Two Case Studies of Autistic Savants: Understanding Their Systemizing Ability

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ABSTRACT

Individuals with autism spectrum disorders, who are minimally verbal or non-verbal, are often regarded to be cognitively impaired. They are always referred as “low-functioning” learners. Hence, autistics who display exceptional abilities are previously known as “idiot savants” – a very impolitic term to use – but today “autistic savants” is a preferred term to use. In this workshop, two case studies will be presented – one is an autistic savant writer and the other, a speedy calculator – and their underlying systemizing abilities are examined.

WHAT IS AUTISM?

The current definition of autism spectrum disorder (ASD) emphasizes on problems in empathizing, which involves two main steps: (1) the ability to attribute mental states to other people as a natural way of understanding them, and (2) having an automatic appropriate emotional reaction to other people’s mental states. These two steps form a major ingredient in successful social interaction. Empathizing concerns what is known as the theory of mind or mind-reading. Empathizing deficits, therefore, refer to one’s failure to make connection to another individual’s experience and to respond appropriately to that person.
However, recent studies suggest that though individuals with autism display empathizing deficits, they have intact or even superior systemizing ability. Systemizing refers to that ability to analyze and build systems so as to understand and predict the functional behavior of impersonal events or inanimate or abstract entities. Myers, Baron-Cohen and Wheelwright (2004) have listed the following six systems: (1) mechanical systems such as machines and tools; (2) natural systems such as biological processes and geographical phenomena; (3) abstract systems such as mathematical concepts and computer programs; (4) motoric systems such as 3-D drawing or piano finger technique; (5) organizable systems such as Dewey Classification System used in library catalogue or a stamp collection; and (6) social systems such as a business management or a football team. The way an individual with ASD makes sense of any of these systems is not in terms of mental states, but in terms of underlying rules and regularities. Such superior systemizing ability can be seen in those termed as autistic savants, who may have two or more savant abilities. However, there is also another lesser known sub-group of autistic crypto-savants, who, “because of their inability to communicate, have savant skills that are hidden, or secret, and unknown to those around them” (Rimland, 1990, p.3). This aspect is often ignored in the current definition of ASD.

**WHAT IS AUTISTIC SAVANT?**

Treffert (2000) describes autistic savant (part of savant syndrome or SS for short) as “a rare, but extraordinary, condition in which individuals with serious mental disabilities, including autistic disorder, have some ‘islands of genius’ that stands in marked incongruous contrast to the overall handicap” (p.15). While it is true that “the majority of autistic savants have low IQs, there are some autistic savants who are highly intelligent” (Exkorn, 2005, p.69).
As many as one in 10 persons with autistic disorder have such remarkable abilities in varying degrees, although SS occurs in other developmental disabilities or in other instances of central nervous system (CNS) injury or disease as well. Whatever the particular savant skill, it is always linked to massive memory. It has been estimated about 50% of the cases of SS are from the autistic population, and the other 50% from the population of developmental disabilities and central nervous system injuries. The estimated incidence of savant abilities in the autistic population is about 10%, whereas the incidence in the learning disability population is probably less than 1% (Hiles, 2002). Since approximately 50% of people with SS have autism, autistic savants is often the preferred term and Edelson (1995) refers strictly to individuals with autism who have extraordinary skills not exhibited by most persons. Such individuals were once known as “idiot savants”, since “idiot” was an acceptable word for mental retardation in the late 19th century, when the phenomenon was first medically investigated, and “savant” comes from the French word for “knowing” and means “a learned person”. It was much later when Rimland (1978) introduced a more appropriate term “autistic savant” (rather than idiot savant) to describe such individuals.

It has been found that about 10 percent of individuals with ASD, who may be intellectually disabled in most ways, show special or even remarkable skills. They can be classified under three categories of autistic savant skills as follows (Exkorn, 2005): (1) Splinter skills: These skills are most common. Autistic savants with splinter skills display obsessive preoccupations with and memorization of trivia and obscure information such as license plate numbers of vehicles and sports statistics, e.g., names of all the recent and past soccer players in the Manchester United FC, which they commit to memory. (2) Talented skills: Autistic savants with talented skills have a more highly developed and specialized skill.
instance, they can be very artistic and paint beautiful sceneries, or for some, have a fantastic memory that allows them to work out difficult mathematical calculations mentally. (3)

Prodigious skills: These skills are the rarest. Prodigious savants have spectacular skills that would be remarkable even if they were to occur in non-handicapped individuals. There are only about 25 autistic savants in the world who display prodigious skills, which could include for instance, the capability to play an entire concerto on the piano after listening to it only once.

Autistic savants can have either a single special skill or display multiple skills. In most cases, their specialized skills are concrete, non-symbolic, right cerebral hemisphere skills (rather than left cerebral hemisphere skills, which tend to be more sequential, logical and symbolic), and most reliant on memory. In general, such savant skills include music, art, mathematics, language and other skills such as knowing time without having to look at the clock, an uncanny ability to know and understand how animals feel, untaught mechanical or computer literacy skills, an unexplainable capability to commit maps to memory, and so on.

**WHAT CAUSES AUTISTIC SAVANT ABILITIES?**

Autistic savant behavior (AuSS) is so far unexplainable. Its etiology can be either congenital or the result of disease or injury to the central nervous system (Shah, 2001). According to Hobson (2002), autistic superior performance is frequently considered to be a side effect of abnormal neuron-anatomical function, rather than a reflection of genuine human intelligence. Treffert (2000) posited that pre- or post-natal insult to the left cerebral hemisphere of the brain causes right cerebral hemispheric compensatory growth, reflected in impairment of languages as well as analytic thought. Hence, there is a heightened
capacity for right-brain-dominated functions such as, musical and visuo-spatial abilities (Di Martino & Castellanos, 2003). Any insult to the cerebral cortex causes memory functions to shift to a more primitive area of the brain (i.e., the corticostriated system), resulting in memory being non-associative, habitual, emotionless, and non-volitional – a conditioned response (Feldman & Morelock, 2003). Another theory proposed by Snyder et al. (2003) suggests that savant skills exist in all of us although not normally accessible. The normal brain is highly concept-driven, i.e., it allows us to function automatically, using unconscious mechanisms to sift through a world of unconscious information and arrive at final judgments and mindsets. However, autistic savants lack this ability for conceptualization. They have to rely heavily on the lower levels of neural information from which we abstract our conceptual schema. Hence, autistic savant artists draw with naturalistic detail, even at pre-school age; autistic savant calculators perform lightning-fast integer arithmetic computation; and autistic savant musicians rely on perfect pitch. All savants recall detail by accessing underlying processes common to all brains, but inaccessible to normal ones (Feldman & Morelock, 2003).

CASE STUDY 1: AN AUTISTIC SAVANT WRITER

morning baby cry white old man lego sky soil soil zero black white old man walk
water white old man give light zero black white old man say light day black night
morning baby cry white old man say water sky sea sunset morning baby cry

Read the above text. You will find that it does not make any sense: no capital letter for the first letter of the first word at the beginning of a sentence, no full-stop, no comma, no preposition, no conjunction … just a string of words and repeated words. This is a piece of
writing done by an autistic savant writer. It is a widely known fact that all autistics have problems with communication. Their language (i.e., grammar, vocabulary, even the ability to define meanings of single words) may or may not be impaired. The problem lies in the way they use whatever language they do have. These autistic writers belong to a minority group of autistics, who despite having communication impairment, display an idiosyncratic ability to express themselves through their unique writing.

This first case study is about a 12-year-old autistic savant writer (let me call him JJ), whom I worked with a few years ago. According to JJ’s parents, who are both Christian missionaries, the child seldom talks to them. They see him as an avid reader who can read for hours. What differentiates JJ from other children his age is that he virtually never reads stories with elaborate plots and highly developed characters. JJ reads fact-filled material only. Left on his own, JJ is more than happy to read the same book about outer space or countries he has visited, for instance, over and over. However, JJ could not understand what he has read. Such a condition is described as hyperlexic.

JJ spends more time writing than reading. His parents describe him as an obsessive writer who has written several books of his “stories” but nobody could really understand after reading them. JJ’s strong preference to read or write is not surprising. Many autistics express themselves better in writing than in spoken language. One reason for this may be that the expressive language problems associated with autism may be partly related to the speed with which processing of spoken language should occur. Another probable explanation why many higher functioning autistic people write better than they speak is that speaking is a more social activity than writing. All the language pragmatics and social
interactional aspects of a conversation – which present enormous difficulties in autism – impinge upon the thinking of an autistic when he speaks. When an autistic writes, he can be alone. Therefore, writing can be a good modality for encouraging expression in autistics.

Very little research has been done on written expression of the autistics. It made me ponder if we could ever understand the autistics through their written expression. I only began my serious study on autistic written expression when JJ’s parents came to me for advice and help. They showed me what JJ had written – book after book – in a unique writing style. I could read JJ’s writing but not understand it. For once, I became “hyperlexic.” After three consultation sessions with JJ’s parents, I decided that the best way to understand JJ was to spent at lease a few full days with him and his family: interviewing his parents, watching JJ doing anything alone, poring through several photograph albums of JJ and his family visiting different cities all over the world and participating in various exciting activities. I began painstakingly to make sense of what JJ had written. Each word or phrase could be linked up to an event or episode that had happened or anything that was taking place in JJ’s life.

Returning to the text shown at the beginning of this case study – *morning baby cry white old man lego sky soil* … – that JJ had written, I asked myself, “What do these words mean?” There could be some hidden antecedents that triggered JJ to write the way he did. Having stayed with JJ for three days, it made sense to me when I linked the phrase “morning baby cry” to the daily happening at home early in the morning when JJ’s baby brother would cry for milk. I called it *chrono-episodic* antecedent. My only problem with the phrase was “so what does it mean? What is JJ trying to express?”
The next phrase “white old man” kept me pondering who the person JJ was referring to. From JJ’s parents, I learnt that JJ once visited the Vatican City on a family tour and they saw the beautiful painting done by Michaelangelo of a white bearded man (representing God) stretching his arm to touch the finger of a mortal man (representing Adam) on the ceiling of a cathedral. They showed me photographs taken at the cathedral they had visited.

On one photograph, I saw JJ being held up by his father and his eyes seemed to glue on the Michaelangelo painting on the ceiling. “Eureka!” I exclaimed excitedly. “That ‘white old man’ refers to God.” I consider photographs as *pictorial* antecedents.

The next word “lego” refers to a construction set of plastic bricks that JJ’s father had bought him as a birthday present. The word could mean “to build” or “to create” something that JJ had attempted to associate with. JJ could use the Lego bricks to create anything he liked, say a house or a horse. JJ used the concrete word “lego” as an action word (verb) here in his sentence. In this case, Lego is regarded as an *activity-related object* antecedent. The last two words “sky” and “soil” were something physical that JJ could see and know that they are always there. From my further conversation with JJ’s parents, I discovered that his mother would read the Bible to him every evening at the balcony of their flat and would use concrete terms to make sense of the verses to JJ. The word “sky” (which JJ would point upward when asked, “What’s sky?”) was used to substitute “heavens”; the word “soil” (which JJ would point downward when asked, “What’s soil?”), “earth”. It began to make more sense to me than before. The sky and soil are what I regard as *non-activity-related object* antecedents. Confidently, I deduced that “morning baby cry” meant “beginning of the day” or “in the beginning”. What JJ had done was conscientiously re-writing the biblical verses that his mother had been reading aloud to him every evening in the way he could best
understand by associating them with the happenings and physical objects around him. In brief, “morning baby cry white old man lego sky soil” means “In the beginning, God created heavens and earth” (Genesis 1:1).

The phrases and words JJ used in his written expression were not meaningless. They were meaningfully related to some kinds of antecedents known to JJ. To decipher the meaning out of the apparently meaningless sentences written by JJ, I had to understand the events JJ had experienced and the objects he had seen and/or handed before found in the hidden antecedents of the words and/or phrases used in his writing. It is also interesting to note that JJ could read the entire verse of Genesis 1:1 without any hiccups, no omission or change of words. However, when asked to write the verse, he rewrote it in his own unique style of written expression. Below is a transliteration analysis of JJ’s sentence:

JJ’s sentence

<table>
<thead>
<tr>
<th>Antecedents</th>
<th>morning baby cry</th>
<th>white old man</th>
<th>lego</th>
<th>sky</th>
</tr>
</thead>
<tbody>
<tr>
<td>soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baby brother cried for milk every morning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father played Lego with him whenever free</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Michaelangelo’s masterpiece seen at the cathedral in the Vatican City</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lego: birthday gift</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother pointed sky for heavens and soil for earth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Original sentence

In the beginning X X
God created heavens and earth X X
In his own written expression, all the words put together somewhat seemed to make sense to him but not to me. This is dissociative processing – an unconscious process in which one or more parts of mental functioning become split off from others and appear to operate outside of consciousness (Corsini, 2002). Hence, in JJ’s case, the phrases and words – morning baby cry, white old man, lego, sky, soil – do not link coherently together. The sentence appears nonsensical and is certainly ungrammatical. The phrases and/or words are dissociated from one another.

However, JJ was able to link each phrase or word to the past or current event/episode he had previously experienced (e.g., a visit to a cathedral in the Vatican City) or could still be encountering on a regular basis in the past (e.g., his baby brother cried for milk every morning, happened two years ago) as well as objects that he had seen and/or handed before. Such events/episodes and objects have provided associative meanings to JJ and so as to enable him to express himself in his own unique written language. At the same time, each of his phrase or word is also associated with the original words in the verse he has heard or read before. This is associative processing, which is a result of life experiences based on connections made to personal, historical events (Corsini, 2002). It is observed that JJ often omitted functional words (e.g., articles and prepositions) which are meaningless to him.
It is interesting to note that the less obvious parallel processing also takes place between JJ’s own idiosyncratic sentence and the original sentence of the verse at the same time during dissociative and associative processes of written expression. This refers to that information processing of two separate but related sets of information sources that are attended to simultaneously, thus accounting for the apparent ability to carry on different cognitive functions at the same time (Corsini, 2002). One information source may be processed consciously (i.e., JJ’s own sentence) whereas another source (i.e., the verse in its original sentence) is attended subconsciously.

With this new discovery of JJ’s unique way of expressing his thoughts in writing, I was at first skeptical of his ability. I went on to do several more transliteration analyses of other sentences found in his other exercise books. It was tedious, but rewarding, especially when these once ungrammatical, nonsensical sentences now become meaningful to me.

I repeated the experiment with three other autistic savant writers. The transliteration analysis did work successfully with two but I did not manage to break into the third one. This is an interesting area where I hope more future evidence-based research studies on transliteration analysis of autistic written expression can be done – breaking the myth surrounding autism as well as opening the once silent, often misunderstood, world of the autistics through their unique, perhaps even creative, writing style.

**CASE STUDY 2: A SPEEDY CALCULATOR**

Children with autism tend to be keen in counting at an early age before even speaking other words. However, the first milestone in mathematical development is the emergence of one-
to-one correspondence, i.e., counting objects one at a time and knowing that one number corresponds to one quantity. Such a physically-based notion is how autistic children acquire mathematical concepts on a visual level (Siegel, 1996).

The second case concerns an 8-year-old child (let me call him Alan) diagnosed with high-functioning autism when he turned five. Alan would just sit in a corner for hours performing rapid addition and subtraction. Since no one knew how to communicate with him, he was not taught multiplication or division. Fortunately, Alan had speech despite being diagnosed “very delayed”. He could speak in English but nobody (other than his parents) really understood what he was talking. He communicated better using the Picture Exchange Communication System (PECS) cards. While working with Alan, I learnt he knew only addition and subtraction, but not multiplication and division. What causes confusion for most children – be they autistic or non-autistic – learning arithmetic operations is that different words are used to describe them (e.g., add, plus, sum, total … are different words referring to the same symbol +), and Alan was having that problem, too.

One day, I noticed Alan enjoyed playing with big wooden dices left in a basket near my table. He would pick them up one at a time, placing them on his table in a row, with the same face (e.g., 5 black dots) upwards as follows:

Dices

![Dices Image]
Then an idea struck me. I could try teaching Alan multiplication with dices. I picked up the number cards and placed them one at a time above each dice as shown on the next page.

<table>
<thead>
<tr>
<th>Cards</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

At first, Alan did not care what I was doing. After placing down the fifth card, I said, “There are five dices altogether.”

Then I started counting aloud the dots on each dice and wrote 5 with a soluble black ink marker on the table-top below each dice. Now, Alan began to take an interest in what I was doing and he repeatedly said “five” as I pointed to each dice. At that point in time, I wondered if Alan really knew what I was doing.

<table>
<thead>
<tr>
<th>Cards</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ink</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
“Good! Five dots on each dice. Now, how many dots are there altogether?” I asked. Using a soluble red ink marker, I added + between the 5’s and put = at the end of the fifth “5”.

<table>
<thead>
<tr>
<th>Cards</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ink</td>
<td>5</td>
<td>+</td>
<td>5</td>
<td>+</td>
<td>5</td>
</tr>
</tbody>
</table>

Alan counted aloud, “5 plus 5 plus 5 plus 5 plus 5 equal 25.” He took the black ink marker from me and wrote 25 at the end of the addition sum, without hesitating to think or check if his answer was correct. I was amazed. *Alan must be a genius*, I thought. *An autistic savant!*

I erased all except the fifth ink-written “5”, the = sign and the answer “25”. Then I pointed at the last number card “5” and shifted it down next to the left of the ink-written “5”. I wrote × in soluble red ink and said, “Five dices (pointing to the dices, one at a time) of five dots (pointing to the five dots, one at a time, on one dice) each equal to five times (pointing to the number card “5”) of five dots (pointing to the ink-written “5” below the fifth dice). And so five times (pointing to the number card “5” again) of five dots (pointing to the ink-written “5” below the fifth dice again) equal to twenty-five (pointing to Alan’s ink-written “25”). That’s how you can say it in another way.”
“Twenty-five dots,” said Alan nonchalantly, and he pointed to the answer repeating exactly what I had said like a tape recorder. Not knowing if Alan had really understood me, I repeated the activity with a different number of dices and each time with a different number of dots. Alan was able to give me correct answers. The boy was simply too good with his addition, and multiplication is really nothing more than a form of repeated adding, something we do naturally. Most of us are adding all the time in our minds. When I say “4 times of 6”, I am really just taking a short-cut to arrive at the same answer as 6 plus 6 plus 6 plus 6.

When teaching multiplication to children with autism, they need to understand what they are performing before moving on to the next level. However, one might ask, “What’s the point?” Alan could easily perform rote multiplication at the level required for admission to a mainstream primary school. However, if he could not use the operation functionally, little has been accomplished except a demonstration of his ability to memorize impressing the people around him. It is important, as Siegel (1996) has pointed out, “to keep comprehension commensurate with performance when learning mathematics” (p.282).
The next task was to move Alan beyond doing multiplication with dices and number cards. I taught him $0 \times$, $1 \times$, $2 \times$, $5 \times$ and $10 \times$ tables the usual way I would with non-autistic children. However, for reasons unknown, Alan seemed somewhat to be resistant to learning $3 \times$, $4 \times$, $6 \times$, $7 \times$, $8 \times$, $11 \times$ and $12 \times$ tables. I began to think of another way to get him learn or memorize these other tables. For example, $7 \times$ table can be a sum of $2 \times$ and $5 \times$ tables, i.e., $7 \times = 2 \times + 5 \times$.

Alan managed to acquire the $0 \times$, $1 \times$, $2 \times$, $5 \times$ and $10 \times$ tables by rote. This is often observed in autistic children who seem to store lists of items in memory for prolonged periods in the exact form in which they were first experienced, without changing them in any way (Baron-Cohen & Bolton, 1993). One possible explanation is that Alan might have a unique way of understanding how the multiplication system works. This can be explained by the child’s superior systemizing ability, which has been described by Myers, Baron-Cohen and Wheelwright (2004) as “the drive to analyze and build systems in order to understand and predict the behavior of impersonal events or inanimate or abstract entities” (p.18). Systems are all around us and they fall into at least six kinds: mechanical, natural, abstract, motoric, organizable, and social systems. In Alan’s case, he displayed superior abstract systems and was able to see patterns in times-tables that he had been taught. He knew that “0” times whatever number is always a zero. To him, the $2 \times$ table sounded like an endless chant (and Alan would go on chanting unless he was told to stop). $5 \times$ table thrilled Alan with 5 and 0 repeating themselves down the table; he could tell me that an odd multiplicand results in a product with a “5” in its unit (e.g., $7 \times 5 = 35$), but an even multiplicand has a product ending
with a “0” in its unit (e.g., 8×5 = 40). For 10× table, Alan learnt to add a “0” to the right end of a multiplicand.

By the seventh session, Alan was doing multiplication with repeated additions to obtain his answers. For instance, 12 × 15 = ?, where 12 is a multiplicand, 15 is a multiplier, and ? is the unknown product to be calculated. The multiplier 15 can consist of the following options: (a) 10 + 5; (b) 10 + 2 + 2 + 1; or (c) 5 + 5 + 2 + 2 + 1 … based on the 1×, 2×, 5× and 10× tables that Alan had already known. Say, Alan decided to choose the option (b): 10 + 2 + 2 + 1. He wrote down four separate alternative multipliers: one column under the 10× table, two columns under the 2× table, and one column under the 1× table. Then he worked out his answers beginning with the multiplicand 1 and moved numerically and sequentially downward until he arrived at the multiplicand 12 to obtain his answer (see below).

**Option (b):**

<table>
<thead>
<tr>
<th>Cardinals</th>
<th>Multiplier</th>
<th>Time-tables</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>× 15</td>
<td>10× 2× 2× 1×</td>
<td>10 + 2 + 2 + 1</td>
</tr>
<tr>
<td>2</td>
<td>× 15</td>
<td></td>
<td>20 + 4 + 4 + 2</td>
</tr>
<tr>
<td>3</td>
<td>× 15</td>
<td></td>
<td>30 + 6 + 6 + 3</td>
</tr>
<tr>
<td>4</td>
<td>× 15</td>
<td></td>
<td>40 + 8 + 8 + 4</td>
</tr>
<tr>
<td>5</td>
<td>× 15</td>
<td></td>
<td>50 + 10 + 10 + 5</td>
</tr>
<tr>
<td>6</td>
<td>× 15</td>
<td></td>
<td>60 + 12 + 12 + 6</td>
</tr>
<tr>
<td>7</td>
<td>× 15</td>
<td></td>
<td>70 + 14 + 14 + 7</td>
</tr>
<tr>
<td>8</td>
<td>× 15</td>
<td></td>
<td>80 + 16 + 16 + 8</td>
</tr>
<tr>
<td>9</td>
<td>× 15</td>
<td></td>
<td>90 + 18 + 18 + 9</td>
</tr>
<tr>
<td>10</td>
<td>× 15</td>
<td></td>
<td>100 + 20 + 20 + 10</td>
</tr>
<tr>
<td>11</td>
<td>× 15</td>
<td></td>
<td>110 + 22 + 22 + 11</td>
</tr>
<tr>
<td><strong>12</strong></td>
<td>× <strong>15</strong></td>
<td><strong>120 + 24 + 24 + 12</strong></td>
<td><strong>180</strong></td>
</tr>
</tbody>
</table>
By the nineteenth session, Alan was learning to compute his answers using a short-cut method. This was achieved after much resistance from the child, who still preferred the long ritualistic way of doing repeated additions. However, for practical reasons (e.g., during a class test that has to be completed within a specified time), I saw the need for Alan to work out his answers without having to go through a long series of repeated additions. Explaining to Alan why he had to take the shortest route to do his multiplication was tough. The child neither understood why he needed to do that nor knew what I meant. It took me another three sessions before I came up with the idea of using a timer.

Alan had to work against the timer to see how fast he would take to complete the multiplication. He enjoyed “playing” (I must admit there were unpleasant times when Alan became frustrated, threw into temper tantrums and refused to work with the timer) that and I was able to convince him to do multiplication with the short-cut method. For instance, using the same $12 \times 15 = ?$, Alan learnt to directly multiply the multiplicand 12 using the smaller alternative multipliers, instead of the bigger multiplier 15, through one of the three possible routes: (a) 10 and 5; (b) 10, 2, 2 and 1; or (c) 5, 5, 2, 2 and 1. Say, Alan chose the second route and mentally computed his answer with the familiar $10 \times$, $2 \times$, and $1 \times$ tables.

*Route (b):*

\[
\begin{align*}
12 \times 15 &= ? \\
\text{where} \quad 15 &= 10 + 2 + 2 + 1 \\
\times 10 &= 120 \\
\times 2 &= 24 \\
\times 1 &= 12 \\
\text{and} \quad 120 + 24 + 24 + 12 &= 180
\end{align*}
\]
By the year end, Alan was able to perform multiplication with numbers of three or more digits easily without a hitch. An impressive feat indeed!

REFERENCES


