APPENDIX B

LINKING THEORIES TO THE TARGETED REVISUALISATION PROGRAMME (TRP) AND THE PHONIC INVENTORIES

1.1 Implications of reading and spelling models on the TRP and the Phonic Inventories

The Targeted Revisualisation Programme, as mentioned earlier in Appendix A, is based on a conception of reading, writing and spelling activities introduced in five levels. The decision as to which level of instruction applies initially to the child's needs (i.e., the type of instructional activities to introduce at the outset of remedial instruction) is based on analysis of the errors made by children in the Phonic Inventories and in the other tests used as part of the assessment process. Analysis of the type of errors made by the child, as well as their frequency, is used to establish the type of words to target in the child's programme, as well as an appropriate order of instruction.

Once an order of instruction has been established (i.e., which type of words to mediate first), Levels One and Two in the Targeted Revisualization Programme introduce the child to reading and writing activities intended to mediate and reinforce the use of the target words in sentences and paragraphs, to develop the analytical abilities to read the target words and similar words in context, and to develop the memory capacities necessary to revisualise and reproduce the target words in written language. Levels Three, Four and Five then introduce a wider variety of reading and written language activities intended to develop the child's reading, word analytic, memory and written language capabilities further.

The Phonic Inventories involve three separate spelling tests, given with the aim of establishing the rules the child uses in writing (i.e., how the child uses

the alphabetical principle in creating words). The first inventory enables identification of errors made with words containing short vowel sounds, and various beginning and ending consonant blends and clusters. The second inventory enables identification of errors made with words containing long vowel sounds based on vowel diphthongs and digraphs, while the third level enables identification of errors made when adding morphological features to root words, involving prefixes and suffixes.

There is thus direct correspondence between the three levels of the Phonic Inventories and the first three levels of the programme, with a low predominance of errors on level one of the phonic inventories leading to placement on Level Two activities in the programme, and low predominance of errors on levels one and two of the phonic inventories leading to placement on Level Three activities in the programme. Absence of errors on all the phonic inventories, and absence of errors on dictation tests lead to placement on Level Four and Five activities in the programme, which involve a variety of activities intended to develop the child's reading and written language activities. Mediation of the structure and rules pertaining to English orthography is conceptualised as the focal task of the remedial therapist at all levels in the programme.

In terms of the above programmatic structure, Frith's stages of reading and spelling relate to Levels One and Two of both the programme and the phonic inventories in the following way.

(i) Level One activities are aimed at developing a basic understanding of the alphabetical principle, and in particular a rule system for developing words of one syllable based on short vowel sounds. This stage involves activities aimed at developing a system for analysing and synthesising consonant and short vowel sounds in a variety of target words. The words targeted are words of one syllable involving use of short vowel sounds, individual consonants and consonant blends/clusters at the beginning and end of words. This is done through the introduction of individual words as well as similar sounding (rhyming) words using different onsets and similar rhymes in word families.

These are presented in writing and read by the child, as well as written by the child. Short sentences using targeted words combined with other short vowel words are also written by the child at this stage.

According to Frith's model, it is necessary that the child master the principles of the logographic stage in order to pass on to the alphabetic stage. In order for this transition to occur, phonemic awareness needs to be reached. The child needs to be able to understand that spoken words can be segmented into phonemes and must be able to segment the sound stream and to memorise and sequence sound segments. Similarly, Level One of the programme assumes that a child has reached a level of readiness for reading, and in particular has established a level of phonological awareness. Thus, Level One of the phonic inventories, which targets words characterised by short vowel and consonant blends focuses on establishing Frith's alphabetic skills by first learning to master the logographic skills.

If the initial assessment via the phonic inventories indicates that phonemic awareness is not present, it follows from Frith's theory that the child has not yet reached the alphabetic stage and probably still uses logographic skills. If this is the case, readiness for reading is developed through a variety of exercises (e.g., listening to and discussion of illustrated stories from books and picture stories from cards and comics, auditory and visual discrimination activities, as well as visuo-motor activities involving painting, drawing, and clay which allow for the representation of words and stories in drawing). In particular, the readiness level of the programme aims to develop the child's phonological awareness through rhyming, analysis and segmentation of words, and synthesis of sounds and phonemic segments into words. Once developed, these skills allow the child to analyse three letter words involving a short vowel into their component phonemes and synthesise three phonemes into a target word. These skills, in turn, introduce the child to the sound/letter relationships which form the basis of instruction in reading, writing and spelling later in the programme, i.e., allow the child to pass to the next stages of reading and spelling – the alphabetic and orthographic stages.

Assessment at the end of the readiness level is conducted pragmatically, using a series of logographic activities which determine whether the child can recognise a number of words, and read these in sequence. Between ten and twelve target words are chosen which are familiar to the child. These can vary according to the experience of the child but include nouns relevant to the family and home context (e.g. mummy, daddy, cat, dog), pronouns (e.g. I, me, he, she), participles and verbs (can, will, see, likes), the definite article (the), and the conjunction (and). These tasks introduce a small number of words which form the basis for the child's mental lexicon, so that the child can recognise, from memory, a particular word as being familiar based on its visual features and therefore can have direct access to them. Once a small number of words (between eight and ten) have been learned by sight this has been done, the sounds and their corresponding letters are introduced through a process involving the matching of sound and image.

This form of readiness assessment is consistent with Frith's theory in that the aim of the readiness stage in the programme is to provide a link to the previous stage of listening to the telling and reading of stories from books, sequences of illustrations and picture story books, and to introduce the notion of reading words and sentences, as well as representing the meaning of the sentences and their component words in pictures. The ability to recognise words from their shape and pattern (salient visual or in Frith's terms logographic features) is taken as an indicator that the child is ready to be formally taught the phonic rules on which reading and spelling are based. This forms the focus of Levels One and Two of the Targeted Revisualisation Programme.

(ii) Once competence at Level One has been acquired, as indicated by absence of errors on Level One of the Phonic Inventories, Level Two activities are introduced. These focus on developing a more advanced understanding of the alphabetical principle as applied in the English language, and in particular developing and understanding of the way in which vowels are used in combination in written language. Level Two, in both the programme and the phonic inventories, thus focuses on activities for applying sounds to letters in

words of one syllable involving use of long vowel sounds based on vowel combinations. As with Level One, this is done through the introduction of rhyming words (word families) involving different onsets and similar rhymes. Rhyming aids the child to recognise spelling-to-sound correspondences.
In terms of Frith's theory, Level Two involves more advanced instruction to use the child's existing logographic skills and to be able to develop more involved and complex alphabetic skills and phonological knowledge. This is done by increasing the transparency of the orthography through the introduction of a seven vowel system based on the use of /y/ and /w/ as vowels at the end of words. Level Two and Three of the Phonic Inventories are being implemented during the stage of the programme, and continues throughout the rest of the programme.

(iii) At Level Three, more complex reading as well as paragraph revisualisation are introduced. At this stage, mental imagery is invoked in the learning of spelling through exercises involving the structural and phonemic analysis of words. Once again, both logographic and alphabetic skills are being used, although these skills are becoming more refined and advanced. At this level, all words which are based on more than one vowel (i.e. words of one syllable involving vowel digraphs, as well as polysyllabic words) are targeted. The aim is to identify which letters are working as vowels, and how the seven vowels (a, e, i, o, u in all parts of words, and y and w at the end of words). This is to say that the child is learning to combine logographic and alphabetic skills in a more systematic way by using the auditory and visual cognitive system as well as imagery in a process of committing words to short and long-term memory.

In terms of Frith's theory, the succeeding two levels, Level Four and Level Five, are primarily based on the premise that the child has reached the orthographic stage and is able to apply his or her conceptual knowledge of how the words sound and spelling rules (alphabetic stage), as well as what the spelling of the words should look like (logographic stage) in order to tackle new words they have not seen before. With this knowledge the child is then able to apply imagery and other cognitive processes to enhance his or her

spelling capabilities, and can do so creatively and competently in a structured manner.

However, it is also possible to conceptualise the Targeted Revisualisation Programme from the standpoint of connectionist theory, to which the discussion now turns.

1.2 Linking the connectionist theories to the TRP and the Phonic Inventories

With reference to the 'Targeted Revisualiation Programme', the following will attempt to provide an adequate account, of how connections between input and output are established. In other words, this section will attempt to provide a connectionist account relating to the programme's aim at all levels of developing integrated use of perception, imagery, language and thought. Piaget and his concepts of cognition, which involves separate but interlinked systems, each of which develops over the life-span of the individual are important here. Secondly, this section will provide a connectionist account of the programme's basis in Luria's suggestions that in the initial stages writing depends on memorising the graphic form of each letter, while with practice the structure of the writing process is radically ordered and converted into a single "kinetic melody". Similarly that the processes of reading, spelling and dictation are developmental, depending at their earlier stages on the participation of both the auditory and the visual cortex in the formation of the skills involved in the activities, while at later stages the activities start to depend on a different system of concertedly working zones of the brain.

Piaget

As a biologist, Piaget was interested in how an organism adapts to its environment (Piaget described as part of intelligence.) Behaviour (adaptation to the environment) is controlled through mental organisations called schemes that the individual uses to represent the world and designate action. This

adaptation is driven by a biological drive to obtain balance between schemes and the environment (equilibration).

Piaget described two processes used by the individual in its attempt to adapt: assimilation and accommodation. Both of these processes are used throughout life as the person increasingly adapts to the environment in a more complex manner. Assimilation is the process of using or transforming the environment so that it can be placed in pre-existing cognitive structures. Accommodation is the process of changing cognitive structures in order to accept something from the environment. Both processes are used simultaneously and alternately throughout life.

As schemes become increasingly more complex (i.e., responsible for more complex behaviours) they are termed structures. As one's structures become more complex, they are organised in a hierarchical manner (i.e., from general to specific).

Piaget identified four stages in cognitive development: (a) *sensoriomotor* (infancy) where intelligence is demonstrated through motor activity without the use of symbols; (b) *pre-operational stage* (toddler and early childhood). In this period, intelligence is demonstrated through the use of symbols, language use matures, and memory and imagination are developed; (c) *concrete operational stage* (elementary and early adolescence), where intelligence is demonstrated through logical and systematic manipulation of symbols related to concrete objects; and (d) *formal operational stage* (adolescence and adulthood). In this stage, intelligence is demonstrated through the logical use of symbols related to abstract concepts.

Piaget's research methods were based primarily on descriptive case studies. While some of his ideas have been supported through more correlational and experimental methodologies, others have not. For example, Piaget (1955) believed that biological development drives the movement from one cognitive stage to the next. Data from cross-sectional studies of children in a variety of western cultures seem to support this assertion for the stages of

sensorimotor, preoperational, and concrete operations. However, data from similar cross-sectional studies of adolescents do not support the assertion that all individuals will automatically move to the next cognitive stage as they biologically mature (Riebeck, 1983). For formal operations, it appears that maturation establishes the basis, but a special environment is required for most adolescents and adults to attain this stage.

Piaget's theory is based on his premise that humans have four separate but interlinking systems: language, cognition, imagery and memory. It must be noted that Piaget was not a connectionist theorist, he was in fact a epistemological constructivist, but because of his view that these systems interlink and work to help each other adds to the connectionist ideology of working within simultaneous or parallel relationships.

Piaget (1955) asserts that the verbal and nonverbal are deeply interrelated. Mental imagery, for instance, transcends and proceeds from the internalisation of deferred imitation. Sensorimotor co-ordinations are at their source to some extent that they lead to language. Thus, language is part of a more general cognitive organisation with its roots in action and in sensorimotor mechanisms deeper than the linguistic phenomenon. More precisely language is one element in a set of manifestations resting on the semiotic function of symbolic play, deferred imitation and metal imagery all partake (Rieber, 1983). Mental representations, for Piaget, transcend the here and now as the outcome of sensorimotor intelligence, and it is in a collaboration between biology and psychology (i.e., working together of information transmitted from the physical senses to cognition and memory) that we can expect some kind of progress in our knowledge (Rieber, 1983). Thus, in the relationship between language and the symbolic function, the latter, which includes mental imagery, deferred imitation, etc., plays a fundamental role in the individual formation of concepts. Language, however, undergoes collective and social regulations providing an inter-individual basis and dimension which makes this form of conceptualisation much larger than simple sensorimotor outcomes.

In other words, language cannot be considered alone; it cannot be detached from the total context of symbolic function which entails at least four behaviour patterns which appear almost simultaneously, namely deferred imitation, symbolic play, evocative memory and mental imagery (Piaget, 1955 cited in Rieber, 1983).

Implication of Piaget's theory on the programme

Piaget's point of language, imagery, memory and perception working together in a whole in parallel is of utmost relevance in the 'Targeted Revisualisation Programme'. It is for this reason that the programme emphasizes that the child colour codes and syllabify each of the words, which facilitates revisualisation, or the use of mental imagery, when the child is asked to close his/her eyes and see the word in his/her mind. Therefore, there has been an attempt to illustrate that as the child perceives the words, perception, language and imagery are working together in the system (child's cognition). Mental imagery functions as a supplementary memory code which enhances the probability of correct recall of concrete words. The more vivid the image, the more effective it should be in memory representation. Vividness is important here, because the more vivid the image, the better recall will be. This point has been researched quite extensively in mnemonic experiments (Paivio, 1979; *will add more authors*). This enables enhanced development of the child's memory capacities necessary to revisualise and reproduce the target words in written language.

In other words, the procedures used for invoking mental imagery in the learning process in the programme suggests that the processes of copying ('deferred imitation') and drawing are central to the development of perception and imagery, and that the processes of perception, imagery and language form the foundations on which cognition is based. The child is thus encouraged to draw as well as read and write, using activities in which images and sequences of images related to concepts and stories introduced in the reading programme. For example, at Level Three, the child chooses words from a given passage, of which he/she then analyses, and then revisualises

the word in the context of the passage through the process invoking mental imagery (i.e., sees the word in the mind). This process is aided by using colour coding of vowels and by syllabification. In this way, the child is learning words and committing them to short term memory or 'schemes' in piagetian terms.. During the dictation stage, the child is asked to retrieve the revisualised word from memory and write it down on paper where he/she can see it and read it, first the words individually and then in the context of a short paragraph. In most cases, the child is able to aware when an error is made. When the child cannot remember the correct sequence of letters forming the word, the mediator will ask the child to revisualise the word again as repeated learning and revisualisation enables the child to commit to word into long term memory. Levels Three, Four and Five then introduce a wider variety of reading and written language activities intended to develop the child's reading, word analytic, memory and written language capabilities further

Discovery learning and supporting the developing interests of the child are two primary instructional techniques central to Piagetian theory and teaching. It is recommended that parents and teachers challenge the child's abilities, but NOT present material or information that is too far beyond the child's level. In terms of the Targeted Revisualisation Programme, the child is given carefully chosen and graded reading material of high image value, for example comic books or picture books. Between ten and twelve target words are chosen which are familiar to the child. These can vary according to the experience of the child but include nouns relevant to the family and home context (e.g. mummy, daddy, cat, dog), pronouns (e.g. I, me, he, she), participles and verbs (can, will, see, likes), the definite article (the), and the conjunction (and). These tasks introduce a small number of words which form the basis for the child's mental lexicon, so that the child can recognise, from memory, a particular word as being familiar based on its visual features and therefore can have direct access to them. Piaget also recommends that teachers and/or mediators use a wide variety of concrete experiences to help the child learn. At Level One and Two in the 'Targeted Revisualisation Programme', words are introduced in families and accompanied by sentences, thus putting the words into a context to which the child can relate.

Drawing a picture of what is read helps the child put everything into a context to which he/she can relate, thereby enhancing the revisualiation process. In addition, the child is asked to read passages out loud as well as silently. The child is encouraged to read own material independently (e.g. before he/she goes to bed) and to read in pairs, either with an adult or other children.

Luria

Luria's model of brain functioning is based upon the idea that there exists co-operation and interaction across relatively large anatomical regions which accounts for the control and functioning of all human cognition. He called these groupings "functional units" (as opposed to anatomical units), and noted that there were three functional units.

Although this system denotes three discrete anatomical and functional units, Luria did not mean to imply that they work in isolation form each other. He was aware that, under normal conditions, no part of the brain operates with complete independence. The functional units all interact to produce optimal performance on any task. For example, to read this page, you must have a certain level of wakefulness (first functional unit), plus the ability to see and make sense out of what you read (second functional unit), and maintain some level of control over your attention, intention, learning and behaviour (third functional unit).

First Functional Unit:

This is comprised of the brainstem and the limbic system. It's main function is to modulate AROUSAL and ACTIVATION. Connections from the first functional unit upwards to numerous cortical and subcortical areas of the brain usually provide increased activation of those parts. Downward connections to the first functional unit (especially from the frontal lobes, or third functional unit), usually decrease arousal. Among other functions, this unit also plays a role in attention and memory, in part by processing information according to its salience (relevance, importance and novelty).

Second Functional Unit:

This comprises the posterior cortex, including the occipital, parietal and temporal lobes. (NOTE: The temporal lobes, as a result of their location also play an important role in the 1st and 3rd functional units, but their main role is here in the 2nd unit.) The primary task of this second functional unit involves SENSATION and PERCEPTION. Each of these lobes have primary, secondary and tertiary areas that process sensation and perception at ever increasing levels of integration and meaning.

The primary areas register basic sensory information (sound, light, touch), provided by the ears, eyes and skin. The secondary regions begin to integrate these sensations into perceptions. For example the sensations of light and angles (sensation), become a recognizable object (perception), such as a book., or sounds are processed into words. At higher levels of integration perceptions are integrated, so that one can simultaneously process all of the sensory information of say, sitting at your desk, in your room, with the radio on in the background, doing some homework, while listening to a friend on the phone. (The ability to consciously and effectively perceive all of this information requires some assistance from the first and third functional units also).

The tertiary or association regions of the second functional unit can produce extremely complex integration and elaboration of information which allow us to do many things that we take for granted, such as:

- recognizing a friend's face or name an object
- understanding what you read or write
- interpreting the verbal and nonverbal aspects of communication
- being aware of your posture and your position in space
- visualizing real and imaginary scenes and objects
- seeing, visualizing, dreaming and daydreaming in colour
- keeping letters aligned while you mentally spell a word
- expressing our emotions in various channels and media

This complex integration also allows us to do more complex things such as think in symbols and images, "see" and understand complex inter-relationships, and creatively recombine information

Third Functional Unit:

This system takes the longest to fully develop. It is comprised of the frontal lobes, and it's job is to maintain EXECUTIVE CONTROL over our thought processes and actions. One of its main evolutionary roots lies in the control over movement and other complex sequences of activity. The frontal lobes essentially cannot function independently. They are richly interconnected to every other part of the brain, with especially thick interconnections to the limbic system and first functional unit. Proper functioning of this system allows us to maintain appropriate, focused, organised thinking and behaviour, as well as optimal "cortical tone" (overall level of arousal/activity of the brain).

Executive control selects information and actions which are optimally suited to the ongoing situation. It does this mainly by *inhibition* of unwanted information or behaviour.

It is in this unit where high order organisation and meaning is developed and enhanced, and is responsible for abstract reasoning, pre-planning of movement (such as writing a story), motivation, initiation and follow-through, cognitive flexibility, accurate self-awareness, trial and error learning.

Implications of Luria's theory on the programme

Luria's contention, in essence, is that the higher psychological processes involved in reading, writing and spelling are formed on the basis of development. This involves not only changes in functional structure as of the process, but naturally, of its cerebral organisation. As this relates to the activities in the programme, this is why such emphasis is placed on multi-sensory teaching and on processing and reproducing text of increasing

complexity, as the means by which hierarchical integration is promoted, at the level of both functional structure and of cerebral organisation.

Thus the child learns through progressing to more complex activities in last three stages, that in addition to associating and learning individual words, that words are part of sentences, that sentences form part of paragraphs and paragraphs form ideas within the context of a story. Further analytical and memory skills are taught so as to facilitate decoding and encoding of written language. This is done hierarchically throughout the programme, although not necessarily sequentially (i.e., first short vowel and consonant blends and clusters, then dipthongs and digraphs, etc). In other words, there is a process of increasing complexity which develops in parallel – which suggests the value of mixing and matching between levels of the programme in developing a particular child's remedial programme.

It is thus not only the functional structure of the processes of reading, writing and spelling which change as the child is able to handle activities of increasing complexity in the programme (as evidenced by the child's analytical and memory capacities to use target words in sentences, sentences in paragraphs, and paragraphs in descriptive and creative writing), but also its cerebral organisation. Each of these aspects imply a connectionist basis in the programme.

For example, listening to and discussion of illustrated stories from books and picture stories from cards and comics, auditory and visual discrimination activities, as well as visuo-motor activities involving painting, drawing, clay which allow for the representation of words and stories in drawing, allow for parallel processing of the same information but through different sensory modalities. This is particularly relevant as it pertains to the second functional unit in Luria's theory, which deals with perception and sensation. For instance, at Level Three of the programme, the child both types the words on a computer and/or writes the same targeted words on paper in cursive (kinesthetic memory). Once the number of words have been learned by sight (visual memory), the sounds and their corresponding letters are introduced through a process involving the matching of sound and image (visual-auditory

memory). Thus, each word is processed not just in one or another single way but in multiple ways operating simultaneously – through visual perception (on paper in cursive or typed in a book, or as seen on the computer), kinesthetic movement (writing and typing) and auditory perception (through for example rhyming, analysis and segmentation of words, and synthesis of sounds and phonemic segments into words).

According to Luria, the second functional unit is largely responsible for this, as it functions to integrate sensations[1] (visual, auditory and kinesthetic) into perceptions, perceptions then are integrated so that the child can simultaneously process all the sensory information. However, being a connectionist theory, the second unit does not work in isolation. It needs help from first and third units to stay aroused and focussed and to control what is being perceived, to understand what is being learned, to interpret stimuli and communication and to be able to form mental images.

Thus a word may be identified through one source but its identity may be confirmed by other sources, thus creating redundancy in the cognitive and memory system. This can be illustrated, when a particular word is identified first by sight because lexical access is fast operating. World knowledge and linguistic knowledge may immediately confirm that the word fits syntactic and semantic expectations. Graphophonic knowledge may verify that the word's pronunciation corresponds to its spelling pattern. In this way, reading and spelling accuracy is maintained at a high level by multiple sources of knowledge operating in parallel. Thus, reading and spelling occurs through the updating of connection strengths in the network and by setting of activation after a word or nonword has been presented. This process describes activities in Level Four and Five of the programme.

[1] Visual perception is characterised by spatial properties. The receptors and higher neural elements of the visual system are spatially organised, capable of receiving, transmitting, and processing information simultaneously given in a spatial array. To the extent that visual imagery is analogous to visual perception, it can similarly regarded as a symbolic function specialised for parallel processing in information. Auditory perception on the other hand, is a system specialised for dealing with temporally (serially) organised stimulus patterns. By using both, information is stored more effectively in memory.

At Level Four, the child is encouraged to read a wide variety of books, to plan and write stories and to use written language both descriptively and creatively. This provides outside knowledge to confirm already learned information (redundancy). Imagery is important here too. Writing at this level is used to reflect the ideas we have in our minds, and that these ideas are often also reflected in mental pictures or images. Similarly, stories or descriptions of objects or events can be reflected both in sequences of words, as well as in sequences of pictures which is representative of ideas. This concept is linked wherever possible to the child's imaging process. When the idea or image changes, the paragraph changes. The aim here is to expand the skills of the child in using written language for communicative purposes. Again, if spelling and reading errors are made, these are targeted and mediated using same procedure of mental imagery as in other previous levels, thereby expanding the child's rule system for generating words and text, and a lexicon of words stored in memory to be used in creative writing.

Level Five sees the child's descriptive and creative writing as being integrated, as reflected in the child's ability to use a variety of regular spelled and irregular spelled words, and a variety of language registers, in different reading comprehension and written language contexts. The aim of this level then is to provide the child with English grammar, literal and figurative word meanings, and different language registers so that the child will be able to function independently on a variety of tasks in regular schooling classes.

In terms of Luria, all three functional units are working together in parallel. Unit 1 for arousal and memory, unit 2 for sensation and perception, and unit 3 for executive control of activities.