ZEN & THE ART OF CALCULATION

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Mind Development Courses

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"Here we are, all by night we're hurled
By dreams, each one, into a several world."
Robert Herrick.

Background

Since 1969 there has been something of a paradigm-shift in cognitive psychology. At the time of our initial presentation, psychologists in the main did not concern themselves with Intuition as a field for research, so the idea of training people to use their intuition was not practiced outside of Asia and particularly Zen Buddhist schools.

Today, many psychologists would accept that, when a person has been doing a certain type of thinking for a long time, the process can be internalized, just as software can be stored on a hard disc of a computer. Such material may then be instantly available, without being painstakingly worked through as a conscious activity.

What has really happened is that the thinker has moved into a higher order thinking habit, which uses groupings of complex mental activities as sub-routines, which can be switched on at will by a simple command. This results in the instant appreciation of problems and their rapid solution in a manner which seems to defy logic.

The modern view of this kind of intuitive judgement is that it is based on experience. Intuitions are thought to be received as pre-judged, emotional complexes (like Wood's Number Grids), or as something one feels, in which smell, touch, taste, sounds, gut feelings and visual symbols playa part. But in reality Intuition operates at a higher harmonic of intelligence, because it quickly assembles the results of many parallel, logical processes in a manner which seems to transcend logic. This is something that manifests itself as 'The Level of Certainty'.

While cognitive psychologists thus have only hazy notions about the subject of Intuition, their Asian counterparts have been familiar with this territory for at least 2,000 years. It is also true that the same universal teachings have come from many sources, widely separated historically and at various points of the globe, when communication was more restricted. The consensus of such teachings cannot be ignored, and much of what was then written is relevant to what we are doing here.

So as to give the Student a better understanding of the theory behind the techniques given in this paper, and certain other areas of Mental Development, there follows a short history of Zen Buddhism, and an introduction to those of it's basic concepts which are relevant to Mental Development.

The Goal of Zen is the state of 'No-Mind'. This is an intuitive way of dealing with the world. The aim of this paper is to enable a Student to turn on a particular form of 'No-Mind' consciousness that can be applied to a practical task - that of arithmetical calculation. The wider purpose of Upper Level Mental Development is to harness the 'No-Mind' state to a still wider range of practical applications. The following short history and discussion of the general principles of Zen should, we trust, give some insights into the way many Mental Development procedures work.

Note: The techniques in this paper are for the purpose of self-actualization. They are not a method of dealing with emotional blocks to learning.

A Short History & Discussion of the General Principles of Zen

Zen Buddhism was derived from the Buddhist religion of China, and, to some extent, the Tantric System of Tibet. These strands of thought were interwoven by a Japanese gatekeeper called Lao-Tzu. His was the first work on Zen Buddhism, called 'The Way', written about 2,500 years ago. Many more books have, of course, been written since.

Zen is only a religion in relation to the legend and ritual imported from China. It should properly be described as a psychological science for the development of the mind and the spirit. The teachings of Lao-Tzu came to be the cause of a schism between the Chinese and Japanese forms of Buddhism. Legend has it that Lao-Tzu wished to resign his post as gatekeeper. Before this was allowed the elders of the city set him the task of writing a book, in the hope that this would dissuade him from seeking his freedom. Lao-Tzu however, rose to the challenge and produced his book entitled 'The Way'. The city elders were so impressed that they released him from his duties and Lao-Tzu went on his way and was never heard of again. But his book had such an impact among the intellectuals of his day that it lead to the formation of Zen.

Lao-Tzu wrote in his book about man's incompleteness, and with astonishing insight he suggested that this had resulted from the fact that, in most people, the evolution of linguistic mental processes had gone wrong. As a result, nearly everyone was in a state of compulsive introversion, living a fanciful dream life of wish-fulfillment, with no proper perception of external reality. Having perceived this situation, he set out in his book a technology he had evolved that would allow a person to overcome this problem and become complete. After following the exercises in the book a person would attain a state of release, referred to as 'No-Mind'. In this state of consciousness a person would be released from compulsive internal distractions related to uncertainties of meaning.

This would leave the mental apparatus free, in a state of extraversion, capable of being applied to problems of the real world. Such a state of mind can additionally be described as the direct experience of reality.

The only shortcoming in Lao-Tzu's ideas was that he sought to discard the verbal evolution of mind, which had occurred during the development of civilized man, and return to a state of consciousness which would occur in consequence of living in an environment where language was not used. Such a state represents a reversion to an earlier condition of mind governed by images, attitudes, grunts, signs and gestures. This state is useful for speeding up one's reactions to threats in the environment, and it makes possible heightened control of the body, as seen for example, in Karate. But it is of little use in the solution of problems involving the use of complex mathematical symbols or language.

Through our research we hope to show that we have discovered a new state of consciousness, identified in many ways with the original Zen idea of 'No-Mind', in that it re-evaluates linguistics correctly and thereby makes possible the immediate and direct perception of solutions to problems, avoiding the introspective, mind-wandering syndrome. Instead of Lao-Tzu's anarchic 'tabula rasa' ideas for clearing the mind of verbal clutter, which is a step backwards to a lower evolutionary state, in order to achieve stability, what was required was a technology for completing a person's verbal evolution. When this is done, such a person will attain a state of consciousness similar to that of 'No-Mind', but with the added ability to apply this state in making intuitive responses to verbal problems.

In acquiring language, man's mentality has been forced to operate in the direction of least efficiency, towards a linear connection of concepts and ideas. It should however, be capable of operating by a process of re-structuring. To give a simple example, the external, objective Universe may be likened to one half of a chessboard, whilst our subjective mental Universe may be compared to the other half of the board. Any change on the objective half of the chessboard therefore demands a compensating re-structuring of all the positions of pieces on the subjective half, in depth. To some extent this is a faculty of mimicry, we are mimicking the changes of the objective Universe. Had language not come into being all our mental processes concerned with the external world would be of this nature. This state of mind is fairly common among primitive races, where speech has not evolved to the point where it can be internalized and used to form thinking patterns. For the civilized man, some of his non-verbal, mental processes operate under the principle of re-structuring, and that is why he is sometimes able to have direct perception, or immediate insight into the solution of non-verbal problems. But this faculty seldom extends to the solution of verbal or numerical problems. Why is this faculty to a large degree lost in civilized man? It is because he has developed to the level at which a species is able to use language for introspective thought. Thus, through the conditioning of language, mental capacity has been sidetracked into an unproductive channel of useless daydreams, fears and fancies, which trail from one into another in a linear fashion, as a conjuror will pull endless strings of ribbons from his pocket. Only for the rare genius do external problems produce continuous and consistent mental operations of re-structuring.

Theory

This course presents a theory derived from three basic Axioms.

The first Axiom is derived from the work of Jean Piaget (the Swiss child psychologist). It is, that mental structures are formed from different integrations of perception and action. From this, we can derive the conclusion that, through the use of language, these mental structures and the way they are integrated, can be modified.

The second Axiom, implicit in the doctrine of mental development, is that, when mental operations have evolved beyond a certain point of complexity, they transcend their original groupings and begin to operate by re-structuring. This might be called cross-fertilization of ideas, and is true even for operations based on language and mathematical symbols.

The third Axiom is that, given a sufficiently high level of integration between the mind and the perceptual apparatus, mental processes will automatically and intuitively go into a mode where re-structuring of language and symbols takes place.

As a result of our research we find that, the easiest way to bring part of our mental operations to the level of operation by re-structuring, is first to develop our numerical and mathematical abilities. By doing certain exercises correctly, the Universe of mathematical symbols is transposed to this higher level. There are two reasons why this is the easiest route to take. The first, and most important, is that mathematical ability seems to be innate in the hard-wiring of brain circuits. There is likewise a linkage between numerical and grammatical usage. Some languages, like Hebrew and Latin, use letters as numbers, and the ASCII computer code operates by giving letters and symbols numerical value. (It is the opinion of many of present-day comparative linguists that many of our language mechanisms are similarly innate, so that, before a child begins to learn to speak, many of the necessary mental patterns concerned with grammar and speech already exist. They arrive at this conclusion by a study of the similarity of languages all over the world, where certain aspects, including baby language, are universal. See Reflections on Language, J.N. Chomsky: New York Pantheon 1975. The Quest for Mind, H. Gardner: Chicago University Press 1981. The Writings of Benjamin Whorf, J.B. Carroll, Cambridge, M.I.T. Press 1956. Making Sense, G. Sampson: Oxford University Press 1980).

The second reason why numerical abilities are the easiest to raise to the level of re-structuring, is that the symbols and usages in mathematics are a closed and universal system. The vocabulary of numbers is limited, whereas in natural languages, vocabularies are large and constantly being added to. In language, meaning is dependent upon context, style and social mores. Mathematical meaning is unequivocal, and in higher mathematics, symbolism tends to be condensed to avoid repetition. Language is related to speech, with varying accentuations and intonations, whereas numbers relate to lengths, areas, volumes and quantities in an invariant way. One symbol suffices for one thing in mathematics, whereas in language, many words of nearly similar meaning are used textually to create a more readable text.

In the case of certain infant prodigies the mental structures concerned with numerical operations evolve to their final state at an early age, and they have become freak calculators. It is through observing such children that one can learn how much a mind becomes limited in capacity when it is forced to become linear in operation. Infant Mathematical prodigies are at their best before they learn to use language for introspection, and often when they reach this level of verbal ability they lose their capacity for intuitive calculation. The reason for this is, that when a person has evolved to the point where language can be used for the purpose of thinking, his mental operations become linear. This diminishes the level of mental integration, speech operations are strung out like washing on a line and mathematical operations have to follow suit.

This brings us to another of the basic Axioms in Mind Development. It states that, when a Student is advancing to a new evolutionary Level of mental operations, during the period before this new Level is fully practiced and stable (that is, relegated to sub-conscious operation), the previous Level of mental operations is largely suppressed. In the case of infant mathematical prodigies, their ability may be classed as a previous evolutionary Level. Parents will have noticed that young children often temporarily lose certain previously learned abilities as their mind is developing.

In the average child numeracy is internalized almost at the same time as verbal skills. This should have occurred by the age of nine. For the vast majority, therefore, there will not have been a time when they experienced the faculty of intuitive calculation. Only one in thirty thousand manage to attain a mathematical state of No-Mind. The mental mechanisms, present in everyone, which are capable of performing Mathematical operations by re-structuring, are heavily repressed immediately they appear, by the linear techniques of grammar and logical reasoning associated with language. The special mathematical structures do not fit this picture and will not therefore integrate with the ongoing structures of language.

Even in the adult of above average intelligence, this capability of handling numerical problems by re-structuring can be repressed in the sub-conscious. This we have demonstrated by the use of hypnosis and special electric apparatus capable of amplifying a person's sub-vocalizations. Experiments were performed on a small group of people using the sub-vocalization detectors attached to their larynx. They were presented with arithmetical problems equal in difficulty to multiplying together two four-digit numbers. It was found that, in nearly all cases, there existed a sub-conscious ability to answer the problem almost instantaneously. Without being conscious of the fact, these people sub-vocalized the answers to the problems, while their own subjective consciousness was still trying to solve them by linear, verbal methods.

There are three main reasons why such mathematical ability operates below the level of consciousness. The first and second reasons are effectively two sides of the same coin, since mental integration begets confidence. So, firstly, for a person to be conscious of a mental mechanism, that mechanism has to be integrated within the conscious part of their mind, in other words, the direct neural connections have to be grown in order to integrate it. Without such connections the arithmetical mentality is easily suppressed, or inhibited, and has no access to the major motor centers operating the vocal chords, it can only access vocalization through a minor centre, perhaps in the opposite hemisphere of the brain. In this sense most people seem to behave like schizophrenics at this level of operations. The mental mechanisms involved with re-structuring are so poorly integrated that they act with a mind of their own, like split personalities. It is mechanisms like these that give rise to the phenomena of automatic writing and 'speaking in tongues' (glossolalia). On questioning the people who took part in the experiment it was found that one of them actually had once experienced writing the answer to a complex sum, without working it out, and had found it to be correct.

The second reason why people are unconscious of this mathematical mechanism is because they lack confidence in the answer that they are given. The conditioning that the mind receives through many years of training in linear operations, based on language, leads people to repress the mathematical ability consciously. The effect of not trusting the answer until it has been worked out in tedious detail eventually silences the intuition.

In adults there is a third cause for the repression of these arithmetical mechanisms, due to the way we were taught to perform sums at school in a linear fashion. No allowance is made for the existence of an intuitive ability. By providing extra rewards for correctly showing the working out of problems a behaviorist system is invoked, described by the educational psychologist B.P. Skinner as 'operant conditioning', which is most effective in establishing a preference for the linear system. Permitting children to use calculators in the classroom is no remedy, since growing the relevant neural connections to the arithmetic centre requires effort and practice in mental mathematics.

Part of the training in this course is therefore concerned with helping the Student both to suspend linear mechanisms and also practicing operations which allow the re-structuring ability to surface.

The Exercise Methods

To achieve a state of 'No-Mind' as far as numbers are concerned one must first break down the conditioning which the average person receives at school. To achieve this goal, habitual responses must be set up which are the inverse of linearity. Mental acceptance must be gained for the idea of solving problems spontaneously and automatically by a process of insight. A mechanism for mathematical calculation that can operate by re-structuring involves many parallel paths of operation, rather like the transputer chip. Several parts of the calculation have to be handled simultaneously. When such parallel working is allowed to happen in the mind, the result will be obtained about five times as fast, so it appears to be instantaneous. For example, in multiplying two four-digit numbers, four successive multiplications are made with each digit of the multiplier and then these are added to get the answer. If each multiplication is undertaken simultaneously and added at the same time, the answer can be got very quickly.

In the normal method of teaching a child is only shown the succession of simple operations required to gain the answer. The teacher never points out which operations can be undertaken in parallel, so the possibility of there being a super-ordinate structure to mathematical operations, which could be applied to the solution of practical problems, is never hinted at. Short cuts are not favored, and may even be discouraged, because they are not in the curriculum. Oddly enough, in the teaching of language, the child is encouraged to make conceptual leaps to the recognition of whole words without spelling them out. This involves a mental ability in the child far in advance of what is being taught in this paper.

<u>EXERCISE ONE</u>

'Exercise' is perhaps the wrong term for what the Student is now asked to do, because it has some reference to a psychoanalytical technique. It is concerned with being given a goal to aim at in connection with the ability to handle numbers. The exercise can be done with one or two persons.

For a Single Person

This involves the technique of self-questioning and a degree of self-discipline. It helps to say the question aloud. Start by asking yourself to find a problem that can be solved by mathematics. When your memory produces such a numerical problem, you give an acknowledgement and write the problem down. Then ask the question again and proceed as before. Continue with the listing for at least half an hour, straining to recall even if one cannot add to the list.

For Two Persons

This Exercise is easier to perform with two people. One person plays the questioner, the other is the trainee. The questioner asks: 'Give me a problem that could be solved by the use of numbers?' The trainee's reply is acknowledged and the question repeated. Continue for ten minutes even if the Trainee has run out of problems.

The questioner then takes problems from a separate list, or his own memory and asks: 'Can this problem (states it) be solved numerically?' When the Trainee has said 'Yes' or 'No' the questioner should acknowledge this and go on to another question. Continue again for ten minutes. On no account should the questioner invalidate the Trainee by saying whether the answer is right or wrong, but he may demonstrate another problem and a model answer. Because of the innate pre-disposition to calculate, the Trainee will know the correct answers to these questions at a sub-conscious level, so if one invalidates his answers it will tend to suppress the voice of his sub-conscious.

EXERCISE TWO

This is an extension of the type of questioning used in Exercise One, but the questions are of a more specific kind. Here again, the mode of questioning is important to the success of the exercise. It is best performed with two people. The questioner should first find out if the Student is familiar with the basic operations of addition, subtraction, multiplication and division. At this point one is concerned with purpose rather than the detail of method, how the operations are applied and to what kind of problem, not the step-by-step numerical manipulations involved. The questioner should make sure the Student knows the meaning of all the words involved in simple mathematics: divisor, dividend, factor, multiple, multiplier, multiplicand, numerator, denominator, carry, significant figures, percentage, decimal notation, etc. It is also necessary that multiplication tables are committed to memory, up to the twelve times table, as some schools do not insist on this any more.

The questioner should next prepare a list of about fifty problems, each should require only one arithmetical type of operation for their solution. Then proceed as follows:

1. State a problem from the List and then ask the Student what type of arithmetical operation is required for its solution;
2. The Student has four choices. When the correct one is given it should be acknowledged. There is no response to incorrect guesses.
3. State the next problem from the List and proceed as before;
4. Having gone through the List once, the same problems should be given in a different order, more rapidly as incorrect guesses are eliminated, until the Student's replies become automatic.

The Questioner should next prepare a second List of problems where two or more mathematical operations for their solution and repeat the procedure in I to 4 above, until the Student can reply correctly without pausing.

The last step of this Exercise is to repeat the second List of multiple operation problems asking the Student to state which mathematical operations are required for the different stages of the calculation, in their correct order.

The questioning drill in this Exercise will establish the first two levels of the mental re-structuring mechanism. The first is the command level which recognizes a numerical problem and calls the operating program. The next Level determines which types of mathematical operation are required and calls them up at the appropriate point. This technique is familiar to users of computers, where numbered choices are presented on the screen of the VDU.

Sample Lists of questions are given in the Appendix to this paper.

EXERCISE THREE

This Exercise is required to further reinforce the use of the second Level of the mental re-structuring process. It consists of learning to recognize the arithmetical operations required for the solution of a problem when that problem is presented in a written form. Normally two persons would co-operate in the Exercise, but it can be performed by one Student. For the Exercise one requires a List of thirty to forty problems, previously written out. Each problem should contain specific quantities in decimal form.

The Student should be given the sheet with all the problems written out and the Questioner points to one problem at a time asking the Student to state the mathematical methods required for its solution, in their correct order. This Exercise is to be performed until the Student is able to recognize the type of problem with the same facility as he would recognize a cup or a table. With practice it should be possible for the Questioner to point to problems very rapidly and the Student answer them correctly.

EXERCISE FOUR

It is now necessary to establish the next level of the hierarchy of mathematical operations in the mind. Problems like addition and subtraction, when presented to the mind, require certain actions to be taken if they are to be solved. This list of successive actions is called an Algorithm. It is stored in the mind and will operate automatically when it is called up, just like the sub-routine of a computer program.

The first step, as we have seen, is to recognize an arithmetical problem when we see it. The second is to identify the category of the problem, what arithmetical methods are to be used. Thirdly we must call the correct sub-routines by their numbered tags as they are needed. The sub-routines are generalized so that they act impartially on a range, or set, of numbers, containing a limited number of digits (those who have studied algebra will realize how it is possible to generalize arithmetical procedures by substituting letters for variable quantities).

As our mind contains limitless space we can use whole words, instead of letters, for any number - like 'multiplier', 'multiplicand', 'divisor', 'dividend'. Each line of the sub-routine can thus be read off easily (computers use codes for sub-routines to save memory space). Memorizing a sub-routine written in intelligible lines like this is easier. It’s like memorizing a poem by rote. Things to be memorized are 'pushed' on to a 'stack'. This 'stack' is like the spring-loaded tray carriers in a canteen, which sink down as trays are added from the top. Provided you take trays from the top of the carrier, in the reverse of the order in which they were added, there is no problem. The memory is also like this. Recall must work in the reverse order. In pocket computers the memory function may be called 'MEM' or 'STO' (short for Store). It works the same way.

Here is an example of a simple algorithm for addition of three numbers:

1. Visualize the numbers to be added in a vertical column with the units’ positions lined up;
2. Add the rightmost digit of the number at the top of the column to the digit below it and push the answer on to the memory stack;
3. Call the number from memory and add it to the next digit directly below. Push the answer on to the stack;

4. Call the last number from memory. If it has more than one digit, push the unit's digit on to the answer stack. Add the tens digit to the tens digit of the top number. Push the answer on to the stack.
5. Call the last number from memory and add it to the tens digit of the number below. Push the answer on to the stack;
6. Call memory and add it to the tens digit of the number below;
7. Call memory. If the number has more than one digit push the tens digit on to the answer stack. Add the hundreds digit to the to the hundreds digit of the top number. Push the answer on to the stack.

And so on, until you run out of further digits.

The Student has to construct and memorize sub-routines on these lines for the operations of addition, subtraction, multiplication and division. These should then be tested on a selection of problems to see that they give the right answer. The sub-routines should then be memorized and the Student asked to recall them on command at their fastest speaking speed. When this can be done with a minimum of error the Student should be asked to just run through the operations in their mind, first as written down, and then finally as the figures would look while writing down the actual operation.

In order to speed up the questioning and response the Questioner may just point at the sub-routine to be run through mentally, or take them in sequence by clapping his hands, gradually increasing the rate of clapping.

EXERCISE FIVE

This Exercise is a refinement of the preceding two exercises and is in two halves. The first half is intended to fill in detail of the first mental level concerned with the recognition of the category to which a problem belongs, sometimes called the anticipatory schema. The refinement necessary here is to sub-categorize the arithmetical operations in the following manner:

<u>Addition:</u> The width of columns of numbers in digits and the height of the columns in digits;

<u>Subtraction:</u> The number of columns;

<u>Multiplication:</u> The number of digits in both the multiplier and the multiplicand;

<u>Division:</u> The number of digits in both the divisor and the dividend.

For this Exercise thirty or forty problems should be written out on a sheet of paper. The Student should be asked in turn what the category of the problem is and what the sub-category is according to the above list.

The second half of the question consists of breaking each operation down into separate steps. When using long division, for example, the trial multiplications of the divisor to obtain a figure less than the dividend by a fraction of the divisor, which then gives the first digit of the answer, the subtraction of this figure from the dividend, and the repetition of the process to the specified number of significant figures, should all be set down as an Algorithm, as in Exercise Four.

The Student should again be taught to memorize the steps in these Algorithms, so that, when given the problem, they can visualize the verbal steps overlying the actual numbers to be operated on. The aim is to become so familiar with the detailed steps that it becomes possible to see where short-cuts in the method can be made. For example, in adding columns of figures vertically, two or more columns may be added at the same time. Similarly, in division, factorizing the divisor into two digit numbers, may enable the sub-routine to be shortened. In multiplication a basic, four digit, sub-routine module could be used and repeated for longer numbers. When adding the results for the complete answer only one digit may overlap the number above, and addition is thus simplified.

The mode of questioning is similar to Exercise Four, except the Questioner now asks for both the category and the sub-category of the arithmetical operation for each problem. The questioning should be carried out to the point where the Student begins to answer automatically with his inner voice.

EXERCISE SIX

Here again there is a refinement of the previous Exercise. Using the same list of problems the Student is asked to identify qualities belonging to a particular sub-category. The Student, on studying the sub-routines, will begin to have insights regarding the mathematical processes. For example, all even numbers are divisible by two; if the sum of the digits in a number is divisible by three, then the number itself divides by three; if the last two digits divide by four then the whole number divides by four; numbers divisible by five end in zero or five; for division by six the rules for two and three are combined; numbers divide by eight if the last three digits divide by eight; numbers divide by nine if the sum of the digits divides by nine; division by ten moves the decimal point to the left; division by eleven is possible if adding alternate digits gives an equal total. Multiplying two four-digit numbers never gives less than seven digits or more than eight.

The Student should be expected to come up with four or five such insights before moving on.

EXERCISE SEVEN

In this Exercise the Student is called on to use the three Levels of computation already described in a practical way, in order to demonstrate the speed of calculation which results from having algorithms and their sub-routines to work with, instead of trying to remember a vast number of previously worked problems.

For each session, the Questioner should prepare a list of forty problems which involve simple calculations involving one or two digit numbers. The first session of the Exercise should use problems of only one category, say addition. The next session, subtraction, and so on. In later sessions a mixture of categories should be used.

The idea is for the Student to be able to solve the problems just by looking at them. The three levels of computation should be followed by an instant and unconscious perception of the answer. For example, adding eight and five should be instantly perceived as thirteen. The Student should, with practice, be able to answer problems as fast as he can read them, and this should be the aim of the Exercise.

EXERCISE EIGHT

This is a more advanced form of the previous Exercise. The Student should now attempt the instantaneous solution of problems with two digits by two with addition, subtraction and division and three digits by one with multiplication.

EXERCISE NINE

This Exercise is concerned with increasing the symbol space of the Student, which will eventually be required for the simultaneous performance of operations unconsciously. The Student should be urged to perform and perceive two simple problems of the type used in Exercise Seven simultaneously. The same list can be used as for that Exercise and the Questioner should point at any two problems at the same time. Having worked through the problems before, the Student should not need to read them again and will be familiar with them from their position on the list.

When the Student has achieved this simultaneous perception, the harder list in Exercise Eight should be used.

EXERCISE TEN

As an extension of the above Exercise, the Questioner has to prepare several two-digit columns of figures for addition. He should ask the Student to attempt to add up the two columns simultaneously. A sub-routine may first be constructed for doing this, following previous patterns, in which the 'carry' to the third digit makes a separate sum kept on the stack until the end of the addition.

The key to success in this Exercise is being able to silence the verbalizations that are compulsorily elicited when one is presented with a succession of symbols. The complex brain patterns involved with sub-vocalization create a delay loop which slows down the calculation and must be by-passed. The technique for doing this is to create the image of a sound, like middle 'C', mentally, as one would by looking at a piano keyboard, or sight-reading sheet music. This note must then be cancelled by the actual sub-vocalization of the same note 'C'. The effect of this, if done properly, is that all compulsive sub-vocalizations are cancelled at the same time. Holding the two, self-cancelling notes in your mind, look at the two columns of figures. You will then be aware that the process of addition takes on a faster verbalization of it's own, rather like two people talking together, doing the addition for you. When you can do this you have reached the first stage of letting go the calculation to the unconscious mind.

EXERCISE ELEVEN

To practice the same, mind quietening, process, one must again increase the complexity of the previous Exercise. The Questioner should therefore prepare a list of three by two digit multiplications. This may require quite a few attempts before you are successful at suppressing sub-vocalization and you actually hear your inner voices doing the operations. Even if some of the answers are only approximations, you must remember that the operation of the sub-routines is at a higher level of ability than the detailed performance.

It is essential here to retain confidence in what you are hearing and producing by your intuition. If you become self-conscious about the process, it will slow down. Continue with the Exercise until correct answers flow naturally and effortlessly.

EXERCISE TWELVE

This Exercise is a continuation of the above procedure. You will require two, very long, single column addition sums, containing at least a hundred digits. This Exercise must be performed in two ways. Firstly, add the column of figures as fast as you can consciously and secondly, try to make the addition by just running the eye down the column, using the mind silencing technique from Exercise Ten above. Remember that the best method of turning off a mental process is to try to turn it on a bit more, so if sub-vocalization persists, try humming the cancelling note out loud, while attempting to do the Exercise faster and faster.

EXERCISE THIRTEEN

For the next Exercise the Questioner must create an alphabet in which each letter corresponds to a one or two digit number. The Student should then be asked to memorize this alphabet.

The Questioner should then take a short passage from a book and, for each letter of each word, substitute the number from the special alphabet that has been created. The Student should then re asked to read this passage in numbers, substituting the letters from memory. With practice it should be possible for the Student to read the passage, and others like it, straight off at normal reading speed. This means that the habit pattern of reading numbers has been relegated to the subconscious mind.

EXERCISE FOURTEEN

For this Exercise the Questioner must produce eight sets of eight problems. Each problem should be complex, involving combinations of addition, subtraction, multiplication and division. All of the 64 problems should give an answer between one and eight, eight should give an answer of one, eight an answer of two, eight an answer of three, and so on. The problems should be written on separate cards, which can then be shuffled to produce a random distribution of solutions.

The method is for the Questioner to turn the cards one at a time giving the Student just time enough to read them and pronounce an answer between one and eight, apparently by guess. The chance expectation for a correct guess is one in eight, so if the Student gets more than eight correct solutions out of the sixty four problem cards, then the subconscious mathematical ability of the mind is now working.

Re-shuffle the pack and try again until the Student gets at least five out of eight, or forty correct answers.

EXERCISE FIFTEEN

This Exercise is intended to practice the Student in the relationships between numbers and to quicken his responses to questioning in this respect. The Questioner should give the Student a quick succession of numbers, not larger than two digits, and ask: ‘What number is this the factor of?’ ‘What number is this a multiple of?’ ‘What number is this the square of?’ ‘What number is this the square root of?’ ‘Is this a prime number?’ The aim is to achieve an almost immediate response.

EXERCISE SIXTEEN

This is more of a psychological type of Exercise, in that it employs stress to induce an automatic response, rather like throwing someone in at the deep end of a swimming pool so that they will learn to swim more quickly. A person's instinct for survival then overcomes their nervousness and lack of confidence.

This Exercise would work on its own without all the preliminary Exercises above, but it would have to be persisted in for much longer and the performance would not be as good. It works because everyone has some sort of intuitive number mechanism. This can be demonstrated by getting someone to generate a succession of numbers at random. You will find that all the numbers so generated do have a relationship, even if it is quite obscure.

There is, however, a direct relationship between our ability to perform a task consciously and the ability to perform the same task unconsciously. The nervous swimmer with a poor stroke, who is thrown in at the deep end, will have a poor unconscious stroke, and it will be subsequently more difficult to improve it. The same is true for numerical habit patterns. The depth, variety and complexity of our intuitive faculty is limited to the same factors of our conscious response - the intuition is just faster.

All the previous Exercises in this course will ensure a high level of discrimination in response, so that you can handle numbers with precision and make it possible for this skill to become intuitive.

The Questioner should prepare a list of problems with a level of difficulty when solved consciously, for example, multiplication of a five digit by a five digit number. These problems should be given to the Student in this order, and no other. The Questioner should state the problem, the Student must make their mind still by the technique in Exercise Ten, then the Student should give the answer when the Questioner claps his hands. An indication should only be given by the Questioner if the answer was right, not if it was wrong. Each problem should be repeated until the correct answer is given, say up to thirty times, before going on to the next problem. The rate of delivery of the questions should be fast enough to give no time for reflection by the Student.

EXERCISE SEVENTEEN

This last Exercise is intended to reinforce and stabilize the intuitive process. It works on the principle of the Zen Koan. This is a complex problem given to a Zen Student to meditate upon, which cannot be solved by the ordinary methods of logic. If he meditates long enough, the Student will escape the yoke of conscious logic and give an intuitive answer. Only then will the Zen Master proceed with the teaching.

The Koan for the operation upon numbers by No-Mind, or the achievement of re-structuring of numerate mental processes, is to multiply any number of 10-12 digits by a number of similar length. The Student should memorize the problem and spend 15 minutes a day trying to solve it. He must try to recall the operations he has performed and then to recall having recalled them. This problem is of such length that it would take several weeks to solve it by conscious mental arithmetic.

One day, perhaps on waking, the Student will find the number comes to them. They will recognize it as the answer from their intuition. From that point they will be released from the yoke of conscious calculation. They will know any correct answer given intuitively and will have achieved the state of No-Mind for the operation of number.

APPENDIX - SAMPLE PROBLEMS

1. Last Friday was the 4th of the month. It is now Thursday. What date is next Wednesday?

(Addition: 4 + 6 + 6 = 16th)

2. Jo and Bill have 70 coins each. Jo loses to Bill at cards, who now has 113 coins. How much did Jo lose?

(Subtraction: 113 - 70 = 43)

3. Bill bet £5 on a horse at 7 to 1 and wins. What does he get back?

(Multiplication: 5 by 7 = 35)

4. Jo has to pay 68p to get 4 miles to town on the bus. How much is bus travel a mile?

(Division: 68 / 4 = 17)

5. How many days are there in the first 6 months of the year?

(Addition: 31 + 28 + 31 + 30 + 31 + 30 = 181, or 365-3/2)

6. You have £10. You buy bread at 70p, tea at £1.50, Soap at 50p, 3 eggs at 15p each. Can you afford a half bottle of whiskey at £7?

(Subtraction: 10 - 0.7 - 1.5 - 0.5 - 0.45 = £6.85)

7. Jo saves £13 a week from his pay. How long must he save up for a car at £481?

(Division: 481/13 = 37 weeks)

8. Bill's car does 40 m.p.g. on the Motorway and 32 m.p.g. locally. He is 16 miles from the Motorway and must travel another 24 miles from the nearest junction to his destination. His total journey is 270 miles. How much petrol does he use?

(Division, Subtraction and Addition: 16/32 + 24/32 + (270 - 40)/40 = 7 gals.)

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Published by Trans4mind