

II—TEACHING MATHEMATICS TO A MULTI-HANDICAPPED BOY: A Case Study

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The child and his learning difficulties

John is an average-sized 10-year old negro boy who was born with a multiple diagnosis of cerebral palsy, spina bifida and a slightly enlarged head due to hydrocephalus. John went home when he was one week old and ran a high temperature a week later when he returned to the hospital for an additional two weeks. A draining procedure for hydrocephalus was performed at the time but the mother was not advised about the placement of a shunt. However, a medical report indicates that John had one when an infant and one when he was four years old.

According to his mother blindness occurred just prior to the placement of the second shunt. Ophthalmological reports state that John sees mere shadows in his left eye and only peripherally with his right. He wears glasses and has recently received bifocals.

Though John can ambulate awkwardly, he was fitted with braces and crutches and, once adjusted to them, has been walking well wearing a helmet when he walks any distance. His upper extremities function normally.

John is the fourth child among five siblings who have difficulty accepting his handicaps, especially his toilet problems associated with spina bifida. Furthermore, the sores on John's buttocks and genitals indicate poor care. Professional instructions apparently are not sufficiently followed up by his mother who tends to be lax in this area.

John's mother is separated from her husband and the family is supported by welfare. She is a heavy-set black woman who gives the impression that her normal education is quite limited. However, it was felt that she was trying to make the best of the situation although the care of John has been (and still is) a difficult task. At a later point, it became known that John was afraid at night and so he would get up to touch his mother or his siblings. Consequently the mother strapped him to his bed to avoid these "disturbances."

Recently, as the result of a psychiatric case conference, play therapy was initiated in the belief that it may be beneficial for him. But John seldom talked about what he was doing. He seemed to be aware of present reality, but in general liked to fantasise. He shied away from discussions of his home. During the four months that he attended these sessions information about his condition was presented to him, but he just listened and then changed the subject.

The Nursery School from the Industrial Home for the Blind stated that John (age 8) could match shapes and name them. He could count to five, sort colours, but could not name them. A year later (age 9.5) John obtained on the Wechler Intelligence Scale for Children a verbal I.Q. of 67, indicating a mildly retarded level, "although this may be an underestimation of his abilities." He was also tested on the Vineland Maturity Scale, on which he scored a Social Quotient of 70. On the Maxfield Buchholz Scale of Social Maturity for Blind Children, he obtained a Social Quotient of 61.

John knew the days of the week, numbers and numbers of months. Although he is quite verbal, his vocabulary was limited. "His greatest strength was in the ability to generalise, a somewhat abstract function."

When John was 9.9 an educational evaluation done by the author indicated that John had a rote count from 1-10. He could not count backwards, could not begin by a given number, nor did he know what comes before or after a number, although he understood the concept of adding by one. He could not subtract. When requested to give four blocks, he returned two in each hand, gave three in each hand for six, and five in each hand for ten.

However, he had no recognition of what a number looked like, could not write them and was unable to identify them when large cut-out numbers were placed in his palm. When asked how many hands he had, it was obvious that he confused his fingers with his hands, since his answer was five.

His hands were sensitive and he recognised things he knew. Thus, he graded by touch all blocks of the Stern material almost faultlessly according to their length.

He also imitated sound patterns of varying length. The report concluded with the recommendation of individualised educational therapy sessions within his own classroom since John demonstrated a fear to be alone in a room with an adult he did not know.

It is often difficult to establish a realistic baseline from which to derive practical goals. A number of careful observations are required to ascertain the child's level, weaknesses and strengths. Thus, at the onset of John's sessions, objectives had not actually been formulated in details, since it was difficult to determine how much John could learn. Moreover, the sessions had to focus primarily on lengthening his attention span to make any significant progress, particularly for learning mathematics, as had been suggested by staff in a previous conference.

Thus, John began his individualised therapy sessions in his own classroom where he had nine 10-15 minute sessions before Christmas. Following these, John had a total of 60 sessions when school closed for the summer. Since his attention span increased gradually a few minutes, the sessions averaged about 25-30 minutes.

The objectives

By considering his short attention span and the necessity of his remaining in his classroom, the objectives were limited to:

1. Learning to know each other so that he would lose his fear of leaving his classroom.
2. Learning to make the number sequence from 1;10 with large plastic numbers.
3. Learning to differentiate between two hands and five fingers on each hand ("altogether 10 fingers").

After the Christmas vacation John consented to leave his classroom and his attention span subsequently increased 5-10 minutes. Therefore other objectives were added, such as which number comes after a given number, since this related to the learning of making the number sequence.

Furthermore, since John gave the impression of being quite a "grown-up boy," the opportunity to work with money in addition to blocks seemed to motivate him.

Children who can see enjoy their brightly coloured workbooks, while John obviously missed out on such activities. Consequently learning to discriminate money

coins was added to his programme. The device to use his own body in relation to blocks and money (penny, nickel and dime) seemed a natural solution. Moreover, John knew how to add by one but did not understand the principle of permutation.

The word subtraction was "translated" to "take away," something that John readily understood.

Thus, in January the objectives for John emerged as:

1. Differentiation between two hands and five fingers (10).
2. Placement of the numbers from zero to ten in their proper sequence with plastic numbers.
3. The concept of which number comes after any given number between zero and ten.
4. Discrimination between the penny, nickel and dime.
5. Addition and subtraction with his fingers.
6. Learning the principle of permutation.

Methodology

Each of John's individualised sessions began by concentrating on one or two of the particular objectives. However, gradually, as one or more topics began to take less time, we could begin with something else within the learning sequence.

Sometimes a few minutes of music were used not only to enhance his sessions, but to lengthen his auditory attention span. It was also noticed that his reaction time was rather slow. His answers to questions were frequently reluctant with a sluggish enunciation and his hands were overly cautious. Thus, echo clapping and speech patterns as used in Carl Orff's method served to supplement his programme.

John learned to feel the numbers rather quickly, although reversals within the sequence, particularly over five, disappeared only gradually during the semester.

Learning to differentiate the nickel from the penny and dime was easy, since it is a large coin. However, the dime and the penny are of the same size, although different metals. John learned this only when his glasses were changed at a later point and the money placed in a black box, so he could see the silver one a bit brighter than the copper one. But he never succeeded in distinguishing them by touch alone.

It took 15 sessions for John to realise he had two hands with five fingers on each hand (altogether 10 fingers). However, once he had internalised this concept he was able to perform transactions associated with multiplications. Thus, he seemed to understand that if one boy equals one dime, two, three or four boys equal that many more dimes. He also "knew" now that if 10 equals two 5's—8 equals two 4's, and so on.

As pointed out previously, John actually gave equal amounts of four (2 and 2), six (3 and 3), eight and ten respectively, so the step of becoming aware that a number "equals" (or is the same as) had not been such a big step. Yet it seemed rather important that John was capable of doing this kind of association processing.

Finger numbers

John's fingers were well co-ordinated and he demonstrated most numbers by using one or two hands. However, he did this inconsistently and thus slowed down his performance. For example, when requested to add 1 and 1, or 2 and 2, he would

indicate the answer on one hand, but when adding 3 and 3 or 4 and 4, he showed the equal amount on each hand. Although this is an acceptable method in this instance, it represented a dangerous pitfall for learning other number constellations since the fingers would then change their numerical value.

For example, when each finger is consistently identified with a given number, the automatic response becomes "attached" to the finger. As in reading, when a symbol becomes associated with a sound (as, for instance, T for "te" or Tommy, a name the child knows) the symbol acts like a label and seems to assume an existence of its own.

To facilitate the process, "crutches" (verbalisations) such as "6 is one hand and one," or "9 is two hands, take away one," can easily be supplied. To keep the fingers labelled consistently from 1-10 (beginning with the thumb as being one while the other thumb is six) greatly facilitates the learning of adding and subtracting. Since the physical exercises all gradually associate with the respective numbers, reaction time becomes shorter with practice, thus speeding up the process considerably until it finally becomes automatic as happens with all who play a musical instrument for some time. Consequently we practised all number stories with two hands but kept it consistent so that five was always his right hand.

Although John tried to follow the above-mentioned instructions he encountered great difficulties with problems such as 4 and 3, since he would have to "complete" one hand before adding two more fingers on the other hand. It still remains to be seen whether or not this approach would speed his computational skill and eradicate his many errors.

There was an additional problem that had to be solved for John, and that was learning the principle of permutation. Previously John had learned to add by one to a number and understood this concept perfectly, but failed to comprehend that 1 and 4 is the same as 4 and 1. Using concrete examples, such as four scissors and one pencil and switching them into different positions and sequences, he gradually understood its sameness.

About a month before Easter—or 25 sessions after Christmas—John seemed to consolidate everything he had learned. He could say which number comes after a given number between 0 and 10, he could add doubles, had the concept of his hands and fingers, the labelling and recognition of the money coins in relation to himself as well as to the blocks and understood the concept of permutation.

Since he wanted to learn the clock we were now able to incorporate this into his programme.

He was rather hazy in his concept of time, and so we had a lengthy conversation about the necessity of keeping time, such as in medicine, birthdays, schooldays, vacations and the like. It was interesting to observe John's development of spatial orientation while learning to indicate the hours of the clock. Although he could draw a circle and knew the numbers in sequence, to find himself suddenly confronted with the numbers written in circle-like fashion, instead of from left to right, confused him no end. Although he pointed out the 3 and the 9 with relative ease, to indicate the 12 and the 6 represented a definite difficulty for quite a while. Thus, the horizontal direction from 9 to 3 was easier for him than the vertical direction from 12 to 6. Even extending his arms forward and back did not facilitate his knowing where these numbers were located on the clock.

To give him another kinesthetic experience a string was attached across a hoop so that he could feel on his own the vertical direction away from him or toward him. This guide seemed to clarify the problem somewhat and, after a little more practice, he was able to show all the numbers on the clock, both the full hours and the half hours without hesitation.

Further objectives

After working with John for about three months (34 sessions) two things were clear: John was motivated to learn and he had progressed. Though some of the material he had learned needed more practising in order to internalise things, he was ready for additional learning objectives:

1. To count to 100 in ones, tens and in fives.
2. To add and subtract in tens.
3. To differentiate tens and units by
 - (a) Reading two placement numbers.
 - (b) Forming the blocks correspondingly.
 - (c) Transferring the two placement numbers into money.
4. The concept of five minutes between the numbers on the clock.
5. To verbalise the number stories as they appear in Stern's Structural Arithmetic.

Methodology

Learning to count in tens came easy to John since he watched "Sesame Street" on TV. During our sessions he had learned also that one dime is one ten (or one boy), and so five dimes were five tens—as were five ten blocks which made 50. He encountered some problems with reversals, but they were mild and frequently he would correct himself. The difficulty consisted of the numbers from 13 through 20 because the numbers are reversed in the English language, such as 18.

The sound of bouncing a small, heavy rubber ball on the table while counting from 1-100 appeared to help John. His speech seems to become more rhythmical and so his counting from 1-100 in ones, tens and fives became quite steady.

The next step was to teach him to say a two-placement number, such as 28, and put the corresponding numbers together. After he demonstrated that he understood this procedure, he was taught to transfer 28 into two tens and one eight block, placing one dime on each ten block and eight pennies on the eight block. Sometimes the problem was reversed and he had to begin with 28 cents, verbalise the number and indicate the corresponding blocks. At the end of the semester John was able to add and subtract in tens, and began to realise that five dimes were 50 cents. By adding or subtracting the dimes John found no more difficulty in distinguishing the tens from the units.

TASK ANALYSIS

1. Make 28 with plastic numbers.
2. Read 28 aloud.
3. Make 28 with the Stern blocks.
4. Place the corresponding money on the blocks.
5. Understand that 28 is
 - (a) Two tens and 8 units or
 - (b) Two dimes and 8 pennies.

Results

As pointed out at the beginning of this paper, John had a rote count but did not know what a number looked like. Neither did he know which number comes before or after a given number. He knew how to add by one, but could not subtract—nor did he understand the principle of permutation. He had an understanding of the importance of money but did not know the value. He knew he had hands and fingers but confused his two hands by stating he had five. He knew what a clock was, but could not set a given time.

However, in June (60 sessions excluding the ones before Christmas) John was able to count from 1-100 in ones, fives and tens. He had the concept of which number comes before or after a given number and understood now the principle of permutation as well as subtraction. He could give any amount of money consisting of dimes and pennies as well as putting the plastic numbers together for double digit numbers. He could also show full, one half and one-quarter hours on a clock.

In conclusion

Although John seems quite secure in his new knowledge, with the summer vacation much may be forgotten by the fall. Thus, it is likely that not only the learning of the basic concepts concerning two placement numbers will have to be repeated, but also much time will have to be spent on practising and consolidating the material before new objectives can be introduced.

Teaching other children by the same methods may have similar positive results. However, those who are subjected to this programme need to have the same basic knowledge as John had. The advantage of this approach is the acquisition of a clear concept of what "tens" mean within a relatively short period compared with the intellectual confusion this concept usually generates. But John learned all his life without much visual stimuli and seemed to have a facility in shifting ideas which other children may not possess. Nevertheless it may be worth while trying it out.

Drawing of a Person

a, b: John's first sessions, Nov. 1972

c: John's last session, April 1974



a



b



c