning. Everything a baby sees, hears, tastes, touches and smells influences the way the brain gets connected. Because we actually participate in building our own brains, and because each of us has a unique history of experiences, each brain is unique.'³

In addition we know that children's brains are much busier than ours. Brain activity can be measured by the amount of glucose it uses to function. By three months the brain areas involved in seeing, hearing and touch are burning up an increasing amount of glucose.

The brain's energy consumption reaches full adult levels at around two years of age and by three is twice as active as an adult brain. This incredible amount of activity remains at twice the level of an adult until the child reaches the age of nine or ten and then continues to decline until it reaches adult levels at about eighteen.

Why all this activity? The brain is busy setting up connections. The number of synapses reaches its peak at two to three years of age (more synapses than adult brains possess). Children in the first plane of development have brains that are literally more active, more connected, and much more flexible than ours.

Babies begin by translating information from the world into rich, coherent and abstract representations. These representations link information from the different senses: allowing babies to interpret their experiences in particular ways and helping them to make predictions related to the new experiences that they are having. Babies translate what they see and hear and feel and taste and smell into a world full of objects with complex multidimensional structures. They can translate touch into emotion, mouth movements into meaningful sounds.

'The baby's world isn't purely concrete anymore than it is simple.' says Gopnik, 'Babies already see the soul beneath the skin and hear the feeling behind the words.'⁴

As children take in experiences from the world, their rules for translating, manipulating and rearranging those experiences also modify and change. Children themselves play an active role in this process by using their human tendencies for exploration and experimentation upon the world whilst at the same time seeking patterns to make sense of what they know. It is a constant process of self-construction—so key to our understanding of the developmental process of human beings.

Also key to our understanding of brain development is that there are specific periods during which optimal development can take place, something Dr Montessori proposed when she referred to both the existence of a special functioning of the mind in the early years and the existence of sensitive periods. Once these periods have passed the opportunity to 'rewire' becomes significantly limited. It is now believed by current researchers that all 'critical periods' for brain wiring begin in the first four years of life. After this time, connections that have been strengthened through use and experience remain, those that have not been reinforced are pruned away.

Even though this sounds wasteful, Steven Rose proposes that the survival of one set of wires and connections within the brain depends, initially, on the presence of many. He says,

'The maintenance of stability requires the entire ensemble of cells to co-operate, to act collectively. In a non-trivial way, each depends on the others in the creation and preservation of the dynamic pattern of connections which maps the world onto the sense organs, the sense organs onto the brain, and then via the brain and the musculature, imposes new patterns on the world beyond. The developing organism in its being and its becoming, in its specificity and plasticity, constructs its own future.'⁵

In addition to the way the mind works the human being comes equipped with a strong desire to find out about the world. From the very beginning of life the human tendencies for exploration, orientation, order and communication are exercised on the child's immediate environment and on human society.

The urge to explore is so strong that fear and the possibility of danger from the unknown is offset by the benefits of what may be learned from the experience. The rapid and profound changes in children's understanding of the world seem related to the ways that they explore and experiment. Children actively do things to promote their

own understanding. They explore objects with every sense that they have at their command, they explore actions, relationships, systems, people objects and language. Children can be seen spontaneously sorting, organising and classifying as they come into contact with the reality that surrounds them.

At the risk of oversimplifying the process, there seems to be a virtuous circle. First observation, initially through the senses and movement, impelled by the vital urges of the child, which in turn leads to the strengthening of existing connections in the brain or the creation of new ones, or both, and this is then followed by further observation and exploration.

What we experience interacts with what we already know about the world to produce new knowledge which enables us to have new experiences and to make and test new predictions, which enables us to produce further knowledge and so on.

Through observation and experimentation the child develops the capacity to understand, to predict and in some measure to control his world. The child looks beneath the surfaces of the world and tries to infer its deeper patterns, trying to figure out the essential nature of things. From the beginning children categorise their world. As they begin to discriminate between things they begin to assign them to certain categories. For example, having experienced 'a horse' for a while all 'donkeys' may also be termed 'horse' until observation and experience dictate otherwise. Categorising helps children to know and predict certain things about objects that belong to that category. In the same way we can observe children exploring the properties of the objects in their world through all their senses to begin with! They look at, touch, taste and listen to anything that comes within their grasp.

This activity, impelled as it is from within, is not done just because we humans can do it. It is done because we need to do it. The child is engaged in the process of self-construction and it is this process that we must understand if we are to aid the developing life of the child.

Having all this knowledge also gives us great responsibility. It is not enough to know it, we must actually do something. Our 'doing' however, is limited to what we can provide for children to help them to help themselves.

It comes as no surprise then, that we have a great responsibility to prepare an environment that will make it possible for the construction of the human being in the first plane of development. To quote Margaret Stephenson,

'Around three, with the onset of the 'conscious' Absorbent Mind, the child needs an environment in which the tendencies can continue to operate, using the actualised potentials that are the result of the previous three years. Dr Montessori asked us to give the child from three to six 'the world' and prepared it for him in the environment of the Casa dei Bambini. The child before three has already met the world and his own immediate society living in that world as his 'unconscious' absorbent mind takes in his surrounding and the activities within it. Those first impressions of the environment and of human society, exemplified by his family, have now to be classified and organised and symbolised through language so that he can carry them around in his mind in the only way that we can hold matter in the intellect, through matching of a word to it. That is why Dr Montessori, genius that she was, told us that the world had to be given to the child from three to six.'⁶

Self-construction is only possible when the intellect is engaged in the work of understanding the world in order to adapt to it. We must create activities for the child that capture the essence of reality, and design them so that the virtuous circle is possible. (Observation and exploration, both of which involve the senses and movement).

In addition we must ensure that precise language accompanies the experience so that it can be carried around in the mind, as this is the only way that matter becomes useful to the intellect.

These activities are in sharp contrast to the often mindless activities, themes and projects, thought up by teachers to entertain children or fill in a spare moment. The 'why don't we all make ladybirds' school of thought, often executed by teachers too!

According to Mario Montessori Jnr,

'When used properly, this material serves two main purposes. On the one hand, it furthers the inner development of the child: specifically, the indirect preparation that must precede the development of any new ego function. On the other, it helps the child to acquire new perspectives in its exploration of the objective world.'⁷

How, we ask ourselves does it do this?

Since our goal is to aid the child's exploration of the world we have to discover ways in which we can help the child to access the world. Much as we may feel tempted, it is physically impossible for us to bring every aspect of the world into the Casa for the young child to explore. Not only are we unable to do this but it is educationally unsound for us to try to do it. We would fail at the outset. However, all objects in the world do share common attributes, they have colour, size, shape, volume, form, weight, texture, temperature, sound, smell and in many cases taste (although we do not choose to explore all objects this way)! We cannot bring the world into the Casa, but we can provide a 'key' to it.

What is a key? There are many ways of expressing this concept. We can say that a key unlocks doors, doors which provide the child with new horizons to explore.

The Compact edition of the Oxford Dictionary describes it as 'that which serves to open up, disclose, or explain what is unknown, mysterious or obscure, a solution or explanation.'

We also use the word key to mean the essential or fundamental elements of something as in the expression - 'the key issues are...'. And lastly a 'key' is what we find at the bottom of a map to help us to interpret and explore the whole map, it helps us find our way. With this knowledge we are guided in preparing for the child not only materials to represent abstract qualities such as the colour tablets for colour and the tactile tablets for texture, (Dr Montessori called them materialised abstractions) but also the 'keys' to the cultural world enabling the children to sensorially explore essential and fundamental elements of the natural and man-made worlds.

In helping children to explore their world they have the opportunity to become careful observers of their surroundings, the activity of exploring and observing helps them to create a more intimate connection between their outer and inner worlds. They become more curious, more questioning and more connected and 'in love' with what they find.

The materials are designed in such a way as to make children aware of the 'inter-relationships' between things. They do this by helping the child to focus on the identities, similarities and differences between things. The simple acts of pairing, sorting, matching and grading give ample opportunity for children to exercise their discriminatory powers. The materials allow not only for children to make distinctions between objects but also allow them to become aware of differentiation within a category.

'To be able to distinguish' said Maria Montessori, 'is a characteristic sign of intelligence'.

To explore the environment using one's intelligence, to build

associations between objects and categories of objects, to have some kind of internal compass, points of reference, truly offers the world to the child. Education as an aid to life!

The activity the child undertakes when engaged in working with material helps children to order and organise their thinking. Human beings spend a considerable amount of their lives trying to make sense of their world. To organise and order their experiences so that they understand them and can make use of them in the future. To have an orderly mind is the true key to rapidity of thinking and problem solving. Let us not confuse order with simplicity. Certainly to have an orderly mind simplifies the process of thinking but to order impressions of the world requires us to have the capacity to classify interconnecting knowledge, to discriminate subtly and modify and expand our thinking. To have things arranged in the mind in this way gives the child a sound base for the development of reason. Equally, the more aware the child is of what is in the world the more questions they can raise about what might be. In this way the sensorial materials also provide the basis for innovative thinking and this combined with the child's drive towards purposeful activity is the foundation of creativity.

Whilst demonstrating the materials to the child it is important to remember that the materials are not there to create impressions for the child, these they already have in abundance simply from the act of living. The focus of the sensorial material is two-fold. To provide challenges to the intellect through the activity they inspire and through their aesthetic qualities to provide nourishment for the spirit.

It is not unusual to hear Montessori teachers comment that the children are not interested in the sensorial materials. Each teacher must question whether their materials and their presentations do both of the above. Presentations can often simply give the child a 'method' rather than a means of exploration! Can be mind numbingly boring rather than intellectually challenging! Presentations can often be given as sufficient in themselves, that is, once the child has paired or graded the activity it can be ticked off and forgotten!

How do the materials and the way that we present them help to challenge the intellect of the child?

- They focus with clarity on the quality to be perceived, helping the child to make decisions and judgements about the actions to be taken. Concentration is developed purely because of the intellectual challenge. The focus is not on pairing or matching or grading, but on trying to discover which things are the same, which are different and how each item stands in relation to another. To solve the problem, to think creatively, to establish a connection!
- They intrigue the child by presenting challenges that can be self-corrected. In this way children are able to test hypotheses, to perceive what had not been revealed before, to overcome their own difficulties by solving their own problems. For example a child is often only really drawn to observe the cylinders in the cylinder block when cylinders that all fitted before they began the activity suddenly do not fit!
- They encourage repetition of the experience which allows children to explore concepts again and again, each time from a different perspective and with different insights. The value of the exercises that accompany the materials cannot be underestimated here. Each exercise exists to reveal to the child what is known but not necessarily consciously explored. Each has its own trajectory, its own lifeline, taking the child further along the path of development until the child's own life takes over and self-motivated exploration takes place.
- Impressions, concepts, ideas all need some kind of anchor within the child's mind. Impressions that do not have names cannot

so easily be organised and classified. It is imperative that the riches gained by the child do not go to waste and therefore each child must have the opportunity to attach precise language to abstractions they have made. It is this knowledge that creates a tool for children to communicate their ideas with others as well as allowing for inner dialogue. In this way, through the activity of games, we can help the child to actualise their thoughts and begin to apply their knowledge in the wider world.

- This all becomes possible because children are allowed the freedom to explore. Having worked with for example the colour tablets, the world of colour can be explored by the child. Through flowers and paintings and music and animals.... The list is endless.

It is worth returning for a moment to what Mario Montessori Jnr had to say in his book *Education for Human Development*.

‘The material does not, in the first place, teach children factual knowledge. Instead it makes it possible for them to reorganise their knowledge according to new principles. This increases their capacity for learning. Because the material serves this function, Montessori referred to it as materialised abstractions’.⁸

On the 4th September 1915, in California, Dr Montessori gave a lecture entitled ‘Sensorial Learning as Developmental Learning’. In describing the purpose of the cylinder blocks she said:

‘We cannot say that this is an exercise which serves to educate the senses. That is an improper and incorrect way of speaking. This stimulus, which provides a reaction of the whole personality, is the putting into action of an inner mechanism.’ Dr Montessori goes on to describe the activity of the child as ‘this exercise of movement and intelligence’.⁹

The sensorial materials, whilst providing activity for the developing mind, also cultivate those human traits that determine whether or not our intelligence can be put to good use. They help in the formation of what Dr Montessori called character. To have a mind that can think is not enough, it is our character that determines whether we use what we know and to what kind of use it is put.

The formation of character, has been expressed by Manning, in 1875, as being that ‘intellectual and moral texture into which all our life long we have been weaving up the inward life that is within us’. Character therefore, the sum of the moral and mental qualities which distinguish an individual, must also be developed as children become active with the sensorial materials.

We are reminded of this additional aspect of the sensory materials by Dr Montessori.

‘He (the child) will choose the tasks conducive to his development and persist in them, attracted and guided by his interest towards a sensory material which leads him to distinguish one thing from another, to select, to reason, to correct himself; and the acquirements thus made are not only a ‘cause of internal growth’ but a strong propulsive force to further progress. Thus passing from simple objects to objects of ever increasing complexity, he becomes possessed of a culture; moreover, he organises his character by means of the internal order which forms itself within him, and by the skill which he acquires.’¹⁰

How does the activity the child undertakes with the sensorial materials aid the development of character?

- The activity children undertake strengthen their ability to make choices and act upon their own judgements and decisions. In the simple act of pairing, for example, the child questions whether two sensory impressions are the same or different, makes a decision, acts upon this decision and bears the consequences

of this judgement. At the same time the child may revise this decision when faced, later, with a final pair that do not match. The activity also strengthens the child’s ability to act for themselves and through the successful completion of activities self-chosen and self-corrected they develop a powerful love of learning and of life itself.

- Each engagement with the materials both develops and extends children’s curiosity. Whilst the child is engaged in activity with the sensorial materials they are constantly referring backwards and forwards between what they are perceiving in the materials and what they already know. A kind of inner dialogue takes place. Do I know this already? Is this related to what I already know? Is this similar to other things I know? If I know this, then the next question that comes to mind is Equally, as the child begins to use their ability to perceive similarities and differences in the qualities that are inherent in the objects of their world and to explore that world, they become increasingly more curious and thoughtful about the world itself.

- The materials capture the child’s attention and arouse interest. Attention is captured in many ways. It is captured by the beauty of the material itself; it is captured because each activity presents the child with a problem to be solved; it is captured because each activity is capable of providing the right amount of challenge for the child and being able to judge how they are doing through the control of error children learn to inspect their thoughts, judge their abilities and resolve to persevere.

- Because each activity responds to the energies present in the child for self-construction, children feel a deep satisfaction as they engage with the material. They become motivated to seek similar experiences from their environment. Activities that answer children’s inner dictates mean that, once interest has been aroused, they explore the activity for increasingly long periods of time. During this time we see the will of the child strengthening and developing. The more the will of children is strengthened in pursuit of activity that satisfies their inner needs the greater their ability becomes to act, or withhold action, for the benefit of themselves and others. In addition the more connected to the world children become, the more ‘in love’ with it they are, and the more in love with their environment, the more likely they are to ‘do what is right’ according to their own conscience.

It is also worth considering the important virtuous circle created by activities that combine both body and mind as they are explored. All activities involve the body in movement and the hand is constantly provoked to make finer more precise movements. All this is done at the behest of an inquiring mind. Thoughts that require action; action that requires thought.

Dr Montessori gives us a useful metaphor to describe these materials. The sensorial material, she says, gives children an alphabet.

‘This alphabet of the outer world has an incalculable value. In fact, culture is not just a matter of accumulating information, but it implies an extension of the personality. Any object presented, any ideas given, any invitation to observe is greeted with interest, because the child is already sensitive to such tiny differences as those which occur between the form of leaves, the colours of flowers, or the bodies of insects. Everything depends on being able to take an interest. It matters much more to have a prepared mind than to have a good teacher’.¹¹

In offering the child the sensorial materials we have helped to prepare a mind that can think and reason. The next imperative is to offer key experiences of the world sensorially in order to sow the ‘seeds of culture’. In doing so we offer the child a means of exploring the world around in greater detail.

Jerome Bruner in his book 'The Culture of Education' says, 'Educational encounters, to begin with, should result in understanding, not mere performance. Understanding consists in grasping the place of an idea or fact in some more general structure of knowledge...Acquired knowledge is much more useful to the learner, moreover, when it is 'discovered' through the learner's own cognitive efforts, for it is then related to and used in reference to what one has known before.'¹²

Having helped children to grasp the essential qualities of the world it is now possible to offer children the essential facts of their world. We are able to do this on the basis of a simple, structured, classified framework of knowledge that begins by appealing to the senses and transforms gradually into providing another way for children to learn to perceive the world. We can offer:

- Sensorial exploration and language activities of the basic land and water forms which make up our physical world;
- Sensorial exploration and language activities of the peoples who live on our earth;
- Sensorial exploration and language of the plants, trees and flowers that decorate our world;
- Sensorial exploration and language of the animal groups that share our world;
- Sensorial exploration and language of the natural scientific laws that govern our world;
- Sensorial exploration and language of the processes of mathematics;

And as we are also spiritual beings we have a means for our spiritual expression we therefore also offer the child:

- Sensorial exploration and language of music and art and dance and drama.

All these activities are shown giving the child only the essential framework required for understanding, the bare minimum. By giving the bare minimum we create the opportunity for children to be at liberty to explore, hypothesise and think creatively.

Many of us find it difficult to believe that children will be interested in a classification of the parts of plants or the classes of animals and we stop short of offering children the overall structure for them to come to grips with. Yet, anyone who is familiar with the Pokemon phenomenon will know that children love classifying and naming. There are over 100 different Pokemon characters, all of which have a hierarchical place in a complex system. Each belongs in its own class and each has the capacity to evolve. Each has a particular effect upon the others when in battle. I have seen children in the playground who, in educational terms, have been written off by their teachers as being 'not the brightest', who understand this vast hierarchy, can calculate the 'hit points' gained or lost against other players and understand the various ways in which they will evolve. This particular ability is recognised by the commercial world and exploited fully - why aren't we convinced that it could be used educationally.

As Montessori teachers, we must ask ourselves if we truly offer the child all the sensorial keys that we have available to us and we must also ask ourselves if we offer this knowledge in its essential form. We must remember Dr Montessori's words when she said,

'We shall not educate the intelligence if we weary it by making it learn things. Our care of the child should be governed not by the desire "to make him learn things" but by the endeavour always to keep burning within him the light which is called intelligence.'¹³

Dr Montessori always believed that children had enormous intelligence, and that they were engaged in the process of their own self-construction. Modern research certainly backs this up.

- She believed that the child is capable of spontaneous organic development.
- She had the insight to offer the child a sensorially-based prepared environment abundant in its simplicity.
- She had the faith and humility to wish to be of service to the child and thus humanity.

Do we?

© Lynne Lawrence

Endnotes

1. Dr Steven Rose, *Lifelines*, Chapter One, page 22
2. Dr Steven Rose, *Lifelines*, Chapter One, page 22
3. Alison Gopnik et al, *How Babies Think*, Chapter Six, page 182
4. Alison Gopnik et al, *How Babies Think*, Chapter Five, page 145
5. Dr Steven Rose, *Lifelines*, Chapter Three, page 151
6. Margaret Stephenson, *NAMTA Journal Vol. 25 No 23. The First Plane of Development*, page 30
7. Mario Montessori Jnr, *Education for Human Development, The Montessori Materials*, page 22
8. Mario Montessori Jnr, *Education for Human Development, The Montessori Materials*, page 22
9. Maria Montessori, *The California Lectures of Maria Montessori*, Lecture 13, page 168
10. Maria Montessori, *The Advanced Montessori Method (Volume 1)*, Chapter 8, page 151
11. Maria Montessori, *The Absorbent Mind, Through Culture and Imagination*, page 158
12. Jerome Bruner, *The Culture of Education*, Preface, page xi
13. Maria Montessori, *Advanced Montessori Method, Vol. 1*, Chapter 8, page 185

Bibliography

- Montessori, Maria, *The Advanced Montessori Method*, Vol. 1, Clío Press, 1991
- Montessori, Maria, *The Discovery Of The Child*, Kalekshetra, 1972
- Montessori, Maria, *The Absorbent Mind*, Kalekshetra, 1982
- Montessori, Maria, *The Formation of Man*, Clío Press
- Montessori, Maria, *The California Lectures of Maria Montessori*, 1915, Clío Press, 1997
- Montessori, Mario Jnr, *Education for Human Development*, Schocken Books, 1976
- Bruner, Jerome, *The Culture of Education*, Harvard Press, 1996
- Eliot, Lise, *What's Going on in There*, Bantam, 1999
- Gopnik, Alison, Meltzoff, Andrew & Kuhl, Patricia, *How Babies Think*, Weidenfield and Nicholson, 1999
- Greenfield, Susan, *The Human Brain*, Phoenix, 1997
- Rose, Steven, *Lifelines*, Penguin Books, 1997
- Stephenson, Margaret, *NAMTA Journal Vol. 25 No 3*. 2000