Dyscalculia: why does it happen and how can it be prevented?

Dyscalculia: a condition that affects the ability to acquire arithmetical skills. Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers, and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence" (Department for Education and Science, 2001).

Maths is at the heart of who and what we human beings are. Maria Montessori said:

"That the mathematical mind is active from the first becomes apparent, not only from the attraction that exactitude exerts on every action the child performs, but we see it also in the fact that the little child's need for order is one of the most powerful incentives to dominate his early life"[1]

So why should it be that, almost as soon as we start our formal education, so many of us develop difficulties, in some cases almost amounting to phobia, about doing maths that requires numerals? I would like to explain how that happens and some of the simple things we can do to prevent it.

These symbols…

參 三 ๓ 3 three "three"

…all represent this quantity.

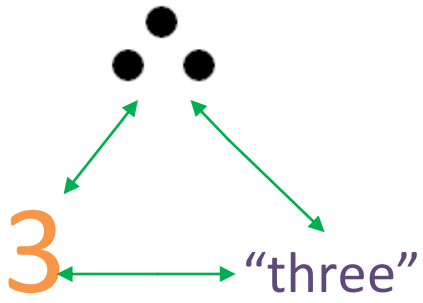
[1] Montessori, The Absorbent Mind,1967, pp189,190

These symbols represent this quantity in Arabic, Complex Chinese, Simple Chinese, Thai, the numeration system English speakers and most Europeans use, the English word we use when writing and the English word we say when speaking. Someone arbitrarily chose these representations so long ago that we cannot remember and they became a convenient shorthand for all those who were let into the secret.

Generally, up until the point of starting school, most children are happily developing mathematical skills and awareness. Most of them master one-to-one correspondence fairly early as they begin to identify self as a separate individual and recognise the separateness of those around them. Spatial awareness also begins to develop, a toddler knows where things belong, and is confused if things are not in their proper place, which she can pinpoint with great accuracy. Before they get to school most children will be able to draw a picture of a house with windows and doors in reasonable places and a face with two eyes, one nose and one mouth. They can clearly recognise the quantity of two. Mathematical development is progressing just as it should; increasing as the child makes more sense of his surroundings and orders her life.

Alongside this develops a growing awareness of numerals. Numerals are all around us and, unlike letters, there are only ten individual symbols that we use to represent number, so they crop up frequently. However, numerals are only the symbols that represent quantity, as demonstrated above. The child will happily, and often very proudly, recite numerals as far as they can go. This is not counting. Pre-school children are in an absorbent phase for language: words hold a fascination; they recite nursery rhymes, repeat dialogue from dvds and chant the alphabet and numerals; the last two, usually, with much encouragement from adults around them. This does no harm at all to the child's mathematical development, unless adults confuse chanting numerals in order with counting aloud and assume that the child is at a different developmental stage from where he really is. The quantity is concrete, the numeral and its sound abstract. Children become ready for abstraction at different rates.

Before introducing a child to any arithmetic it is essential to be sure they recognise the links between the numerals, the quantity they represent and the sound we make when we speak about them. Thus, for example:



It is also essential to be sure that:

1. The child recognises that one is one: a single object. This knowledge is linked to the child's awareness of Self –himself or herself –as a single individual, distinct from all others.

2. The child can count, enumerating correctly, with no emissions, a sequence of quantity increasing in size by a single one each time.

This is part of the fundamental basis for doing arithmetic.

Furthermore there are key concepts, the understanding of which is essential if the mechanics of arithmetic are to make sense. These key concepts underpin mathematical understanding and we can see them at work even in something as simple as counting:

- If we have one object we can label the quantity 1; if another object is added to the first the quantity has been changed: this is the first concept: **Change**.

- The original quantity has been changed as a consequence of adding another single object: this is the second concept: **Consequence** –the cause of the change was adding the object, the effect was that the quantity was greater.

- Before the new object was added there was only 1, after it had been added there were 2, there is an element of time here: this is the next concept: **Time**, where we measure change against a particular, constant standard.

- If the child does not name the numerals in the correct sequence the numeral will not match the quantity: this is the next concept: **Sequence**.

- If the second object was not put in a proper place or position to be recognised as changing the first quantity then the relationship of the first object to the second could not be recognised and the order of the counting would be disrupted: this is the last concept: **Order**: things in their proper place and position and condition as opposed to disorder: things not in their proper place or position or condition.

In the words of Ronald D Davis:

"Whenever we are doing math, whether it is simple arithmetic or astrophysics calculus, all we are doing is order vs disorder, sequence and time. This is what math is composed of. If you don't have these inherent concepts you cannot understand math."[2]

Some children take longer than others to come to an understanding of these concepts. If they are taught arithmetic before they have grasped them, this lack of understanding can interfere with their ability to do even that arithmetic which we regard as simple. Failure affects self esteem and can lead to phobia.

As we have seen, children are born to establish order within their environment; but what can we as parents do to support them?

Given freedom and opportunity children's mathematical ability develops with no need for assistance. Our primary role is to observe the child's interests, follow where they lead and provide that opportunity.

How can we do this?

[2] Advanced Davis Procedures for Math, Handwriting and Attention Difficulties. Ronald D Davis. Copyright DDAI (Davis Dyslexia Association International) 1998.

1. First and foremost trust the child. Children have an innate, unconscious knowledge of what they need for their current stage of development.

2. Remember that our priorities may not be theirs and relax. If your priority is maths then whatever the child's interest, there will be maths in there.

3. If there are certain games and activities that a child is particularly interested in then provide more of them and allow the child space and time to explore.

    a) When an interested child observes an adult counting, she may well wish to do so too. Keep counting but make it very clear that you are separating those things that you want to count from everything else and that you touch or move each object counted as you say the numeral.

    b) Making patterns is a fundamental maths skill; all sorts of things can be used to make patterns—buttons, rice, dried peas, lentils, small pieces of shiny or coloured paper, the child's toys.

    c) Matching and pairing games hone the child's observational skills and enhance recognition of one-to-one correspondence. You can start with real objects, for instance pairing socks, sorting the washing into correct piles for each member of the household and putting in the right drawers, or matching tins from the cupboard.

    Two packs of playing cards, starting with only the picture cards, can be good for pairing and there is any number of matching card games produced for children. But before laying them all out upside down and turning two over, try taking a small number of cards, perhaps 3 to start with, and lay them out face up. Take the 3 matching cards and show the child how to hold the cards one at a time and compare them with those laid out until a match is found for each.

    d) Lining up cars or arranging and stacking blocks or Lego, sorting buttons or threading beads can satisfy a child for hours. Never believe they have short attention spans –if their attention is wandering it is because their interest is not on the activity so that

particular activity is the wrong one for them at that time. All kinds of ordering and sequencing and numbering may be going on here, without anyone ever noticing.

e) Playing board games or card games involving adherence to rules and turn-taking reinforces order and sequence, while those that involve throwing dice require the child to apply one-to-one correspondence and then to count the right number of places moved. You will soon know if your child is not ready for these kinds of games and can stop or modify the rules to suit what your child needs.

All these activities engender understanding of the key concepts which will gradually be unconsciously absorbed.

The parallel task we, as parents, have is to help our children towards abstraction. The way we do this is by stimulating their imagination, but based in reality.

Here are some examples:

1. Share a picture of a child from another country and encourage your child to imagine and discuss how life will be different for the child in the picture. Ask questions about the picture such as, 'Is the sun shining?' 'Does it look warm or cold?' Share with your child what you both think and why. Talk about what is happening and imagine what might happen next for the child in the picture. You can use pictures of animals in the same way. Calendars can be good sources of pictures to use.

2. Many of the games recommended earlier can also lead to use of imagination, memory and abstraction. You could find a picture of a tin of beans, give it to the child and ask her to find a tin in the cupboard that matches, then make it more interesting by showing the picture and asking her to go and find the matching object at the other end of the room, carrying the memory with her. Or find a picture of him wearing a particular jumper, or carrying a toy and see if he can find it.

3. Looking at photographs of the child can lead to discussions about what they were doing in the picture and can get them to remember. This brings their memories into

the present and they can possibly project into the future using their imagination as you talk about what they would like to do another time.

4. For some children it can be fun to stop in the middle of a story and imagine what might happen next, others find that really frustrating.

5. Guessing games, such as putting an object (a Q tip, a teaspoon, an orange, a small toy…) inside a sock so that the child feels it and has to use her imagination to work out what image fits with the information she has. Have a photograph of someone they know and let them guess who. They can ask questions and you can give clues. You can play this game at first by showing the child the photo and saying, 'I wonder who this is?' Later on you look at the photo and ask, 'Can you guess who this is?'

All of these games can help your child develop the skills to engage in abstract thought. Furthermore, it seems to me, that these two lists and more is probably what most parents are doing.

These games and activities can happily continue as long as your child wants to play them, even after they go to school and, let's face it; this is where the problems start. There is evidence from the research of Alan Thomas and Harriet Pattison for their book, '*How Children Learn at Home'*, that home-educated children who do no formal learning, go on to achieve most satisfactory results in GCSEs and higher education in maths. This probably just goes to show that the best way to prevent dyscalculia is to keep the child away from formal tuition until they are truly ready. However, particularly once the child is in school and if formal numeracy instruction has been started there are things you can do to support them:

1. When you see a number such as 29 or 134 describe it as 2 tens and 9 units or 1 hundred, 3 tens and 4 units. This helps your child's understanding of place value in base 10.

2. Always make sure you have concrete objects that your child can use to gain an understanding of the abstract, rote learning they may be experiencing. In the early days buttons, beads and bricks will be enough, later you will want something like

Lego bricks out of which you can make tens and hundreds and even thousands. In this way you can explore together with your child what is meant by symbols such as + and – and x and ÷ and =. You can show that division is just sharing and the answer is what 1 gets. Get paper with at least 100 large squares on it and build the times tables using beads or balls of plasticine on the squares so that the tables have meaning. If you use the concrete, even if you had difficulty with arithmetic yourself, you can help your child and if the concrete is always there and available your child can check their abstract computation for themselves.

3. If you know that, despite whatever games and experience he has had already, your child cannot count securely then much of what is being taught him in school will be inappropriate. Discuss this with his teacher. Take off the pressure and he will get there, in his own time. Create deep confusion by pushing him before he is ready and he may never get there.

Many children starting school are not ready for learning to do arithmetic with a pencil; this fact is at the root of the problems that then develop and get labelled as dyscalculia. Put simply, this is why it happens and it can be prevented by patience and careful observation. Simple measures, such as those mentioned, could be put in place, even in school during Key Stage 1, to allow development of math's skills through play, exploration and the use of the imagination. When the child is ready for arithmetic she will let you know, and then he will not develop dyscalculia.