



THE NEUROLOGICAL BASIS OF INDIRECT PREPARATION

Annette Haines, Ed.D., shares her final lecture from the 2011 primary refresher course:

Montessori can be seen as a Guided Discovery method...

In *The Absorbent Mind*, Montessori says, “Children feel a special interest for those things already rendered familiar to them (by absorption) in the earlier period. On these they can focus their minds with great ease.”¹

As a thought or a re-lived memory is passed from brain cell to brain cell via jumping synapses, a biochemical electromagnetic pathway is established. Each of these neuronal pathways is known as a “memory trace.” (Montessori called them engrams.)

We now understand better how all this happens. With the new brain scanning technology, we can peer into the brains of normal



Figure 1



Figure 2

individuals and see what is going on. Following blood flow in the brain, researchers have found that memory engages the hippocampal region and the prefrontal cortex. A stimulus creates a spreading activation along neural pathways. When there is priming and repetition, that is when the stimulus activates previously activated pathways, less neural activity is needed to process the same stimuli.²

Every time you have a thought, the biochemical/electromagnetic resistance along the pathway carrying that thought is reduced. It is like trying to clear a path through a forest. The first time is a struggle because you have to fight your way through the undergrowth (see figure 1).

The second time you make the trip that way will be easier because of the clearing you did on your first journey. The more times you go down the same path, the less resistance there will be until, after many repetitions, you have a wide smooth track which requires little or no clearing. A similar function occurs in your brain; the more you repeat patterns or maps of thought, the less resistance there is to them. Therefore—and of greater significance—repetition in itself increases the probability of repetition. In other words, the more times a “mental event” happens, the more likely it is to happen again.³ The mental undergrowth has been pruned and the path is easier to follow. I have chosen a picture with a truck, a motorized vehicle in this slide to show that our wide, smooth path, our habitual way of thinking, becomes *automatic*. But just because we have always thought one way doesn’t mean that, with a little effort, we might discover a whole new way of thinking if we would just make the effort to explore one of all the possible paths through the brush, paths not previously taken (see figure 2).

Performance is enhanced by what psychologists call “priming.” Taken from my latest, favorite source, Wikipedia, “Priming is the implicit memory effect in which exposure to a

stimulus influences response to a later stimulus. It can follow perceptual, semantic or conceptual stimulus repetition.”⁴ Further, “The effects of priming can be very salient and long lasting, even more so than simple recognition memory,” and “unconscious priming effects can cause changes in affect (emotion) long after the original experience has been consciously forgotten.”⁵

Even today, the neuroscience of human memory is dominated by an interest in the two forms of memory that involve different kinds of consciousness. Foremost a distinction is made between explicit and implicit memory. Explicit memory involves conscious remembering of prior knowledge, often by means of intentional retrieval of that knowledge, whereas implicit memory involves influences of prior episodes on current behavior without intentional retrieval and sometimes without conscious remembering of the prior episodes. Many studies of implicit memory have focused on priming.

Priming may be visual, verbal, kinesthetic or stereognostic, that is, taken into the muscular memory. Researchers now believe that it works best when the two stimuli are in the same modality. For example visual priming works best with visual cues and verbal priming works best with verbal cues. Montessori is phenomenal in this regard because, for example, the cue for the noun, verb, adjective and so forth are visual symbols—always geometric in form and always the same color; the categories of the decimal system are always represented with green blue red and green; when we talk we use the same or very similar verbal phrasing: for example, “who is it that, what is it that” is the question for the subject. This continues throughout the primary and elementary classes. When there is a spill we say, “Let’s get the spill bucket, the sponge and the drying cloth.” When its time to clean up we put things away so that “it is ready for the next person.” There is also semantic priming.

Figure 3

Subplane	Mind	Priming	Preparation
0–3 years	unconscious	implicit	indirect
3–6 years	conscious	explicit	direct

Our lessons give both visual and verbal priming and cues, but not only visual and verbal. Some of the unconscious priming done in an effective Montessori program is kinesthetic, some is stereognostic, and so forth. Prior exposure can facilitate the processing of information and is an important mechanism for the facilitation of perception and memory.

We might then suggest that what Montessori called indirect preparation is actually unconscious “implicit” priming. What is direct preparation is more consciously perceived by the learner and can be seen as conscious or “explicit” priming. Either way, it is preparation (direct or indirect) that primes the pump of memory and makes this so-called Montessori method so effective (see figure 3).

But it can't be effective unless we are aware of the connections—aware of the goal we're hacking our way towards, aware of the sequence of presentations and the reason the sequence is designed the way it is. The sequences of lessons in Montessori's method are not haphazard. This IS a scientific pedagogy and it works when we work it. But only then.

I can remember as a young, new, novice teacher feeling as if I was kind of throwing things at the children to see what would stick, to see what they would repeat, to see what would interest or engage them. This willy-nilly approach worked—somewhat. But it became so much more effective when I began to really understand the rationale behind the sequence and the connections available within the prepared environment. Once I understood these, I could make Montessori a truly *Guided Discovery* method.

I am going to step out on a limb here and introduce an idea that has not been talked about for a while, at least in children's house circles. It is the idea of the psycho disciplines. At our last meeting in Rome, the AMI trainers had a whole session on the idea of psycho disciplines. This is probably because there will soon be two new books published: [Psycho Geometry](#) and [Psycho Arithmetic](#). With the publications of these two books comes the re-introduction of the idea that there are disciplines

which emerge through the Montessori educational continuum. The disciplines might include:

- I. Mathematics
 - a. Arithmetic
 - b. Geometry
 - i. Solid or ii. Plane
 - c. Algebra
- II. History
- III. The Arts
 - a. Graphic Arts
 - b. Dance
 - c. Music
- IV. Literature/writing
 - a. Poetry
 - b. Expository Prose
 - c. Fiction
- V. Botany
- VI. Zoology
- VII. Geology
- VIII. Geography
- IX. Physics
- X. Chemistry

There may be others I haven't thought of, but you get the idea. In other words, these psycho disciplines represent the whole of human endeavor, all the domains of human thought. If we are educating the human potential, as Montessori suggests, this is education for life, not a preparation for the elementary class, or preparation for any other form of school, but preparation to become an all grown up human being.

I had planned to have an exercise at this point where we broke into groups and each group would be asked to draw a web of interrelated ideas similar to the *Mind Maps* of Tony Buzan.⁶ We won't have time for this, as we only have a few more minutes. Your drawing could have taken the form of a simple diagram (but it probably wouldn't have been that simple). For example, you can take any of the disciplines above and draw a webbing of thoughts and ideas and interconnections that illustrate what you understand of how the presentations and materials in the primary classroom support and underlie the development of capacities and competencies necessary for success in each domain. Or make a more geometrical design if you like—like the one published long ago in [Communications](#).⁷ Each of your diagrams would be different and there would be no control of error.

CONCLUSION

Indirect Preparation as Preparation for Life

The web of life—what sounds like high-minded fancy science, using psychology, neurology, functional MRI scanning, etc. only reflects what we already know. In fact we have known it for a long time.

What have we known? We have always known that we can only learn what we already know. No one can really teach us anything. We have to learn for ourselves and our brains will light up when we hear something that resonates with what we have experienced—what we already know.

We also intuit that everything is connected and the great joy of learning something is in discovering the connections that are already there.

Chief Seattle, Chief of the Suquamish Indians, allegedly wrote to the American government in the 1800s. In this letter he gave the most profound understanding of "God in All Things." In this letter, as you may know, he said, "This we know: the earth does not belong to man, man belongs to the earth. All things are connected like the blood that unites us all. Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web, he does to himself."

All of life is connected, just as our lives today are connected to the child we were long ago and the indirect preparation we received for who we were to become one day. What we are doing every day, even what we are doing this morning, is in some way a preparation for the future, our future—a future we do not and cannot know. We can only know in retrospect. Just as Montessori looked back and saw the indirect preparation the child had received that enabled her to explode into writing, we can look back at our own lives and realize that an experience long ago was not a coincidence but a part of the whole scheme of our life which is still unfolding.

If we are to give the world to the young child, we cannot give it like subjects in a textbook, like isolated elements of a school curriculum or as teacher-planned units of instruction. We must give it as a whole, but in a way that will allow the child to discover for himself, not only the interrelatedness of all things, but also his or her pathway to becoming the person he or she was born to be.

¹ Montessori, M. (1995). *The Absorbent Mind*. Henry Holt and Co. New York. 172.

² Squire, L. et. al. *Proc. Natl. Acad. Sci. USA*. Vol. 89, pp. 1837-1841, March 1992, Neurobiology.

³ Buzan, T. *The Mind Map Book*. Penguin Books. New York, 29.

⁴ Kolb & Whishaw: *Fundamentals of Human Neuropsychology* (2003), page 453-454, 457.

⁵ Tulving, Endel; Daniel L. Schacter; Heather A. Stark (1982). "Priming Effects in Word Fragment Completion are independent of Recognition Memory". *Journal of Experimental Psychology: Learning, Memory and Cognition* 8 (4).

⁶ Buzan, op. cit.

⁷ AMI Communications. *Prepared Paths to Culture*. 1973, No. 4. Amsterdam, Holland. p. 12.