

Neuroscience and the Montessori approach

Current neuroscience research has shown some fascinating links to Maria Montessori's views of child development; **Jeremy Clarke** tells us more.

Neuroscience – the study of the nervous system and the brain – has undergone a rapid increase in the rate of discovery over the last twenty years.

This is mainly due to the development of fMRI (functional magnetic resonance imaging) scans which are able to measure neural activity in the brain by gauging the change in the levels of oxygen in the blood as it flows between brain cells. When these scans are carried out on subjects who are engaged in specific mental processes, the areas of the brain that are functioning during that process can be identified. This can lead to correlations being made between activities and processes, and the areas of the brain that are needed to carry them out.

Whilst researching this area I was struck by the way many of the findings had very strong links to what Dr Montessori thought about children's development, and how they fitted with the Montessori approach both at home and in the classroom. Although the evidence to back up the ideas may be new, some of the ideas themselves are not, being first described around 100 years ago. Here I will highlight how some of the key principles of our approach are supported by current research.

The freedom to repeat is afforded to all children in Montessori settings, and is supported by considerate adults. It is not just respect that is given to children through these actions though, but cognitive development also. Cooper and Geake (2003) state clearly that "... repetition is necessary for effective learning ..." (p.14). This is because the young brain is both 'plastic' and 'use-dependent'. This means that connections between neurons can both be formed and broken as the brain grows. If a particular experience grows

neural connection, then the repetition of this experience will strengthen that connection, making it less likely to be lost. This also supports a consistent approach to routines and materials in settings, as repeating the same experience in the same way will serve to build strong connections.

When Dr Montessori wrote "the hand is the instrument of man's intelligence" she was emphasising the relationship between sensory experience and learning. Research shows us that sensory-motor development is important for cognition, imagination and language, and that "... conceptual knowledge is embodied, that is, it is mapped within our sensory-motor system ..." (Galesse and Lakoff 2005, introduction.) The importance placed on sensory input within Montessori settings leads to the provision of a rich variety of resources that can be used in a directed way (for example the knobbed cylinders being presented), or 'freely' (such as a child exploring the pink tower independently). The cognitive benefit of these two approaches are equally valid as "... adaptation and skills learning tasks lie along a spectrum with model-based processes prominent in the former and model-free processes in the latter." (Krakauer et al 2011, conclusion).

Presentations that are done by an adult can be very valuable to the child. When done with one individual, the adult can ensure that they only perform precise actions whilst the child is looking at them. This gives the child a much greater chance of repeating the modelled actions, and is believed to be due to the existence of 'mirror neurons'. These are neurons in the brain that are active both when an action is performed and when someone else performing that action is observed. Essentially this theory states that by observing your movements, a child's



brain is activated in the same way as it would be if they were doing the action themselves. Research by Chong et al (2008) suggests this allows learning through imitation, whilst Iacoboni (2005) believes this also enables children to begin to understand the intentions of others, and to make predictions about their intentions.

Using positive language, and modelling this for children so they are able to do the same with their peers', works in practice to foster a respectful environment in which effort is valued above the final product. Research carried out by Erk et al (2003) shows that words stored in a positive emotional context are remembered better than words stored in a negative context. In an environment where adults are positive and freedoms exist to support the child following their natural path of development, relaxed and engaged children can be seen. This relaxed atmosphere has been found to be essential to learning: "... scans demonstrate that under stressful

conditions information is blocked from entering the brain's areas of higher cognitive memory consolidation and storage." (Willis, 2007) In other words, a child who is anxious cannot retain his or her learning.

Murray (2013) has highlighted the many links between Executive Functions (EF) and Montessori practice. EF describes working memory, control of inhibitions and mental flexibility, and can be seen through the

worth remembering that the approach was born not from brain scans but from evaluated observations – a skill we can all continue to practice and develop.

References

Chong, T, Cunningham, R, Williams, M, Kanwisher, N, and Mattingly, J. 2008 MRI Adaption reveals mirror neurons in human inferior parietal cortex, *Current Biology*, 18 October 2008
Cooper, P. and Geake, J. 2003

Brain's Concepts: the role of the sensory-motor system in conceptual knowledge, *Cognitive Neuropsychology*, 2005, 21

DOI:10.1080/02643290442000310
Iacoboni M, Molnar-Szakacs I, Gallese V, Buccino G, Mazziotta JC, et al 2005 Grasping the Intentions of Others with One's Own Mirror Neuron System. *PLoS Biol* 3(3): e79.
doi:10.1371/journal.pbio.0030079
Krakauer J. W. and Mazzoni, P. Human

The importance placed on sensory input within Montessori settings leads to the provision of a rich variety of resources that can be used in a directed way (for example the knobbed cylinders being presented), or 'freely' (such as a child exploring the pink tower independently).

demonstration of creativity, flexibility, self-control and self-discipline.

Diamond and Lee (2011) have found that the Montessori approach fulfils 15 of the 17 known characteristics that strengthen EF. These characteristics include active learning, the teacher as an observer, the child planning their learning and peer learning/vertical grouping.

It is clear that there is plenty of current research that supports the Montessori approach, but it is also well

Cognitive Neuroscience: Implications for Education? *Westminster Studies in Education*, Vol. 26, No. 1

Diamond, A. and Lee, K. 2011 "Interventions shown to aid executive function development in children 4 to 12 years old." *Science* 333(19).

Erk, S, Kiefer, M, Grothe, J, Wunderlich, A, Spitzer, M, and Walter, H. 2003 Emotional context modulates subsequent memory effect. in *NeuroImage* 18

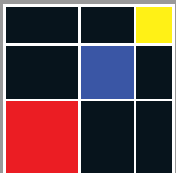
Gallese, V. and Lakoff, G. 2005 The

sensorimotor learning: adaptation, skill, and beyond, *Curr Opin Neurobiol* 2011, doi:10.1016/j.conb.2011.06.012

Murray, A. 2013 *The Montessori Method: Archetype of Educational Innovation* AMS

Willis, J. 2007 *The Neuroscience of Joyful Education Educational Leadership Online* (Vol. 64 Summer)

Jeremy Clarke is the Distance learning Operations Manager at MCI.



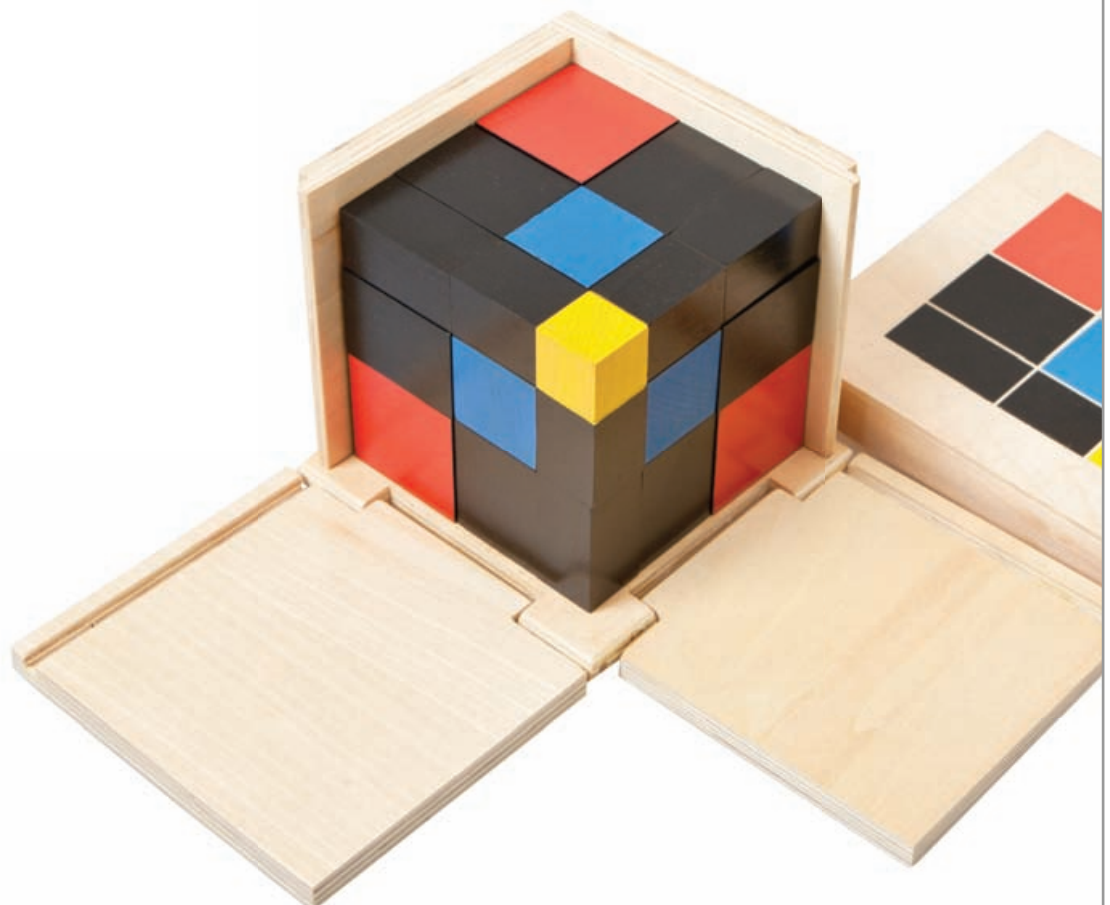
Absorbent
Minds
Montessori

Quality
Montessori
equipment for
all budgets

**Nienhuis
distributors**

Many new
products

For best prices,
please order
online with
free delivery
over £250
ex VAT



www.absorbentminds.co.uk