

The Role of Private Speech as Mediator of
Attention in Problem Solving Tasks among
normally achieving pre-school children.

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The Ontogenetic Development of Private Speech and its Role in Mediating Effective Attention levels, in Normally Achieving Pre-school Children.

Abstract

This research project attempted to test assumptions about the development of private speech and its relationship to attentional modes of engagement, and task performance. Results showed an ontogenetic trend from audible, externalised types of private speech to less audible, more internalised forms, consistent with Vygotsky's assumption that private speech undergoes a curvilinear course of development. Use of on-task private speech was accompanied by greater task attentional focus in the form of motor and looking behavioural modes of engagement and a reduction in non-attention behaviour and successful performance in problem-solving.

"The relation of word to thought, and the creation of new concepts is a complex, delicate and enigmatic process unfolding in our soul." (Tolstoy, 1903, 143, . in Vygotsky, 1986)

A. Introduction

In studying the development of overt mental processes, we seek to explain complex forms of mental activity. Vygotsky demonstrated through the use of the experimental methods, that processes usually hidden beneath habitual behaviour, can be rendered visible and observable (Cole and Scribner, in Vygotsky, 1978). Vygotsky asserted the essential role that speech plays in the organisation of higher mental process enables Psychology to understand the ontogenetic processes involved in the formation of complex mental activity (ibid.). Language becomes integral to the child's development from the first instance that objects are named and defined, creating a new form of experience that can only be achieved through social interaction (Luria, 1959). Not only does this change the child's conscious activity but also the form of the child's thought, since the word requires reorganisation of mental processes creating new forms of attention, memory, thought and action. As such, speech transcends its role as a means of communication, it becomes " a means of deeper analysis and synthesis of reality" and a "higher regulator of behaviour" (Luria, 1959,14)

i. The ontogenetic development of Private Speech.

Private speech refers to speech spoken aloud by children which is neither addressed to a listener, nor produced due to any signs of understanding by a listener; it may be directed to the self or to no-one in particular. (Berk, 1986).

Such utterances are "egocentric", as they have neither been adapted nor addressed to a particular audience (Piaget, in Vygotsky, 1978). These vocalisations are "thought spoken aloud" (Berk 1986, 671) due to the young child's inability to think in purely covert ways (Kohlberg, Yager & Hertjholm, 1968). "(T)he child talks only about himself, takes no interest in his interlocutor, does not try to communicate, expects no answers, and often does not even care whether anyone listens to him" (Vygotsky, 1962 in Wertsch,, in Zivin, 1979, p.79.) The point of view of the audience is not taken into account, but serves only as a stimulus at best (Berk, 1986, p.671).

Vygotsky's exposition of mediated psychological processes emphasises the social origins of speech and language. Originally social or communicative in purpose, speech later splits into

speech-for-oneself, and speech-for-others. Speech splinters from its social function, is transformed from its external genesis, to give rise to both the external and internal manifestations of private speech; early social communication precipitates private speech, and initiates all uniquely human higher cognitive processes (Berk, 1986). This explanation acknowledges two developmental roots in the ontogenesis of language, one representative, the other communicative. The course of language from the social to the mental domain, explicates the shift from an inter-psychological plane to an intra-psychological domain; cognitive functions that are developed through social interaction become internalised at a mental level. Each function in the child's cultural development appears twice; first on a social level, and later, on the individual level; first between people (inter-psychological) and later within the child (intra-psychological). Once well practiced, these processes enable children to think in words rather than vocalise words.

External private speech, which precedes internal speech, acts as a transitory structure, a

bridge between social or communicative speech and internal speech. The transition from an originally communicative function evolves into an individualised inner mental capacity. Inner speech remains a form of speech, no longer an aspect of talking, but a function in itself (Kozulin, in Vygotsky, 1978, xxxviii); thought connected with words, a kind of verbal thought, a psychological interface between culturally determined language and inner dialogue and language. The communicative intent underlying private speech, is not yet differentiated in its communicative function between self and others. The orientation of the young child is thought to reflect the child's inability to engage in silent thought, as well as the mental incapacity to differential between the context of speaking to oneself and to others rather than "egocentricity" (Vygotsky, 1978). Private speech provides the functional basis for inner speech, while its external form is rooted in communicative speech (ibid. 1978), verbal thought is not innate but is embedded in a socio-historical process. The dialectical unity of the systems of practical intelligence and sign use epitomise complex human

behaviour (Vygotsky, 1978).

The assertion that thought derives its existence through words (Vygotsky, 1986) imbues private speech with the role of transforming mental processes; thought does not merely find expression through words, it finds its reality and form through speech. Private speech, both internal and external, while an accompaniment to activity, serves for mental orientation and problem-solving planning. The child learns to master the environment using these utterances to serve as an externalised instrument of thought, a tool for planning, guiding and regulating one's actions. Private speech functions as a plan conceived but not yet realised, and assists regulation and control over action. The relationship between environment and behaviour is altered through the involvement or use of signs in a typically human manner. Speech, and accompanying goal-directed action, both constitute part of the same complex psychological function that is directed towards a common solution. Children solve tasks with speech as much as with their eyes and hands (Vygotsky, 1978). Speech emancipates the child's operational thinking from the concrete dimension,

and thereby facilitates planning, solving the problem through speech first, then through motor action.

"The most significant moment in the course of intellectual development, which gives birth to the purely human forms of practical and abstract intelligence, occurs when speech and practical activity, two previous completely independent lines of development," (Vygotsky, 1978, 24)

Through the mediation of speech, the child is both subject and object of his or her own behaviour. In Vygotsky's conception of a system of signs, the entire psychological process is reconstructed on a totally new basis where the use of signs and language guides the child to master the environment using an internally established connection between the stimulus and the corresponding sign (ibid. 1978). The original role of speech, upon its conversion to inner speech, comes to organise thought, and assumes an internal mental function (ibid. 1978). Although socially grounded, these processes become part of the child's independent developmental achievement. Language empowers the child to take the role of other, enabling a

reciprocal awareness of the utterances of others as well as one's own (Mead, in Vygotsky, 1978).

Children using private speech, are only able to see themselves from the perspective of others, and do so by describing their activities. In the process they begin to differentiate the speaking-self from the talking-to-self (Berk and Garvin, 1984). Kosulin observes a "striking similarity" here between G.H. Mead's "concept of significant symbol" and Vygotsky's "struggle for consciousness" as higher mental functions that are products of mediated activity (Introduction by Kosulin, in Vygotsky, 1978). Language assumes an additional function as a mechanism for role-taking, and reciprocal interaction in addition to the socialisation of thought. Speech that has been internalised, sanctions dialogue with the self (internal dialogue), which has been facilitated by the capacity to take perceive oneself from the perspective of others. In this sense the communicative nature of speech is applied to the self as the child engages in an "internal collaboration with (the) self" (Vygotsky, 1960, 450). The purpose of directing speech to oneself is

understood to be a means of thinking out aloud, of guiding one's own activity. In this form, inner speech is self-directed as opposed to describing own activity, another function of inner speech. Both internal and external forms of speech are best understood as part of a dialogue in which the child realises the meaning of actions and roles by taking both sides of a dialogue. Understood this way, external private speech assumes three underpinning types, that of describing own activity, of self-dialogue and of cognitive self-guidance. Conceptualised hierarchically, Mead's interpretation shifts ontogenetically from "describing" to "dialogue" onto active guiding (Kozulin in Vygotsky, 1978). Findings of a similar developmental hierarchy have been consistent with this (Kohlberg et al, 1968).

The ontogenesis of speech develops from a pre-intellectual speech and preverbal level (when speech is nonintellectual and thought nonverbal), to an application of the use of tools, the use of grammatical forms and structures, to the emergence of egocentric speech, then finally to the stage of "inward" or "underground" speech (Vygotsky, 1978).

External speech or egocentric speech is typified by utterances vocalised to the self, whereas internal speech is illustrated by the child who can count mentally, operating with relations and inner signs. The internal reconstruction of an external operation ("I need a red") exemplifies the process of internalisation. This arises through a series of developmental events, changing from an external operation until reconstructed internally, with the support signs (Vygotsky, 1978). Different types of private speech utterances, within both the categories of internal and external speech, are thought to fluctuate in frequency, in relation to this course, depending on their regulatory function. The observation of similar stages, from egocentric speech in the presence of peers as a collective monologue, to the point when the child assumes his egocentric talk is understood by those nearby, implies consistency in ontogenesis between Piaget and Vygotsky's accounts, in spite of their differences in interpretation. (Piaget in Vygotsky, 1986, 231). Egocentric or external private speech, like social speech is audible, and while it is functionally different from

social speech, this aspect presents difficulties for differentiation between the two. Its expression is social, but it functions as inner speech. Early private speech accompanies the child's actions and reflects the problem solving processes through which the child is working. Later it precedes the action, as an aid to a plan that has been conceived and is to be put into action. Just as the younger preschooler labels a painting on completion, private speech accompanies action.

Internal speech

With cognitive maturity, speech becomes internalised as verbal thought (Berk, 1986). Speech is internalised psychologically before it is internalised physically; external private speech becomes inward once its function changes. Private speech does not merely accompany activity, it serves for mental orientation in overcoming difficulties. Its disappearance does not signify its demise, since it is only the aspect of its vocalisation that has diminished. Having developed structural and functional properties that differentiate it from social speech, verbalisation no longer serves its function, and falls away. Speech for oneself,

renders vocalisation unnecessary and meaningless as its purpose becomes increasingly differentiated. In the same way that a child who counts mentally, no longer needs to count on fingers, the faculty to think words instead of verbalising words, accompanies increased abstraction from sound.

Private speech must therefore be understood ontogenetically, not as a single unitary phenomenon, but as one that undergoes changes in its structural hierarchy. Through different stages of development we gain insight into the cognitive processes that accompany and guide speech (Wertsch, in Ziven, 1979). Ontogenesis involves the simultaneous intermingling of operations from more than one force of development (Wertsch, 1979), namely a "natural" or "biological" one, and a "social line". For example, in the early stages of development, a child's attention would be part of a natural or primitive period, since attention here is a function of the child's general organisational development, "part of the structural and functional development of the central nervous system" (Vygotsky in Wertsch, 1985). When the two lines merge into a socio-biological plane in the development of speech, it

must be viewed in terms of the interrelationship between natural and cultural forces, as they mutually transform one another in an "emergent interactionism" (Kohlberg and Wertsch, 1987). The introduction of a psychological tool or sign-like language causes a fundamental transformation to a mental function like attention, as well.

Private speech is a problem solving tool or a scaffold to learning (Berk, 1986), functional, adaptive and may be used by some children more or for longer than others. Internalisation of private speech is paced by mental maturity (Berk, 1986, Frauenglass et al 1985, Kohlberg et al 1968). Speech at the level of describing own behaviour is not yet fully directive in function, may consist of abbreviated utterances, and operates at an early stage of internalisation, but does not intend to be social, nor is it addressed to anyone else, and is inextricably linked to action; speech and behaviour are bound together as two aspects of a single phenomenon at the early stages of private speech. Private speech serves a developmentally positive parasocial function (Berk and Garvin, 1994). Children who use self-directed speech use it to give

themselves directions, to remember, to plan future acts, maintain sequences in memory (ibid. 1968) and as such the purpose of inner speech appears to improve cognitive functioning. This is attributed to the shift from a form of inter-psychological functioning where social speech emerges with an increasingly intra-psychological function through its self-regulative role (Vygotsky, 1956). The child takes a step towards the ability to carry out goal directed actions when he applies and carries the process to an intra-psychological plane, that was once only carried out on an inter-psychological plane. Self-guidance becomes more condensed with fewer social communicative features in later development. The rise in the percentage of private speech during the ages of two and four years, has been attributed to an increase in cognitive growth (Vygotsky, Luria, 1961), which, in turn, was ascribed to emerging internalisation due to an increased capacity to guide and discriminate one's actions, and to plan or precipitate action (Kohlberg, et al, 1968).

The naming process, whether it refers to a painting, task or plan, is an important ontogenetic

step in the process of internalised verbal thought. It is neither coincidental nor surprising that the planning function of language in problem solving tasks, or the ability to apply labels to paintings yet to be painted, and the internalisation of counting and sequencing all mature at very much the same developmental age. The timing of private speech utterances appears to be as crucial to its development as to its type. By preceding action, private speech assumes the role of planning, orienting and guiding, which are characteristic of verbal thought. In this way, private speech provides a transitional interface between vocal and inner language, where language and thought overlap. It is part of the transformation process through which verbalisation becomes a tool for cognitive development. *"It is no accident that speech turns out to be used first as a means for accumulating experience and later as a means for liberating the agent from concrete conditions so that it is possible to focus on the conditions necessary for carrying out an action"* (Fuson, in Zivin 1979, 153). The planning function of speech is illustrated in problem-solving tasks. Signs and words, initially

used for social contact, become the basis of a new, higher form of activity. The shift though subtle, is significant as speech changes its role from accompanying to planning. While rooted in the socio-cultural history of development, each has its own genesis for each child. (Vygotsky, 1978). Verbal thought is qualitatively unique in that once it has arisen, it cannot be reduced to prior speech or thought independently (Kohlberg and Wertsch, 1987). Prespeech intellect as an elementary process becomes a mediated psychological process that cannot be the same: "At seven years of age we see a form of speech that is almost 100% different from the social speech of the three year old in its functional and structural properties (Vygotsky, 1956 in Kohlberg and Wertsch, 1987.) When this speech disappears (about 7), externalised speech diminishes, becomes fragmentary and appears only in reduced forms (Luria, 1961).

The child has come to perceive the world through speech, all experience of the environment is controlled by a complex mediated process. Speech becomes a vital part of any cognitive process and subsequently all mental development. Perception

assumes a verbal dimension not only a visual one. Private speech has a distinctive course of development in terms of chronological and mental age, in that it can be understood as a "way station" between outer speech and internal thought and self-control (Kohlberg, et al 1968). Not only does the course of private speech alter in its ontogenetic development, it may also alter in the sense that different types of private speech represent different developmental structures with common self-defining or self-communicative functions (G.H. Mead). The curvilinear relationship of private speech categories in association to age indicates that private speech is common among 4 - 6 year old children, and declines thereafter, once children are capable of internalising logical thought (Kohlberg et al 1968).

Ontogenetically, speech moves from a very expanded form to an increasingly abbreviated one before becoming "internalised" and "subvocal or underground". This progression reflects the formation of a new type of mental activity, and may have only disappeared in overt form but may retain its intellectual role and regulative function

internally. By tracking the transformation from external to inner speech, we can hypothesise that, in becoming more abbreviated, inner speech possesses quite a different structure from external speech; the expanded audible form becomes whispered, fragmented and condensed. The predicative character of inner speech indicates that the problem solver understands the given and does not need to be signalled through speech and focuses upon the new. (Luria, 1982). In their relationship of "emergent interactionism", Vygotsky viewed language and thought as arising from different roots, but merging in their ontogenetic development. "Thus they do not die away but evolve, their development is inversely related to the coefficient of egocentric speech," (Vygotsky, 1956, 345). The demise of external speech brings about a proportionate rise in unintelligible self-directed speech, such as inaudible muttering. As private speech becomes differentiated from social speech, its own functional capacities progress from describing ongoing actions to be guided by conscious goals; internal private speech becomes more concerned with formulating and executing actions which require

decontextualised representation. Evidence of a proportionate increase in private speech that is self-regulating with age, includes planning and selecting rather than pointing and matching. Berner (1971) and Klein (1864) found no significant decrease in the number (as opposed to amount) of private speech utterances with age, while Fuson (in Zivin, 1979) found a higher incidence with 2 year olds than older preschoolers.

It is imperative, for Vygotsky, that the ontogenetic process of language and thought be perceived as a dynamic one, not merely an unfolding of behaviour (Kosulin, in Vygotsky, 1978). The role of language as a psychological tool that helps to form other mental functions like thought, cannot be reduced to a uni-dimensional level. Such a process is subject to upheavals, changes and reversals as interacting factors like higher mental functions, cultural development and mastery over one's own behavioural processes fluctuate and change. Increasing mastery over action is facilitated by the regulatory role of speech with other forms of engagement with task. Language, both a mental function in itself, that undergoes its own cultural

development, and a form of mediation, must also be understood as a mode of engagement. The role of speech as regulator or mediator, occurs within the context of engagement in a task, incorporating higher mental processes that facilitate the task. In a unique and dynamic way, speech operates in association with supporting modes of engagement that facilitate the task.

ii. Modes of Engagement

a. The role of Speech in the function of attention

"Any function in the child's cultural development appears twice, ... on the social plane, and then on the psychological plane ... This is equally true with regard to voluntary attention, logical memory, the formation of concepts and the development of volition." (Vygotsky in Kohlberg and Wertsch, 1987)

Attention plays an integral role in learning, by enhancing selectivity, maximising the intake of information and subsequently affecting performance in cognitive tasks. Higher mental functions like attention do not act in isolation to other mental, perceptual and linguistic processes. Many infant utterances are "attentional vocative" (Bruner, 1983, 80) in the manner in which they use speech to refer

to objects. The word specifies that there is something somewhere to attend to. Such instances or expressions like "look" or object highlighting are alerting signals to the child to shift attentional focus. Verbal strategies that are attentional in their functioning bring modes of engagement together in their mutual support and goal. Speech assumes the role of a signal for "something to look at" (Bruner, 1983, 73). Looking behaviour takes the form of searching for a target and maintaining a focus on target becomes a specific form of attention management. Motor behaviour accompanies looking with behaviours like pointing, or the emergence of "primitive marking systems" for singling out the noteworthy (ibid. 1983, 75). Language assumes a new function in directing attention to objects by naming them, describing their perceptual properties, like colour or size, or referring to their locations ("the next red", "after the red is blue"). External speech utterances not only describe or direct, they assume an additional function through engagement, now directing attention in a verbally stated way. The speaker directs his or her own attention to the relevant object by vocalising about that task, or

vocalising while actively engaging in the task. In this sense, speech takes on another mode of engagement with the task.

Speech attracts attention from a very early age, and has the impact of inhibiting other processes or responses by acting as a social stimulus for orienting responses. (Wertsch in Luria, 1982). The indicative function of words assists the child in mastering attention, creating new "structural centres in the perceived situation" (Vygotsky, 1978, 35). As the child classifies objects through the use of words, comparisons between objects based upon the physical attributes of the object (concrete properties such as size, shape, colour) are singled out. The word serves both a referent and semantic role, its dual functions of referring to an object or property, through which various features of the object are isolated or generalised, as well as its function as a means of social interaction. Speech thereby fulfils the purpose of engagement with the task or object, as well as focusing other forms of engagement onto the said activity. The ability to assign words or signifiers to objects requires the

capacity for mental representations and processes for spatial indexing (ordering of colour) and a dictionary of words that can assist the perceptual process (like colour, size or number). The ability to focus attention on given objects (whose attributes may or may not be more compelling) to the exclusion of others in the environment imbues speech with the role of verbal orientation (Luria, 1961). Labelling is a prominent form of speech in young children applied to single out the object of interest and focus perception in the visual field. In time, the child begins to perceive the world through the mediation of speech, not only visually . The result is that the previously "natural, involuntary" process of attention becomes a complex mediated process. Looking at the object, or engagement with the task, becomes inextricably integrated with the spoken word; looking or task engagement form an interwoven relationship with speech engagement. Speech that focuses a child's attention, regulates action, over a long and dramatic developmental period from the second year of life (Luria, 1982, 91) until verbal engagement, task engagement and looking engagement become

inextricably interwoven in every attentional episode. "The speaking child has the ability to direct attention in a dynamic way" (Vygotsky, 1978, 36). An attention system incorporating higher level control, planning and self-regulation has been found to operate in preschoolers, or children under the age of seven. (Richards and Gibson, 1997).

It is imperative that the dual function of speech as mediator of alternative modes of engagement, and speech as a mode of engagement, in itself, be distinguished. This study recognised the dual role of speech as a mode of engagement and mediator of thought. In line with the traditional assumptions concerning private speech, utterances were categorised (according to Kohlberg et al, 1968, Berk and Landau, 1983, Berk and Garven, 1984, Frauenglass and Diaz, 1985) as:

1. External speech referred to speech that is vocalised and addressed to no-one in particular, other than perhaps the speaker, a kind of "self-speech". The types of utterance expected in this category were word play, sounds, singing, affect expressions, describing and self-guiding comments, which were either on-or-off-task centred.

2. Internal Speech was coded when the spoken words appeared to have "gone underground", and only the fossils of speech remain in the form of lip and tongue movements or inaudible muttering. Since the content of internal speech is not apparent, it could not be referred to as on or off task speech. Given the assumptions of the ontogenetic course of private speech, however, it was assumed to be task-centred.

3. Social Speech referred to speech directed to another, whether peer or teacher, and coded as on-or-off-task. On-task Speech instances (both Social and External), which centred on the task, were considered indices of speech engagement. The content of speech indicated whether the utterance was off-task. Speech is used to invoke attention by labelling and drawing the focus of attention onto the assigned object.

b. Looking Engagement as a Mode of Attentional Functioning

"Attention serves to specify, amplify and expand distinctions that the child already has about the world." (Bruner 1983, 30). The ability to direct attention is essential for determining successful completion of practical operations (Vygotsky, 1978).

The attentional demands of a task requires that the child actively determines what is central above all other elements in the perceptual field. A selective process, attention is predicated upon a response to a specific event or stimuli, and inhibited response to simultaneous events; attention is essentially a process of differential targeting of stimuli for the intake of information. Central to the targetting and selecting process is the mode of looking behaviour. Looking is essential to the attentional act. Differentiated levels of attention can be understood in terms of different modes of engagement, where looking is a central act. Focussed and selective attention requires the capacity to withstand competing distractions, and control strategies are needed to plan, programme, and regulate goal-directed behaviour (Sohlberg, 1989). In terms of looking indices, this necessitates regulation of looking behaviour in a goal directed way. On a continuum of control over situational factors, the five levels of focussed, sustained, selective, divided and alternating (or lapses) attention illustrate the key role looking plays in directing attention.

Essentially, focussed attention refers to the ability to respond discreetly to stimuli, where the relative proportion of looking behaviours indicates the degree to which focussed and selective attention has been applied in a goal-directed way. Divided attention applies when the subjects can manage the task with more than one kind of activity simultaneously with skill and the appropriate motor response and use of memory. The conditions of a naturalistic setting dictate that subjects have the capacity to apply divided attention to a task. Wertsch (1975, in Zivin, 1979) reports on the ability of 4 year olds to do two things simultaneously, such as scanning a room while remaining involved in the task (divided attention). Lapses of attention or lowered alertness to the task are examples of non-attention. Here attention is variable or disrupted, and the focus of looking is maintained for only a brief period; there is an inability to manipulate information or to hold information in memory for the task and the child is drawn off task by extraneous irrelevant stimuli, whether external or internal.

Evaluation and singling out elements of relative importance is necessary for effective

attention. The ability to verbally control the perceptual field enables the child to reorganise what was or is being attended to. This demands the capacity to reconstruct separate activities that are part of the required operation, so that the field of perception is no longer tied to the visual field, but is a component of a dynamic series of psychological activities. This aids the function of memory, since signs in the form of the word allow for intention and symbolic representation of purposeful action. Attention supports the evolution of these functions. Research has indicated that differences in active processing during engagement vary from focussed to casual attention depending upon the active nature of processing stimulus; attentional phases are separable and distinguishable during engagement and are not expressed as a single fixation episode. An attentional episode is comprised of a shift from stimulus orienting to sustained attention and completed with attention termination, and the application of supporting modes of engagement in the process. Different components of attention including alerting and encoding, appear to have different psychological mechanisms

underlying them. Attention is controlled by certain neural processes, arousal or physiological responses to stimuli, activation or tonic physiological readiness to respond, and an effortful coordination of arousal and activation (Posner and Boies, 1971 in Ruff, 1986). Arousal, alertness, and orientating signify a change in the state of attention when initiated by a change in environment and are indicated by changes in behaviour and modes of engagement. The alteration in state involves both physiological and behavioural processes, thereby facilitating the intake of information. Active manipulation of an object in synchrony with looking engagement both act as indirect measures suggesting the arousal and alert states expected in attention during the processing of information.

This research project differed from past studies by conceptualising attention in terms of behavioural indices representing three modes of engagement, namely speech engagement, task engagement (in the form of motor action), and looking behaviour, rather than focussed, divided or moderate and non-attention. Attention was therefore understood in terms of modes of engagement, that

harness the subject's capacity to attend to the task at hand. As a mode of engagement, speech assumes an indicative function through the use of the word. Task engagement exemplifies attention to the task using motor action; indices indicating task engagement involve the active manipulation of objects have been interpreted to imply engagement with task. Examining, as opposed to other activity, is hypothesised to reflect focussed attention and the active intake of information (Ruff, 1986). "(L)ooking, usually, some combination of fingering and turning the object around, and an intent expression on the face" typify behavioural indices for both looking and task engagement (ibid. 1986). Motor actions and looking behaviours were observed and coded according to their contribution to the task solving process. Where task engagement involved active manipulation, looking engagement was inferred from indices of looking behaviour that imply direct visual processing of the object or task at hand.

Looking behaviour, therefore, was categorised according to the selected area in the subject's perceptual field, to the exclusion of other events

or stimulus. Past studies (Berk and Landau, 1993) applied Pechman's conception of attention (1978) (adapted from the Conner's Teachers Scale, 1969). A continuum representing focused, moderate and diverted levels of attention, in synchrony with Sohlberg and Mateer's typology (1987) have indicated the corresponding level of vigilance or distraction from the task. Such a classification system is subject to interpretation of observed behaviours, and the overall attention type of individual subjects, is assigned to an exclusive category. Recorded data indicates the inferred type of attention rather than the mode of engagement itself, and overlooks the relative contributions of different modes of engagement. In this study each speech utterance was recorded in conjunction with an index of behaviour signifying the mode of engagement, thereby recording speech, task and/or looking engagement. In this way, the continuing stream of attentional behaviour and its relationship to speech utterances was captured. Every shift in engagement, regardless of its relationship with speech or other modes of engagement were recorded. A tripartite approach to attentional behaviour was

adopted, incorporating all three modes of engagement and their mutual relationships with the assumption that attention is not a unilateral behaviour:

- (1) Looking at the object implied direct engagement with the task when the subject was observed looking at beads, string or model. Looking at others, referred to looking at the instructor with an intent expression (2) Or to peers with an intent expression (3). Looking elsewhere, without visual engagement with the object was referred to as non-attention (4).

c. Motor behaviours typifying of task Engagement

Motor behaviours included as a mode of task-engagement were organised according to the focus of motor actions. Unlike Pechman's classification of Self orientated, task orientated and Communicative motor behaviour, motor behaviour was categorised according to indices of behaviour (in relation to engagement with task) as:

- (1). Self Engagement.

Motor actions directed to the self which have no apparent or direct contribution to the task were referred to as self-engaged motor actions. These include self manipulating the body (1), and rhythmic

movement of the body parts (2).

(2). Task Engagement.

Motor action in pursuit of task performance was termed task engaged behaviour. Engagement that was part of the process of task completion included these types of motor actions : Pointing (1), Selecting (2). Matching (3), executive actions (4), and communicative gestures related to the task. (5).

(3). Non-Engagement referred to actions including gross body movements (1), or manipulating the object in ways inappropriate to the task (2), or communicative gestures unrelated to the task (3).

iii. The ontogenesis of attention

"Any function in the child's cultural development appears twice, ... on the social plane, and then on the psychological plane ... This is equally true with regard to voluntary attention, logical memory, the formation of concepts and the development of volition" (Vygotsky, 1978 in Kohlberg and Wertsch, 1987.)

Elementary mental functions, particularly attention, are "totally determined by stimulation from the environment" and have the capacity to be transformed into higher mental ones through "self-generated

stimulation, that is, the creation and use of artificial stimuli which become the immediate causes of behaviour" (ibid). The integration of linguistic mediation produces a major qualitative change in the functioning of a mental process like attention. Higher mental processes that are mediated by speech can be expected to follow an ontogenetic course; if speech plays an indicative role in regulating attention, then modes of engagement that signify attentional behaviour may be assumed to evolve and mature in their development. Recent studies (Ruff and Lawson, 1990) have demonstrated an increase in attention during the period between two and six years of age. They hypothesised that the increase between these age levels, should be accompanied by increased levels of attention. Their results showed that the children sustained focused attention as they grew older. Moreover they discerned a distinction in the quality of attention as the child or infant became more accustomed to the activity or object. For instance, divided attention was more likely to occur after considerable time had been spent on an activity rather than initially. This is attributed to the appeal of the physical

characteristics of the objects initially, and the capacity to apply greater abstraction to the task with time. The change in attentional capacity was speculated to be an increase in powers of attention that accompany increasing chronological maturity. An independent manifestation of cognitive development, the increase in attentional power could either be due to increasing chronological maturity, or increasing complexity of the demands of the activity or play. Ruff et al (1990) speculate that the higher frequency and longer episodes of attention recorded amongst the older children are related both to the children's growing ability to generate more elaborate activities and to increased self-regulatory skills. An understanding of the regulatory role of speech in the ontogenesis of attention necessitates that the course of speech engagement and its association with modes of engagement be analysed. A trilateral understanding of the nature of attention was therefore adopted, where the relationships between modes of speech, looking and task engagement were examined. A deeper analysis of the constituents of each mode of engagement was explored to elucidate the dynamics of

attention.

As attention becomes more controlled, and regulated by other mental processes, including speech, it is referred to as voluntary (as opposed to "involuntary or natural attention") (Vygotsky, 1978). "Voluntary attention is an exertion of effort in activities which are selected by current plans and intentions" (Ruff et al 1990, 53). Individuals who exhibit such effort should therefore have reduced resources with which to attend to stimuli or information that occurs outside the attended event or performance, and be subsequently less distractible. The transition from involuntary attention to become the higher mental process of voluntary attention involves deliberate control and awareness as the child intellectualises the function and controls it in the process of higher mental functions (Vygotsky, 1986). Attention is part of the process of consciousness as it structures what is perceived and remembered, as it permits an awareness of the activity of the mind. Voluntary attention, then, in comparison to involuntary attention, is socially constructed through the social mediation and language. The function of

attention is initially involuntary, and becomes controlled as the more relevant elements in our world are focussed using mediation through language. At this level, a social one, mediation is inter-psychological, but once the child comes to control attention and it assumes a voluntary dimension, it is internally mediated, and operates at an intra-psychological level. Involuntary attention becomes culturally mediated as the child internalises social experiences. The evolution of higher psychological processes involves conscious realisation and voluntary control, including voluntary attention. Psychological tools enable mastery over natural forms of individual behaviour and cognition (Kozulin in Vygotsky, 1978) and in likewise fashion, speed aids voluntary attention. Psychological tools like language are internally oriented, "transforming the natural human abilities (like involuntary attention) and skills into higher mental functions" (Vygotsky, 1978, xxv). Lower "natural" or biological functions like elementary attention shall be transformed according to human social goals and conduct through psychological tools.

iv. Research on the relationship of Private speech and attention

For Vygotsky and his followers, the functional use of the word as a means of focussing attention and selecting certain features for analysis and synthesis, is the central role in concept formation (Vygotsky, 1986). Concept formation demands many basic intellectual functions, including attention, but these are "insufficient without the use of a sign or word" (Vygotsky, 1986, 106). In this way words direct our mental operations, control their direction and provide a conduit for the solution to the problem encountered. It is not simply the speech that is important, rather it is the psychological processes that occur internally (Luria, 1982). In this sense, language merely serves as a tool or mediational means to enhance psychological activity, and is not restricted to speech activity. Berk (1986) found that higher levels of private speech were more positively associated with focussed attention, and lower levels of private speech with distracted types of attention. According to the three levels of private speech, in its ontogenesis towards inner speech,

subjects using more lower levels of private speech, were more diverted from the task, and spent less time focussing on the task. At the second level, attention was moderately focussed, on the whole, and at the third level, attentional behaviour was more focussed than at the earlier levels. In terms of her hypothesis, the use of private speech is related to more self control in children, and more focussed attention on the task at hand. Speech, then, cannot only be understood as a means of regulating thought through the forms of private speech as a mode of engagement with the task, it can also be conceptualised as a mode of engagement in the same way as motor engagement is. The progressive internalisation of private speech is accompanied by cognitive changes that should produce behavioural changes to facilitate efficient task solutions including sustained attention and inhibition of bodily movements (Berk and Landau, 1983).

We can study inner speech or verbal thought while still in its overt form while its structural properties are yet being shaped, while speech is audible and accessible to observation and measurement. According to Vygotsky, externally

mediated activity functions as a means to accomplish a goal. Higher mental functions like cognition, memory and perception, are mediated by signs, once external, but like language, become internal, shaping the consciousness of the user. Mental processes like cognition can be understood in studying the tools and signs that mediate them in their interfunctional links with processes like attention. The tools and signs affect the activity and the relationship between functions. Private and inner speech function to plan and regulate the activity or task under scrutiny by monitoring, controlling and organising structures.

v. Hypothesis

Examining the role of private speech in the development of higher mental processes, requires not only an understanding of the ontogenetic course of speech, but also its dual role as a form of engagement, and its reciprocal interplay with supporting modes of engagement. It was therefore hypothesised that:

1. Private speech follows on ontogenetic course of development with age, shifting from predominantly external speech at the age level 1, rising to a peak

at age level 2, then declining at age level 3, when more internal forms of speech predominate.

2. Modes of engagement in the form of looking and motor indices of behaviour will increase with age in problem solving tasks.

3. There will be a close relationship between the ontogenetic development of private speech and different modes of engagement. Private speech will play a role in regulating or mediating engagement.

4. Successful task performance will be enhanced by the production of private speech.

B. Method

i. Factors in the Problem solving context

a. Situation

The "scarcity of private speech is an artifact of the typical research paradigm" (Frauenglass and Diaz (1985, 357). Certain situational contexts increase the rate of private speech; the use of laboratory tasks are associated with minimal verbal mediation (Berk, 1986). Where the task is undertaken in relatively unfamiliar settings, there is a relatively (in terms of percentage) small

amount of private speech (Zivin, 1972). Production of private speech increases in a setting given the illusion of understanding by others, the presence of potential listeners (collective monologue) and vocalisation (Vygotsky, 1956, in Wertsch, 1987, 205). In support of the parasocial origins of private speech, most studies report that correlations are higher in the presence of peers and social participation (Berk and Garvin, 1984). The actual amount of talk may not be as important as the content (Chi et al, 1989), or the context. Dyads talked more than children alone, and were consistently higher in their scores (Teasley, 1995). The presence of others, especially peers, may have the desirable effect of producing a greater amount of speech; the relationship of private speech to sociality is generally positive (Kohlberg et al, 1968). This implies that more social children are more likely to engage in more mature private speech. In fact, children characterised as more social emitted more mature forms of private speech (Berk and Garven, 1984). Sociality refers rather to social context, where more speech is elicited. Most studies involving children's peer collaboration

studies, report two categories of children, those who talk, and those who don't, and work silently (Teasley, 1995). Whether the choice of partner is a factor, or whether some dyads rather than individual children, work without talking was not evident, but merely placing children together doesn't ensure talk or collaboration. Alternatively, there is evidence that talkers are less successful than non-talkers on the whole (Frauenglass and Diaz, 1985).

b. Choice of task

An attempt to relate Piaget's stages of cognitive development to estimates of attentional capacity has been made (McLaughlin, 1963, in Chapman, 1997). Children's ability to reason is constrained by their limitations in simultaneously attending to concepts. Corresponding to Piaget's stages, each level is characteristic of children at different stages of cognitive development. At the first level at the sensory-motor stage, it might be assumed to be characteristic that a child can only attend to one concept at a time and draw no inferences. In keeping with this, our research aimed to introduce only the concept of colour in the bead threading task to the youngest age group. A

child at the preoperational stage, however, would be assumed to be able to attend to two concepts, make comparisons, and draw rudimentary inferences involving identity and difference, hence the size and colour of bead were differentiated. A child at the concrete stage of operations would attend to four concepts simultaneously, and make subtle comparisons involving graded similarities and differences. The introduction of number as a construct necessary for the completion of the task was included with colour and size for the oldest group. In summary, the qualitative difference between children's reasoning would be accounted for in terms of quantitative measures. The bead task in our project attempted to approximate this line of conceptual development, from the attribute of colour, to colour and size, to colour, size and number.

c. Level of Task Difficulty

Children who are able to solve a problem or complete a task independently, are assumed to be operating within the zone of their actual development; the task could be described as age-appropriate. Should mediation be necessary, they

are assumed to be operating in the zone of proximal development (Vygotsky, 1978). Failure to complete the task correctly implies that the activity was beyond the subject's zone of actual development, whereas success implied it was within their capacity.

d. Task Success

Inconsistent findings, (Fuson, 1979, Frauenglass and Diaz, 1985), have led to the argument that either private speech increases with difficulty (Kohlberg et al, 1968) and facilitates success in problem solving, or that as difficulty increases, the prospects of success are diminished and the incidence of private speech cannot be seen as an indicator to facilitate task performance. In such situations private speech may serve the role of reducing stress rather than guiding performance and bringing action under the control of thought. Secondly, it was queried whether the use of private speech facilitated modes of engagement. In other words, were behavioural indices of attention (in the form of different modes of engagement) enhanced by the presence of private speech? The former may be more motivational in function, the latter may focus

upon component parts of a task. Cognitive processes need to be supported by talk, and revolve around strategies, plans, explanations and intentions.

This study attempted to show that the association between the modes of engagement facilitates the process of problem solving. Speech engagement and task engagement are assumed to regulate the subject's attention and subsequently improve task performance. A high rate of completion of the task could be interpreted as evidence that, not only does private speech regulate attention in the form of looking and task engagement, but also that the enhanced benefits of attention in the context of private speech, is more effective for problem solving. Such a judgement excludes other variables, amongst others, innate ability, developmental maturity, manual dexterity, and claims that the formula for successful completion of this task lies purely in the equation of private speech, certain types of motor behaviour and looking engagement. It must be noted too, that the concurrence of these modes of engagement is a moment when certain looking behaviour and motor behaviours have occurred simultaneously with certain speech

utterances. The relationship between these modes is dynamic, and cannot be assumed to be unidirectional or causal. In other words, when private speech occurs disproportionately with looking at the object, there is a dynamic and mutually directed interplay between these two forms of engagement. In fact, while private speech may be helping to regulate modes of looking engagement, looking may strengthen or reinforce the imperative to articulate one's actions in the form of self-describing or self-guiding comments.

e. The Presence of Within Task Difficulty

The "experimental study of the mechanism of transformation of natural psychological functions into higher functions of selective attention ..."
(Vygotsky, 1978, xxvii) focussed on the use of external means, where the experiment offered maximum opportunity for engagement in a variety of activities that could be observed (Cole and Scribner, in Vygotsky, 1978). The introduction of obstacles to children at different ages produces different conditions of task difficulty, which Vygotsky sought to reconstruct in terms of the changes in intellectual operations that unfold in

normal development. Confrontation with a difficulty elicits external speech that functions to assist the child out of the difficulty (Vygotsky, 1929). Children are most likely to generate private utterances under conditions of difficulty (Goodman, 1981), when entering the zone of proximal development. The use of verbal links to overcome a given difficulty provides the child with practical ways of forming new functional systems to solve these problems. In this study, the introduction of an impediment that prevents the child from completing the task successfully was observed to be followed by the appearance of speech. The child encountering such a problem would move from the practical to the verbal sphere (Vygotsky, in Luria, 1982). Initially this speech would not be addressed to anyone in particular, but may be expressed socially thereafter. Within-task difficulty was expected to increase the amount of speech (Vygotsky, 1934, 1962); results indicate some ambiguous support for this. When both age and type of difficulty are controlled for, Kohlberg et al (1968) found an increase in utterances for more difficult puzzles, whereas Yaeger (1968, in Zivin, 1979) reported a

significant effect with age. Hypothetically, affective and self-regulating comments might be expected to increase given the presence of difficulty. Numerous studies indicate the presence of increased private speech under conditions of difficult or cognitively demanding tasks, nevertheless (Berk & Garvin, 1984, Kohlberg et al, 1968). Children are most likely to generate private utterances when faced with a potential problem for which they see no solution (Goodman, 1981). Berk and Landau (1993) cite numerous studies to support a positive association of task performance and concurrent, task-relevant private speech.

ii. Subjects

There were three age cohorts of normally achieving pre-primary school children drawn from two local schools. Except for two African pupils, all were of Indian or White descent. All children belong to an upper middle class socio-economic strata. Of the 84 subjects, 27 were aged between $3\frac{1}{2}$ and 4 years and 5 months, $4\frac{1}{2}$ and 5 years and 5 months, and $5\frac{1}{2}$ and $6\frac{1}{2}$ years old at the time of the task. Every subject performing the bead sequencing task was videotaped. This was recorded during the

free play period of the mornings, between June and August of the school calendar. Written observations of the speech, motor and looking modes of engagement were noted by the experimenters. Although the subjects worked independently, they worked in close proximity.

iii. Procedure

A naturalistic setting emulating the typical school environment was structured in the present study. Ongoing adult presence (experimenters) simulated a social context. Instructions were given to speak out aloud, to overcome expectations of silence in the traditional classroom context. This did not present any difficulty in the pre-primary classroom, where freedom of speech prevailed. The task assigned to Age group 1 ($3\frac{1}{2}$ - $4\frac{1}{2}$ year old group) was to thread coloured beads in a certain sequence onto a string as per model. Two tasks were given to the intermediate age group, referred to as Age group 2, the same task as assigned to the Junior group, and a second which introduced the concept of size. On completion of the first bead task, pupils were asked to copy another model in strict sequence of colour and size. For the older age cohort, known

as Age group 3, two tasks were administered; the one which had been administered to the Intermediate age group(level 2), and a second which consisted of copying a string of beads using a sequence of number variation as well as colour and size(level 3).

Task conditions that hinder the pursuit of a goal were expected to produce a greater quantity of private speech in this study, and an obstacle was systematically removed from task levels 2 and 3 to introduce "difficulty". Difficulty in this sense is to be distinguished from level of task difficulty as discussed earlier. With the exception of the Junior age cohort, a controlled obstacle to problem solving was introduced during the tasks, namely the removal of large red beads during tasks for the Intermediate and Senior age groups. The absence of this bead prevented subjects from progressing and successfully completing the next two tasks. Once pupils were aware that there was no such bead available, they adopted one of two strategies, to point out its absence (External Speech) and ask for it (Social Speech), or to move themselves from the situation and to find one elsewhere (Task engagement). As expected, the type of speech changed in attempts to

overcome the obstacle. The label "with difficulty" therefore refers to instances of speech or behaviour in conjunction with this task condition.

Three experimenters coded the speech utterances, types of motor behaviour and indices of looking behaviour observed on the videotape. Instances of Speech were categorised as (1) Social, (2) External and (3) Internal, differentiating between on and off task Social and External speech. Motor behaviour was coded as (1) Self-engaged, (2) Task-engaged and (3) Non-engaged. Looking behaviour was coded as (1) Looking at object, (2) Looking at Instructor, (3) Looking at Peers, and (4) Non-attentional looking. The results were statistically analysed, in terms of frequency of the modes of engagement, relationships between the three modes of engagement and their ontogenetic inclinations.

C. Results

1. Speech Engagement

1.a. The ontogenetic development of speech

Chi square test yielded a statistically significant relationship (34,84159 at $DF=4$, where $p<0.001$)

between speech type and age. When the categories of Speech were cross tabulated against age, there was a fairly even distribution of categories of speech overall. The relative proportions of combined Speech categories were similar for External Speech, Internal Speech and Social Speech (Table 1). The distribution of speech instances in age group 1, was greatest for External speech, and rose more in age group 2, while Internal utterances grew slightly and Social Speech utterances declined. The shift to Internal Speech in the Intermediate group was consolidated and predominated in age Group 3, while External Speech declined and Social Speech stabilised.

1.b. Types of Speech Utterances across the Age groups.

The Chi square indicated that there was a statistically significant relationship (100.36768 at $DF=16$ where $p<0.01$) between External Speech types and age. An analysis of the types of speech utterances classified under the categories of External, Internal and Social Speech revealed that certain speech utterances are primarily responsible for these changes. External Speech types showed a

dramatic incline in Self-guiding comments over the three age groups (Table 2.). Overall, there was a decrease in the use of Word Play and repetition, sounds and singing, and describing actions, while there was an increase then decline in Counting. Alternatively, Affect expression rose in Age group 2, declined sharply in Age group 3, but represented the most prevalent type of utterance (after Self-guiding) and was predominant in Age group 2.

1.c. The Relationship between On-task Speech

utterances and indices of Looking behaviour.

The Chi square (119,38711) between External, Internal and Social Speech and looking behaviours was significant at the 0.01 level (9 DF). Since Social and External Speech can be selected for on-task utterances, but inner Speech cannot, these frequencies shall be presented separately (Tables 3,4, 5). On task External Speech and Internal Speech were most associated with Looking at the object whereas Looking at Teacher or Instructor was most associated with On-task Social speech. Non-attention forms of looking behaviour were low for all types of speech utterances.

An analysis of any age related changes in

External and social speech was undertaken. The Chi square scores were similarly significant, 93,5454 ($DF=2$) for age group 1, 327,3922 ($DF=3$) for age group 2, and 171.883 ($DF=3$) for age group 3 at the 0.001 level of significance. In all age groups, there was a very high association of Looking at object and External Speech (Tables 6,7,8). Although the relative frequency of External speech utterances declined ontogenetically, Looking at the object and On-task External speech remained positively associated. The relationship between On-task External speech and Looking at the object was evenly distributed over the ages implying consistency over time, even given the changes of external speech ontogenetically.

The Chi square (718.3016 at ($DF=3$), at the 0.01 level of significance, indicated that the ontogenetic course of Internal speech and its association with Looking behaviour (Tables 9,10,11) was significant. Internal speech revealed a strong association with Looking at the object behaviour for all age groups, even in Age group 1, where there were very few instances of Internal speech. This rose dramatically in age groups 2 and 3.

1.d. The Relationship between Speech and task Success.

The Chi score (17.31919 (DF=4) was significant at the $p < 0.001$ level, when the level of task success was tabulated with speech categories at different age group levels. Most speech associated with Task Success in age group 1 was Social, although most subjects were unsuccessful. External speech was most associated with Non-success.

For age group 2, with Task level 1, the Chi square indicated significant results. (17,77519 (DF=4) at $p < 0.00$ level). With a higher success rate, more speech of all types was associated with success and were greater for Internal speech than External or Social speech. (Table 12.). At task level 2, the results were significant (17,42201 at DF=6 at $p < 0.01$); successful outcome was associated most with External speech utterances. More speech of all types was associated with Success than with Non-Success, but Social Speech was associated most of all with Non-success.

In age group 3, 100% success was recorded for both task levels, and a test of significance could not be calculated. For both task levels, Internal speech

was the speech type most associated with success.
speech categories (80%).

TABLE 13:

The results of task success at different age levels
and task levels:

	Success	Correct/Incorrect		Failure
<hr/>				
Age group 1:	19%	5/27	22/27	81%
<hr/>				
Age group 2:				
Task level 1	71%	20/27	7/27	29%
<hr/>				
Task level 2	63%	17/27	10/27	37%
<hr/>				
Age group 3:				
Task level 1	100%	27/27	0/27	0%
<hr/>				
Task level 3	100%	27/27	0/27	0%
<hr/>				

2. The ontogenetic development of Looking behaviour

a. Looking as an age related Phenomenon

These results were significant at 0.01 level,

with a Chi square score of 57.64634(DF=3), Table 14.

Looking at object was highest in age group 2, second highest in age group 3, whereas most looking in age group 1, was Looking at Teacher. Non-attentional looking was low, especially in the oldest group and was most in age group 2. "Looking at Teacher" and peers declined in age group 3.

b. The Relationship of Looking behaviour and task success.

The results were statistically significant (Chi square=45,83848 (DF=6) where $p < 0.001$). This relationship was examined at each age and task level. In age group 1, task level 1, there was a high rate of non-success (Table 15). Looking at object was then associated more with non-success than success. Nevertheless Looking at object was still the most common indices of all looking behaviours, albeit associated with task failure.

In Age group 2, the results were not statistically significant (Tables 16,17) for both task levels.

In Age group 3, (Table 18,19), the results were significant (Chi square=168,09 at 2 DF for task

level 2, and Chi square=398,003 at 3 DF where $p < 0.001$). Most Looking behaviour that was associated with Success was Looking at object for both tasks.

3. Motor Behaviour

3.a. The ontogenetic course of motor behaviour

The variation of behaviours within these variables was statistically significant, Chi Square = 28.78774 (DF=4, $p < 0.001$)(Table 20). Motor behaviour for all age groups was mostly associated with Task engaged behaviour, with small amounts for Self engaged, and less so for Non engaged. All motor behaviour (particularly non-engaged) showed a marked incline in age group 2 and a decline to age group 3. Task engagement rose age group 2 and declined slightly in age group 3.

The Chi square score for Self engagement and Age was 16.90217(DF=2) at the 0.01 level of significance, indicating these are not chance events (Table 21). There was more engagement of all types in age group 2, even Non-engaged motor behaviour. In the category Self Engagement, self manipulation constituted most of the types of behaviour. Self engagement rose steadily with age, suggesting an

important and continuing contribution to the context of the task.

Non engagement with task was found not to be statistically significant with age (Table 22).

3.b. The Relationship of Task engagement with Looking engagement.

The results here were significant (Chi square = 98.71018 (DF=15) where $p < 0.001$). Looking at object was the indices most associated with all types of task engagement (Table 23.)

3.c. The Relationship between Executive behaviours in Task engagement and the combined categories of External, Internal and Social speech.

Analysis of this relationship (Table 24) indicate significant results (Chi=53.5235(2) where $p < 0.001$). Both External and Internal Speech were equally positively associated with executive motor actions compared to Social Speech. These results also indicated on ontogenetic trend (Tables 25, 26, 27.) The results were significant at $p < 0.001$ level for age groups, with Chi = 8.9310, 36.6377, and 53.0206 (DF=2) for age groups 1, 2 and 3 respectively. External speech most mostly associated with executive behaviours in age groups 1

and 2. At age level 3, the strongest association shifted from External to Internal speech, where internal speech was only associated with task engagement.

3.d. The Relationship of On-task motor behaviour and task success.

Table 28, indicates significant results (Chi square = 22.09393 ($DF=4$) where $p<0.001$). Task engagement was associated more with non-success than success, because most subjects at age level 1 were not successful.

Age group 2, indicated a significant relationship (Chi-square = 17.62862(4) and 33.37801(6) where $p<0.001$ for task levels 1 and 2)(Table 29). Task levels 1 and 2 revealed somewhat different results, given that the success rate was much higher for both tasks. Task engagement was associated with success for both task levels.

For age group 3, task level 2 and 3, a 100% success rate was recorded and the significance could not be statistically calculated. Most engagement was task engaged for task level 2 and 3.

D. Discussion

According to Vygotsky's theory of the ontogenetic development of private speech, utterances addressed to self will rise in the third and fourth year only to decline and be transformed into inner speech from 5½ to 6 years old. In order to determine whether there are ontogenetic changes in the types of speech used, it was assumed that Private speech follows a process of internalisation. The ontogenetic course of private speech was supported by the results (Tables 1a), in that External speech utterances from 3½ (38%) to 4½ year olds (44%), and declined in 5½ year olds (29%). The latter decline could be attributed to the rise in Internal forms of speech over the three age groups (23% to 28% to 43%, respectively). The rise in the percentage of external private speech from the first to second age level, was inferred as evidence that speech plays an increasingly regulatory role between the ages of 3½ and 4½ years of age, supporting Vygotsky's hypothesis that there was an increase in cognitive growth over this period. The rise in internal forms of speech from the second to the third age group was interpreted as growing

internalisation of speech due to the increased capacity to guide one's actions and plan action (Kohlberg et al, 1968). Certain types of speech utterances appeared to account for the predominance of External Speech in age group 2 (Table 1b); self-guiding comments, a type of External speech, rose dramatically in age group 2 and stabilised in age group 3 (53% and 55%). The nature of Self guiding comments is intrinsically task orientated, supporting the claim that External speech regulates problem solving activities. It was noted that more than any other types of External speech, Affect expressions rose in the second age group (from 3% to 8% of all utterances) and declined sharply in age group 3 (4% of all utterances). The fall-off of affect expression could in part be linked to the dominance of Internal speech in age group 3. The contention that private speech has its origins in social speech before evolving inwardly into forms of verbal thought was supported. The use of types of speech that involve the use of signs (word signifiers like "red, red") suggested that speech may regulate actions. In time this verbal accompaniment shifted to support mental orientation,

providing support for the hypothesis. The results also indicated that private speech moves from directing actions to guiding and planning action.

3.c. The Relationship of task engagement with Looking engagement.

The results here were significant (Chi square = 98.71018 ($DF=15$) where $p<0.001$). Looking at object was the indices most associated with all types of engagement (Table 23).

3.d. The Relationship between Executive behaviours in Task engagement and the combined categories of External, Internal and Social Speech.

Analysis of this relationship (Table 24) indicated significant results (Chi=53.5235(2) where $p<0.001$). Both External and Internal Speech were equally positively associated with executive motor actions compared to Social Speech. These results also indicated an ontogenetic trend (Tables 25,26,27). The results were significant at $p<0.001$ level for age groups, with Chi=8.9310, 36.6377, and 53.0206 ($DF=2$) for age groups 1,2 and 3 respectively. External speech was most associated with executive behaviours in age groups 1 and 2. At age level 3, the strongest association shifted from

External to Internal speech, where internal speech was only associated with task engagement.

3.e. The Relationship of On-task motor behaviour and task success.

Table 28, indicates significant results (Chi square=22.09393 (DF=4) where $p < 0.001$). Task engagement was associated more with non-success than success, because most subjects at age level 1 were not successful.

Age group 2, indicated a significant relationship (Chi square=17.62862(4) and 33.7801(6) where $p < 0.001$ for task levels 1 and 2)(Table 29). Task levels 1 and 2 revealed somewhat different results, given that the success rate was much higher for both tasks. Task engagement was associated with success for both task levels.

For age group 3, task level 2 and 3, a 100% success rate was recorded and the significance could not be statistically calculated.

D. Discussion

1.a. Speech as Mediator

According to the theory of the ontogenetic

development of private speech (Vygotsky, 1978), external speech rises in the third and fourth year of age, then follows a process of internalisation in the five to six year-old. This was supported by the results (Table 1), in the finding that External speech utterances increased from age group 1 to age group 2 and declined in age group 3, while Internal speech rose over the three age groups. External speech played an increasing regulatory role between the ages of $3\frac{1}{2}$ and $4\frac{1}{2}$ years of age, while the increase in Internal speech reflected the growing internalisation of speech, which can be attributed to the improved capacity to guide one's actions and plan action (Kohlberg et al, 1968). Hypothesis 1 was upheld.

Certain types of speech utterance accounted for the dominance of External Speech in age group 2 (Table 2); Self-guiding comments, which rose dramatically in age group 2 and stabilised in age group 3, are intrinsically task centred, supporting the claim that External speech regulates problem solving activities. The use of signs (word signifiers like "red,red") suggested that speech mediates cognitive processes and regulates actions.

The rise and decline in Affect expressions could be explained by the dominance of Internal Speech in age group 3, as verbal accompaniment shifted from a motivational function to support mental orientation. (Fuson, in Zivin, 1979). The results also indicated that private speech moves from directing actions to a guiding and planning function, that is inextricably linked to action (Berk & Garven, 1994). Mead's hierarchy of External speech types from describing to dialogue to guiding was confirmed (Kohlberg et al, 1968, Kozulin in Vygotsky, 1978). This supported the hypothesis that speech is not only a form of engagement, but also has a regulatory role in action (Hypothesis 3).

1.b. Speech as a mode of engagement

It was hypothesised that Speech utterances in a problem solving context perform a dual function, both as a means of regulating mental processes and as a mode of engagement. External speech utterances indicated engagement with task, the content of utterances signified attention to the task. Speech that occurs in conjunction with other modes of engagement, can be understood to facilitate and regulate these behaviours and simultaneously to act

as a supportive form of attentional functioning. The highly significant association between On-task External Speech and Internal Speech manifestations with Looking at the object suggested a dual and dynamic interplay between the two behaviours (Tables 3 and 4), supporting the hypothesis that speech (both Internal and External) operates hand-in-hand with Looking modes of engagement. Speaking to self (On-task External or Internal Speech) was more critical than speaking to others (Social Speech) during Looking engagement, which was interpreted as support or the attentional role performed by speech. The interwoven relationship between modes of engagement implies that a dynamic interplay between looking and uttering operates in the context of problem-solving. Speech as a mode of engagement, acting in collaboration with Looking at the object, was illustrated in the content of External Speech utterances such as "Where's the red?", which directed attention to the mode of looking behaviour and mediated mental actions. The attentional system operating in pre-schoolers of all three age groups supported the contention that higher level control, planning and self-regulation was functioning with

speech as a mode of engagement (Richards and Gibson, 1997). More qualitative research into the dynamics and content of this relationship would provide insight into the interchange between the modes of engagement. In summary, speech utterances played a significant role in directing looking onto the task.

1.c. The Relationship of Speech and Looking modes of engagement

On-task External Speech and Internal speech were strongly associated with attentional indices (Looking at object) and non-attentional indices were poorly associated with all forms of speech utterance (Table 4). These results suggest that, in spite of the evidence that Speech does occur in conjunction with non-attentional modes of Looking, the role of speech is more positively linked to modes of engagement than non-engagement. The relationship between Speech and Looking modes of engagement also carried implications for age; in spite of the changing course of both External and Internal speech, Looking at the object behaviour remained closely associated with its ontogenesis, in a strong and stable association over the three age groups (Tables 6,7,8,9,10,11).

This was confirmed by the low rate of Non-attentional looking, and looking at the instructor or peers, with all types of speech when engaged in a problem solving task. The results indicate that, regardless of the fluctuations in the course of private speech from external to internal speech, the relationship between private speech utterances and looking behaviours remains high. It was concluded that, as looking becomes more controlled and indices of voluntary attention emerge, there is also mediation through language. Higher psychological processes involving voluntary control appear to operate in conjunction with mediation through speech, thereby facilitating greater mastery over behaviour and cognition (Kozulin in Vygotsky, 1978).

1.d. The role of Speech in task success

The relationships between task success and speech as mediator, and task success and speech engagement were ambiguous. The presence of any mode of engagement, whether it be looking, task or speech, cannot determine successful outcomes; neither attention nor mediation through speech, even when used concomitantly, can determine successful task performance. The presence of all three forms

of engagement may be necessary components of task success as facilitators, but this does not ensure task success, as the results revealed (Tables 12, 13). External speech varied according to the rate of success (Age group 2) or failure (Age group 1), showing that while speech did mediate, it did not determine task results. The absence of support for Hypothesis 4, demands that this relationship be re-examined. Further to this, the age appropriateness of each task level must be questioned; the high failure rate for age group 1 and the absolute success rate for age group 3 suggested that task 1 was beyond the developmental capacity of the first age group and task level 3 was within the age group's actual zone of development. The success in age group 2 suggests that both tasks were age appropriate, and that task level 1 was easier than task level 2. This does not explain why task level 1 appeared too difficult for age group 1. Clarity is needed here in order to establish whether a task that is too difficult produces more or less speech, in comparison to an age appropriate task, or whether, perhaps, a task that is too easy does not produce much speech at all! The choice of task,

unfortunately, remains a compelling but elusive research design challenge.

Nevertheless, in age group 2, where task level was most appropriate, some deductions can be mooted. Speech of all types was associated with task success rather than non-success. Of these speech utterances, Internal speech had the strongest association of success in task level 1, whereas, External speech was more strongly associated with successful outcomes in task level 2. Internal speech has been linked with more advanced cognitive maturity than External speech, yet it facilitated success more in the easier task. From these results, it is difficult to interpret the role speech played in assisting success. Only the association of Social speech with Non-success, suggests that while the other forms of speech had positive outcomes for success at times; Social speech was more likely to occur in conjunction with non-success. By a process of inversion, it could be tenuously argued that Social speech is less likely to mediate problem solving and enhance success than other speech types.

2. Looking behaviour as a Mode of Engagement

2.a. The ontogenesis of looking as a mode of
attentional engagement (Hypothesis 2)

Congruent with the finding that attentional levels increase between the ages of two and six, (Ruff and Lawson, 1990), it was found that when looking engagement was used as an index for attentional behaviour, there was a rise in attentional functioning with age. Looking at the object constituted the greatest proportion of looking behaviour with age (Table 14). Indices of looking behaviour that signified Non-attention declined sharply with age.

During the same period in which private speech is internalised, children appear to use more task engaged motor and looking behaviour. The development of more internalised thought is paralleled by an apparent increased ability to use more looking engagement. Certain indices of looking behaviour appeared to be more directly linked to attentional engagement than others. While Looking at the object implies focussed looking, Looking at the instructor or peers could be interpreted as divided attention, and non-attention clearly deficient of engagement (Sohlberg, 1987). As the

sole indices for engagement, Looking at the object (Table 14) accounted for most looking behaviour. The relative proportion varied for each age group rising with each year. This implies that subjects looked more at the object with age, and were more engaged in terms of looking indices with age. The implication of the steady rise in attention in the form of looking behaviour, together with the small number of instances of non-attentional looking, indicates that Looking at the object becomes more focussed and exclusive with age. Attention appears to become more voluntary, and under the control with age (Vygotsky, 1978, Ruff and Lawson, 1990).

For the purposes of this study, the relative contribution of focussed and divided attention was not investigated. However, there was evidence supporting the contention that four year-olds can execute a task while Looking at Teacher or Peers and not at the objects involved in the task (Wertsch, 1985). These looking indices were reported in conjunction with On-task Social speech (Tables 3,4,5) and to a lesser degree with Task engagement (Table 23), giving support to the claim that engagement in the task is not only indicated when

the subject is looking at the object. Furthermore, even when other looking behaviours were recorded, the success rate of age group 3 was 100%, suggesting that Looking elsewhere does not necessarily prohibit success. A system classifying indices of Looking behaviour onto a continuum of focussed, divided and non-focussed attention could provide important pointers to differentiated levels of attention.

3. Task engagement/Motor behaviour

3.a. The ontogenetic course of motor engagement

The high frequency of Task engagement was a significant finding, confirming this as a mode of engagement in problem solving. The dominance of motor action of any type in age group 2, suggested more engagement of all forms could be expected. However, the relative proportion of task engagement in age group 3 implied more efficient and focussed motor action at this age level. It could be concluded that there are fewer actions, but more effective task engagement here, and enhanced attentional control accompanies this action. The steady role of Self Engagement was an interesting finding. In Self Engagement, there are only two types of motor action, most of which is self-

manipulation and, of lesser frequency, rhythmical movement of self (Table 21.). Self-engaged behaviour, of the self-manipulative kind, rises steadily with age, suggesting an important and continuing contribution to the context of the task. The possibility that Self-engagement is part of a process which involves acts that precede attention like arousal, alerting and orientating is a hypothesis yet to be explored (Posner and Boies, 1971), but one that offers important information about the process of attention, rather than simply conceptualising attention in isolated episodes.

3.b. The Relationship between Task engagement and Looking engagement

Task engagement and Looking at the object were found to enjoy a strong relationship as expected. Non-attentional looking was poorly associated with motor behaviour, suggesting that engaged looking is strongly associated with task engaged motor actions, and looking must be predominantly focussed in conjunction with task engagement. Engagement with the task is assumed to intensify when the subject is both "looking" at the component parts of the task and "examining" them (Ruff, 1986). Heightened

levels of attention are assumed to be in operation when these modes of engagement co-occur. This was most apparent when looking at the object and executing the beads or object in some task oriented way. Past research argued that this constituted the most focussed form of attention. Active manipulation of the objects central to the task was found to be strongly associated with appropriate looking actions, but did not exclude the role of speech as mediator or mode of engagement.

3.c. Executive actions as a mode of engagement

Certain types of engagement play a more crucial role than others to the task. While pointing, matching and selecting may facilitate the task, Executive actions predominated in all types of engagement and operated at the heart of what constitutes attention and modes of engagement. Together with Looking at object, it is the essential ingredient of engagement. This is not to undermine the role of private speech as a regulator of action or mode of engagement, but to emphasise the intrinsic nature of executive action. Imposed as a condition, the instruction not to speak, or point, for example, could not, in themselves, prevent

completion of the task, whereas not being able to thread (executive behaviour) or look at the beads, string and model would. The finding that Looking at the Teacher, or peers, occurs while manipulating the task through selecting, matching, pointing or executing actions, suggested that the executing function can be implemented without direct visual focus (divided attention).

3.d. Speech and executive action

The correlation of Types of Speech with Executing actions cuts to the core of the relationship between speech utterances and the motor actions required for task completion. Both External and Internal speech enjoyed a sizeable proportion of associations with executive actions (Table 24). That these types of speech engagement occur in conjunction with executive actions implies that they play a role in regulating or influencing the accompanying task engagement. The relatively weak association of Social speech with executive actions supports this. Furthermore, the steady growth of Internal speech and rise and subsequent decline of External utterances illustrates the ontogenetic course of private speech in conjunction with

executing the task. That speech follows an ontogenetic course is supported by the concurrence of task engaged behaviour, suggesting that speech mediates the task solving process in different forms of speech in different age groups. The finding that Internal speech was only associated with Task engagement (Table 25, 26, 27) and not at all in conjunction with self or non-engagement supported the role that Internal speech plays in regulating Task engagement.

3.e The Relationship between Task engagement and Task success

The relationship between Task success and Task engagement was ambiguous. The presence of modes of engagement signified attention but not task success, as the results revealed. Hypothetically, it was expected that task engaged motor behaviour would be associated more with success, and that non engagement would be associated more with failure. The analysis was inconclusive both within the age group and the level of the task. In fact, while the results or outcomes are important for analysis, the processes involved in problem solving tasks were at the core of this investigation, not the products.

E. Conclusion

This study attempted to reconceptualise the role of speech as mediator of mental action by incorporating its role as mode of engagement. There was also a shift in the conceptualisation of Attention, which was understood as interacting modes of engagement, in a break with past studies. The findings showed a strong relationship between speech engagement and other modes of engagement; the dynamic and evolving interplay between these modes of engagement suggested reciprocal and mutually regulating processes in operation. The interchange between the three modes of engagement was well supported by the results as was the role of private speech as a form of mediation in task solving activities. In a complex, dynamic relationship all three forms of engagement, revealed evidence that they all play a critical and fundamental role in enhancing the level of engagement in task solving. The simultaneous occasion of speech, motor and looking engagement signify focussed attention. Certainly, it appears that there is a close relationship between all three modes of engagement,

where speech acts in a dual capacity.

Speech is social in origin, in the sense that it develops out of social interaction. From the findings, it was apparent that participation in problem solving tasks, in a social context is critical to the emergence of private speech (Vygotsky, 1978) and the school environment was conducive to this. The results also indicated strong support for the theory of Ontogenetic Development of Private Speech. That private speech or modes of attention facilitated task success, was a misconception. The word plays a central role in concept formation, by focussing attention, selecting specific features for mental processing and regulating action. The mediation of speech occurs in a context of Looking engagement, Task engagement and Speech engagement. Mediation is at first inter-psychological, but as voluntary control and conscious cognitive processing intersect, mediation becomes internally oriented, transforming natural human capacities into higher mental functions (Kozulin in Vygotsky, 1978).

References

Berk, L.E. (1986). Relationship of Elementary School Children's Private Speech to Behavioural Accompaniment to Task, Attention, and Task Performance. Developmental Psychology (22) 5, 671-680.

Berk, L.E. (1994) Why Children Talk to Themselves. Scientific American.

Berk, L.E. and Garvin, R.A. (1994) Development of Private Speech Among Low-Income Appalachian Children. Developmental Psychology (20), pp. 271-286.

Berk, L.E. and Landau, S. (1993) Private Speech of Learning Disabled Children and Normally Achieving Children in Classroom Academic and Laboratory Contexts. Child Development (64) pp. 556-571.

Bruner, J. (1983) Child's Talk : Learning to Use Language. Oxford, Oxford University Press.

Chapman, M. (1997) Piaget, Attentional Capacity and Functional Implications of formal structure. Advances in Child Development. Vol.20. pp 289-334

Daugherty, M. and Logan, J. (1996) Private Speech assessment : A Medium for Studying the Cognitive Processes of Young Creative Children. Early Child Development and Care. (115) pp 7-17.

Frauenglas, M.H. and Diaz, R.M. (1985) Self-Regulatory Function of Children's Private Speech : A Critical Analysis of Recent Challenges to Vygotsky's Theory. Developmental Psychology (21) 2, pp. 357-364

Fuson, K. (1979) The Development of Self-Regulating Aspects of Speech : A Review. In Zivin, G. (1979). The Development of Self-Regulation Through Private Speech. New York. John Wiley & Sons.

Goodman, S.H. (1981) The Integration of Verbal and Motor Behaviour in Preschool Children. Child Development (52), pp. 280-289.

Kohlberg, L., Yaeger, J. and Hjertholm, E.

(1968) Private Speech : Four Studies and a Review of Theories. Child Development (39) pp. 691-736.

Kohlberg, L. and Wertsch, J.V. (1987) in Kohlberg, L. (ed). Child Development and Child Education : A Cognitive Development Review. Chapter 5. Language and the Development of Thought. New York. Longman.

Lansink, J.M. and Richards, J.E. (1997) Heart Rate and Behavioural Measures of Attention in Six, Nine and Twelve-month old Infants during Object exploration. Child Development, August 1997, Vol. 68, (4) pp. 610-620.

Luria, A.R. (1959) Speech and the Development of Mental Processes in the Child. London. Staples Press.

Luria, A.R. (1961) The Role of Speech in the Regulation of Normal and Abnormal Behaviour. U.S.A. Library of Congress.

Luria, A.R. (1977) Cognitive Development : It's

Cultural and Social Foundations. Cambridge. Harvard University Press.

Luria, A.R. (1982) Language and Cognition
U.S.A. Library of Congress.

Richards, J.E. and Gibson, T.L. Extended Visual Fixation in Young Infants : Look Distributions, Heart Rate changes, and Attention. Child Development, 1997 Vol. 68 (6) pp. 1041-1056.

Ruff, H.A. (1986) Components of Attention during Infants' manipulative Exploration. Development Psychology (57) PART I, pp 105-115.

Ruff, H.A. and Lawson, K.R. (1990). Development of Sustained, Focussed Attention in Young Children During Free Play. Developmental Psychology (26), pp. 85-93.

Sohlberg, M. and Mateer, K. (1989) Introduction to Cognitive Rehabilitation. New York. Guildford press.

Teasley, S.D. (1995) The Role of talk in

Children's Peer Collaborations. Developmental Psychology. Vol 31 (2) pp. 207-220.

Vygotsky, L.S. (1978) Mind in Society. The Development of Higher Psychological Processes. London. Harvard University Press.

Vygotsky, Lev. (1986) Thought and language. Cambridge. M.I.T.

Wertsch, J.V. (1982) Introduction : Lectures on Language and Cognition. In (Luria, A.R.)(1982) Language and Cognition. U.S.A. Library of Congress.

Wertsch, J.V. (1985) Vygotsky and the Social Formation of Mind

Wertsch, J.V. (1979) The Regulation of Human Action and the Given-New Organisation of Private Speech. In Zivin, G. (1979). The Development of Self-Regulation through Private Speech. New York. John Wiley and Sons.

Zivin, G. (1979) Removing Common Confusions

About Egocentric Speech, Private Speech, and Self-Regulation. In Zivin, G. (1979) The Development of Self-Regulation through private Speech. New York. John Wiley and Sons.

Zivin, G. Ed. (1979) The Development of Self-Regulation through Private Speech. John Wiley and Sons, New York.

APPENDICES :

The Role of Private Speech as Mediator of Attention in Problem-solving Tasks in Normally Achieving Preschool Children.

TABLES

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TABLE 1 : THE RELATIONSHIP BETWEEN EXTERNAL, INTERNAL AND SOCIAL SPEECH WITH AGE GROUP

SPEECH3 speech with combined categories by AGE age of subject
(diffic=2 and speech3>0)

SPEECH3	AGE				Row Total
	Count				
	Row Pct				
	Col Pct				
	Tot Pct	1.00	2.00	3.00	
EXTERNAL	1.00	94	174	87	355
		26.5	49.0	24.5	38.3
		40.0	44.3	29.0	
		10.1	18.8	9.4	
INTERNAL	2.00	54	112	129	295
		18.3	38.0	43.7	31.8
		23.0	28.5	43.0	
		5.8	12.1	13.9	
SOCIAL	3.00	87	107	84	278
		31.3	38.5	30.2	30.0
		37.0	27.2	28.0	
		9.4	11.5	9.1	
Column		235	393	300	928
Total		25.3	42.3	32.3	100.0

Chi-Square	Value	DF	Significance
Pearson	34.84159	4	.00000
Likelihood Ratio	34.51634	4	.00000
Linear-by-Linear Association	.24608	1	.61985

Minimum Expected Frequency - 70.399

Number of Missing Observations: 0

TABLE 2: Speech utterance by age of subject

		AGE			Page 1 of 2	
		Count				
		Row Pct				
		Col Pct			Row	
		Tot Pct	1.00	2.00	3.00	Total
SPEECH						
	1	12	1			13
		92.3	7.7			3.7
		12.8	.6			
		3.4	.3			
	2	15	16	3		34
		44.1	47.1	8.8		9.6
		16.0	9.2	3.4		
		4.2	4.5	.8		
	3	4	2	1		7
		57.1	28.6	14.3		2.0
		4.3	1.1	1.1		
		1.1	.6	.3		
	4	9	27	14		50
	Affect	18.0	54.0	28.0		14.1
		9.6	15.5	16.1		
		2.5	7.6	3.9		
	5	36	16	14		66
		54.5	24.2	21.2		18.6
		38.3	9.2	16.1		
		10.1	4.5	3.9		
	6		3	3		6
			50.0	50.0		1.7
			1.7	3.4		
			.8	.8		
	7	17	93	48		158
Self-guiding	10.8	58.9	30.4		44.5	
	18.1	53.4	55.2			
	4.8	26.2	13.5			
8		4	1		5	
		80.0	20.0		1.4	
		2.3	1.1			
		1.1	.3			
	Column	94	174	87	355	
(Continued)	Total	26.5	49.0	24.5	100.0	

SPEECH speech utterance by AGE age of subject

Page 2 of 2

SPEECH	AGE				Row Total
	Count				
	Row Pct				
	Col Pct				
	Tot Pct	1.00	2.00	3.00	
	9	1	12	3	16
		6.3	75.0	18.8	4.5
		1.1	6.9	3.4	
		.3	3.4	.8	
	Column	94	174	87	355
	Total	26.5	49.0	24.5	100.0

Chi-Square	Value	DF	Significance
Pearson	100.36768	16	.00000
Likelihood Ratio	102.22249	16	.00000
Linear-by-Linear Association	36.91516	1	.00000

Minimum Expected Frequency - 1.225
Cells with Expected Frequency < 5 - 13 of 27 (48.1%)

Number of Missing Observations: 0

Table 3 : THE RELATIONSHIP BETWEEN ON-TASK EXTERNAL SPEECH AND LOOKING ENGAGEMENT

SPEECH2 combined speech categories (no difficulty)

		ATLOOK				
Count		1	2	3	4	Row
Exp Val						Total
Row Pct						
Col Pct						
Tot Pct						
SPEECH2		1	2	3	4	Total
1.00		263	14	8	11	296
external speech		263.0	14.0	8.0	11.0	100.0%
		88.9%	4.7%	2.7%	3.7%	
		100.0%	100.0%	100.0%	100.0%	
		88.9%	4.7%	2.7%	3.7%	
Column		263	14	8	11	296
Total		88.9%	4.7%	2.7%	3.7%	100.0%

>Statistics cannot be computed when the number of non-empty rows or columns
>is one.

Number of Missing Observations: 0

TABLE 4 : INTERNAL SPEECH AND LOOKING ENGAGEMENT

ATLOOK	Count	SPEECH2		Row Total
		internal speech 2.00		
1	273			273 92.5
2	7			7 2.4
3	12			12 4.1
4	3			3 1.0
Column	295			295
Total	100.0			100.0

Number of Missing Observations: 0

- - - - Chi-Square Test

ATLOOK attention/looking

Category	Cases		
	Observed	Expected	Residual
1	273	73.75	199.25
2	7	73.75	-66.75
3	12	73.75	-61.75
4	3	73.75	-70.75
Total	295		

Chi-Square	D.F.	Significance
718.3016	3	.0000

TABLE 5 : THE RELATIONSHIP BETWEEN ON-TASK SOCIAL SPEECH AND LOOKING ENGAGEMENT

		SPEECH3	
ATLOOK	Count		
	Row Pct		
	Col Pct		
	Tot Pct	3.00	Row Total
	-----+		
1	1	83	83
		100.0	34.7
		34.7	
		34.7	
2	-----+		
	2	113	113
		100.0	47.3
		47.3	
3	-----+		
	3	41	41
		100.0	17.2
		17.2	
4	-----+		
	4	2	2
		100.0	.8
		.8	
		-----+	
Column		239	239
Total		100.0	100.0
Chi-Square			D.F.
118.2050			3
		Significance	.0000

TABLE 6 : THE RELATIONSHIP BETWEEN LOOKING ENGAGEMENT AND ON-TASK EXTERNAL SPEECH (AGE 1)

ATLOOK attention/looking by SPEECH2 combined speech categories
age 1, No difficulty, on speech

		SPEECH2	
Count		external	Row
		speech	Total
		1.00	
ATLOOK	-----+-----+		
	1	59	59
			89.4
	-----+-----+		
	2	2	2
			3.0
	-----+-----+		
	3	5	5
			7.6
	-----+-----+		
Column		66	66
Total		100.0	100.0

Number of Missing Observations: 0

- - - - - Chi-Square Test

ATLOOK attention/looking

		Cases		
Category	Observed	Expected	Residual	
1	59	22.00	37.00	
2	2	22.00	-20.00	
3	5	22.00	-17.00	

Total	66			

Chi-Square	D.F.	Significance
93.5454	2	.0000

TABLE 7 : THE RELATIONSHIP BETWEEN LOOKING ENGAGEMENT AND ON-TASK EXTERNAL SPEECH (AGE GROUP 2)

ATLOOK attention/looking by SPEECH2 combined speech categories
age 2, no difficulty, on task

ATLOOK	Count	SPEECH2		Row Total
		external	speech	
		1.00		
-----+-----+	1	135		135
				88.2
	2	7		7
				4.6
-----+-----+	3	1		1
				.7
	4	10		10
				6.5
-----+-----+				
Column		153		153
Total		100.0		100.0

Number of Missing Observations: 0

----- Chi-Square Test

ATLOOK attention/looking

Category	Cases		
	Observed	Expected	Residual
1	135	38.25	96.75
2	7	38.25	-31.25
3	1	38.25	-37.25
4	10	38.25	-28.25

Total	153		

Chi-Square	D.F.	Significance
327.3922	3	.0000

TABLE 8 : THE RELATIONSHIP BETWEEN LOOKING ENGAGEMENT AND ON-TASK EXTERNAL SPEECH (AGE GROUP 3)

ATLOOK attention/looking by SPEECH2 combined speech categories
age 3, no difficulty, on task

		SPEECH2		
ATLOOK	Count		external speech 1.00	Row Total
	1		69	69 89.6
	2		5	5 6.5
	3		2	2 2.6
	4		1	1 1.3
	Column Total		77 100.0	77 100.0

Number of Missing Observations: 0

Chi-Square Test

ATLOOK attention/looking

Category	Cases		
	Observed	Expected	Residual
1	69	19.25	49.75
2	5	19.25	-14.25
3	2	19.25	-17.25
4	1	19.25	-18.25
Total		77	

Chi-Square	D.F.	Significance
171.8831	3	.0000

TABLE 9 : INTERNAL SPEECH AND LOOKING BEHAVIOUR IN AGE GROUP 1

(age 1)No difficulty		SPEECH2	Page 1 of 1
	Count	internal speech	Row
		2.00	Total
ATLOOK	-----+	-----+	
	1	5	5
			83.3
		+-----+	
	3	1	1
			16.7
		+-----+	
	Column	6	6
	Total	100.0	100.0

Number of Missing Observations: 0

TABLE 10: INTERNAL SPEECH AND LOOKING BEHAVIOUR IN AGE GROUP2
(age 2)

		SPEECH2			
ATLOOK	Count		internal	Row Total	
			speech		
			2.00		
	-----+				
	1		101		
					90.2
+-----+					
	2		4		4
					3.6
+-----+					
	3		5		5
					4.5
+-----+					
	4		2		2
					1.8
+-----+					
	Column		112		112
	Total		100.0		100.0

Number of Missing Observations: 0

TABLE 11: INTERNAL SPEECH AND LOOKING BEHAVIOUR IN AGE GROUP 3

ATLOOK attention/looking by SPEECH2 combined speech categories
(age 3) no difficulty

		SPEECH2		Row Total
ATLOOK	Count		internal speech 2.00	
	-----+-----+			
	1		126	
			97.7	
	+-----+			
	3		3	
		2.3		
+-----+				
Column		129	129	
Total		100.0	100.0	

Number of Missing Observations: 0

TABLE 12 A : THE RELATIONSHIP BETWEEN EXTERNAL, INTERNAL AND SOCIAL SPEECH WITH TASK SUCCESS (AGE LEVEL 1)

TLEV1TS task level 1 success by SPEECH2 combined speech categories (diff=2, task level=1 and age=1)

		SPEECH2			
	Count	external	internal	social	
Row	Pct	speech	speech	peech	Row
Col	Pct	speech	speech	peech	Total
Tot	Pct	1.00	2.00	3.00	
TLEV1TS		-----+	-----+	-----+	
	1	4	2	12	18
		22.2	11.1	66.7	7.7
		4.3	3.7	13.8	
		1.7	.9	5.1	
		-----+	-----+	-----+	
	2	6	13	10	29
		20.7	44.8	34.5	12.3
		6.4	24.1	11.5	
		2.6	5.5	4.3	
		-----+	-----+	-----+	
	4	84	39	65	188
	44.7	20.7	34.6	80.0	
	89.4	72.2	74.7		
	35.7	16.6	27.7		
	-----+	-----+	-----+		
Column	94	54	87	235	
Total	40.0	23.0	37.0	100.0	
Chi-Square		Value		DF	Significance
-----		-----		----	-----
Pearson		17.31919		4	.00168
Likelihood Ratio		16.27634		4	.00267
Linear-by-Linear		7.19492		1	.00731
Association					
Minimum Expected Frequency -		4.136			
Cells with Expected Frequency < 5 -		1 of	9 (11.1%)		
Number of Missing Observations:		121			

TABLE 12 B : THE RELATIONSHIP BETWEEN EXTERNAL, INTERNAL AND SOCIAL SPEECH WITH TASK SUCCESS (AGE LEVEL 2, TASK LEVEL 1)

TLEV1TS task level 1 success by SPEECH2 combined speech categories
(diff=2, tasklevel=1 and age=2)

		SPEECH2			
	Count	external	internal	social s	
	Row Pct	speech	speech	peech	Row
	Col Pct	1.00	2.00	3.00	Total
TLEV1TS	Tot Pct	1.00	2.00	3.00	Total
	1	42	49	20	111
		37.8	44.1	18.0	62.7
		50.6	81.7	58.8	
		23.7	27.7	11.3	
	2	37	7	12	56
		66.1	12.5	21.4	31.6
		44.6	11.7	35.3	
		20.9	4.0	6.8	
	4	4	4	2	10
		40.0	40.0	20.0	5.6
		4.8	6.7	5.9	
		2.3	2.3	1.1	
	Column	83	60	34	177
	Total	46.9	33.9	19.2	100.0
Chi-Square		Value		DF	Significance
Pearson		17.77519		4	.00137
Likelihood Ratio		19.54246		4	.00061
Linear-by-Linear		.84455		1	.35810
Association					
Minimum Expected Frequency - 1.921					
Cells with Expected Frequency < 5 - 3 of 9 (33.3%)					
Number of Missing Observations: 60					

TABLE 12 C : THE RELATIONSHIP BETWEEN EXTERNAL, INTERNAL AND SOCIAL SPEECH WITH TASK SUCCESS (AGE GROUP 2, TASK LEVEL 2)

TLEV2TS task level 2 success by SPEECH2 combined speech categories
(diff=2. tasklevel=2, age=2)

		SPEECH2			
Count					
Row Pct		external	internal	social s	
Col Pct		speech	speech	peech	Row
Tot Pct		1.00	2.00	3.00	Total
TLEV2TS	1	76	45	50	171
		44.4	26.3	29.2	79.2
		83.5	86.5	68.5	
		35.2	20.8	23.1	
	2	10	3	8	21
		47.6	14.3	38.1	9.7
		11.0	5.8	11.0	
		4.6	1.4	3.7	
	3	4	2	3	9
		44.4	22.2	33.3	4.2
		4.4	3.8	4.1	
		1.9	.9	1.4	
	4	1	2	12	15
		6.7	13.3	80.0	6.9
		1.1	3.8	16.4	
		.5	.9	5.6	
Column		91	52	73	216
Total		42.1	24.1	33.8	100.0

Chi-Square	Value	DF	Significance
Pearson	17.42201	6	.00785
Likelihood Ratio	17.54979	6	.00746
Linear-by-Linear Association	10.76176	1	.00104

Minimum Expected Frequency - 2.167
Cells with Expected Frequency < 5 - 4 of 12 (33.3%)
Number of Missing Observations: 66

TABLE 13 : THE RATE OF TASK SUCCESS IN EACH AGE GROUP

TASK	SUCCESS	FAILURE
AGE GROUP 1	19 %	81 %
AGE GROUP 2		
TASK LEVEL 1	71 %	29 %
TASK LEVEL 2	63 %	37 %
AGE GROUP 3		
TASK LEVEL 2	100 %	0 %
TASK LEVEL 3	100 %	0 %

TABLE 14 : THE COURSE OF LOOKING ENGAGEMENT WITH AGE

AGE age of subject by ATLOOK attention/looking(no difficulty)

AGE	ATLOOK				
	Count				
	Exp Val				
	Row Pct				
	Col Pct				
	Tot Pct	1	2	3	4 Row Total
1.00		218	78	46	14 356
		255.5	57.3	29.5	13.6 28.4%
		61.2%	21.9%	12.9%	3.9%
		24.2%	38.6%	44.2%	29.2%
		17.4%	6.2%	3.7%	1.1%
2.00		370	78	37	33 518
		371.8	83.4	43.0	19.8 41.3%
		71.4%	15.1%	7.1%	6.4%
		41.1%	38.6%	35.6%	68.8%
		29.5%	6.2%	3.0%	2.6%
3.00		312	46	21	1 380
		272.7	61.2	31.5	14.5 30.3%
		82.1%	12.1%	5.5%	.3%
		34.7%	22.8%	20.2%	2.1%
		24.9%	3.7%	1.7%	.1%
Column		900	202	104	48 1254
Total		71.8%	16.1%	8.3%	3.8% 100.0%
Chi-Square					
		Value		DF	Significance
Pearson		57.64634		6	.00000
Likelihood Ratio		64.10275		6	.00000
Linear-by-Linear		36.63905		1	.00000
Association					

Minimum Expected Frequency - 13.627

Number of Missing Observations: 1

TABLE 15 : THE RELATIONSHIP BETWEEN LOOKING ENGAGEMENT AND TASK SUCCESS
AGE GROUP 1

TLEV1TS task level 1 success by ATLOOK attention/LOOKING
(diffic=2,agel, tasklev=1)

		ATLOOK				
Count		1	2	3	4	Row Total
Row Pct	Col Pct					
Tot Pct						
TLEV1TS	1	20	11		8	39
		51.3	28.2		20.5	11.0
		9.2	14.1		57.1	
		5.6	3.1		2.2	
	2	26	9	13	2	50
		52.0	18.0	26.0	4.0	14.0
		11.9	11.5	28.3	14.3	
		7.3	2.5	3.7	.6	
	4	172	58	33	4	267
		64.4	21.7	12.4	1.5	75.0
		78.9	74.4	71.7	28.6	
		48.3	16.3	9.3	1.1	
Column Total		218	78	46	14	356
Total		61.2	21.9	12.9	3.9	100.0
Chi-Square		Value		DF	Significance	
Pearson		45.83848		6	.00000	
Likelihood Ratio		36.88048		6	.00000	
Linear-by-Linear Association		10.81159		1	.00101	

Minimum Expected Frequency - 1.534
Cells with Expected Frequency < 5 - 2 of 12 (16.7%)

Number of Missing Observations: 0

TABLE 16 : THE RELATIONSHIP BETWEEN LOOKING ENGAGEMENT AND TASK SUCCESS
AGE GROUP 2 (TASK LEVEL 1)

TLEV1TS task level 1 success by ATLOOK attention/looking
(diffic=2,age=2,tasklev=1)

		ATLOOK					
Count							
Row Pct							
Col Pct							
Tot Pct		1	2	3	4	Row Total	
TLEV1TS	1	129	15	13	2	159	
		81.1	9.4	8.2	1.3	67.4	
		68.3	53.6	81.3	66.7		
		54.7	6.4	5.5	.8		
	2	50	9	1		60	
		83.3	15.0	1.7		25.4	
		26.5	32.1	6.3			
		21.2	3.8	.4			
	4	10	4	2	1	17	
		58.8	23.5	11.8	5.9	7.2	
		5.3	14.3	12.5	33.3		
		4.2	1.7	.8	.4		
Column		189	28	16	3	236	
Total		80.1	11.9	6.8	1.3	100.0	
Chi-Square		Value		DF	Significance		
Pearson		11.29956		6	.07955		
Likelihood Ratio		11.26950		6	.08040		
Linear-by-Linear		1.97169		1	.16027		
Association							

Minimum Expected Frequency - .216
Cells with Expected Frequency < 5 - 6 of 12 (50.0%)

Number of Missing Observations: 1

TABLE 17 : THE RELATIONSHIP BETWEEN LOOKING ENGAGEMENT AND TASK SUCCESS
AGE GROUP 2 (TASK LEVEL 2)

TLEV2TS task level 2 success by ATLOOK attention/looking
(diff=2,age=2,tasklevel=2)

		ATLOOK					
Count							
Row Pct							
Col Pct						Row	
Tot Pct		1	2	3	4	Total	
TLEV2TS	1	131	36	12	27	206	
		63.6	17.5	5.8	13.1	73.0	
		72.4	72.0	57.1	90.0		
		46.5	12.8	4.3	9.6		
	2	15	3	2	3	23	
		65.2	13.0	8.7	13.0	8.2	
		8.3	6.0	9.5	10.0		
		5.3	1.1	.7	1.1		
	3	13	1	1		15	
		86.7	6.7	6.7		5.3	
		7.2	2.0	4.8			
		4.6	.4	.4			
	4	22	10	6		38	
		57.9	26.3	15.8		13.5	
		12.2	20.0	28.6			
		7.8	3.5	2.1			
	Column		181	50	21	30	282
	Total		64.2	17.7	7.4	10.6	100.0

Chi-Square	Value	DF	Significance
Pearson	15.62104	9	.07523
Likelihood Ratio	20.39263	9	.01564
Linear-by-Linear Association	1.17659	1	.27805

Minimum Expected Frequency - 1.117
Cells with Expected Frequency < 5 - 8 of 16 (50.0%)
Number of Missing Observations: 0

TABLE 18 : THE RELATIONSHIP BETWEEN LOOKING ENGAGEMENT AND TASK SUCCESS
AGE GROUP 3 (TASK LEVEL 2)

TLEV2TS task level 2 success by ATLOOK attention/looking
(diff=2,age=3,tasklevel=2)

		ATLOOK			
Count					
Row Pct					
Col Pct					
Tot Pct		1	2	3	Row Total
TLEV2TS	1	124	18	7	149
		83.2	12.1	4.7	100.0
		100.0	100.0	100.0	
		83.2	12.1	4.7	
Column		124	18	7	149
Total		83.2	12.1	4.7	100.0

- - - - - Chi-Square Test

ATLOOK attention/looking

		Cases		
Category	Observed	Expected	Residual	
1	124	49.67	74.33	
2	18	49.67	-31.67	
3	7	49.67	-42.67	
Total		149		

Chi-Square	D.F.	Significance
168.0939	2	.0000

TABLE 19 : THE RELATIONSHIP BETWEEN LOOKING ENGAGEMENT AND TASK SUCCESS
AGE GROUP 3 (TASK LEVEL 3)

TLEV3TS task level 3 success by ATLOOK attention/looking
(diffic=2,age=3,tasklevel=3)

		ATLOOK				
	Count					
	Row Pct					
	Col Pct					
	Tot Pct	1	2	3	4	Row Total
TLEV3TS		-----+				
	1	188	28	14	1	231
		81.4	12.1	6.1	.4	100.0
		100.0	100.0	100.0	100.0	
		81.4	12.1	6.1	.4	
		-----+				
	Column	188	28	14	1	231
	Total	81.4	12.1	6.1	.4	100.0

- - - - - Chi-Square Test

ATLOOK attention/looking

Category	Cases		
	Observed	Expected	Residual
1	188	57.75	130.25
2	28	57.75	-29.75
3	14	57.75	-43.75
4	1	57.75	-56.75

Total	231		

Chi-Square	D.F.	Significance
398.0043	3	.0000

TABLE 20 : THE RELATIONSHIP BETWEEN SELF- , TASK- AND NON-ENGAGEMENT WITH AGE

MENG motor engagement combined by AGE age of subject
(diff=2,meng>0)

MENG	AGE				Row Total
	Count				
	Row Pct				
	Col Pct				
	Tot Pct	1.00	2.00	3.00	
1.00 SELF	20	54	42	116	11.3
	17.2	46.6	36.2		
	6.6	13.0	13.5		
	1.9	5.2	4.1		
2.00 TASK	273	329	264	866	84.1
	31.5	38.0	30.5		
	89.8	79.3	84.9		
	26.5	31.9	25.6		
3.00 NON	11	32	5	48	4.7
	22.9	66.7	10.4		
	3.6	7.7	1.6		
	1.1	3.1	.5		
Column		304	415	311	1030
Total		29.5	40.3	30.2	100.0
Chi-Square		Value		DF	Significance
Pearson		25.99804		4	.00003
Likelihood Ratio		27.71263		4	.00001
Linear-by-Linear Association		7.95508		1	.00480

Minimum Expected Frequency - 14.167

Number of Missing Observations: 0

TABLE 21 : Self Engagement in Relation to Age

SELFENG self engagement by AGE age of subject (without difficulty and selfeng greater than 0)

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SELFENG	Count	AGE			Row Total
		1.00	2.00	3.00	
1.00	19	39	42	100	86.2
2.00	1	15		16	13.8
Column Total	20	54	42	116	
	17.2	46.6	36.2	100.0	

Chi-Square	Value	DF	Significance
Pearson	16.90217	2	.00021
Likelihood Ratio	21.32448	2	.00002
Linear-by-Linear Association	2.34680	1	.12554

Minimum Expected Frequency - 2.759

Cells with Expected Frequency < 5 - 1 of 6 (16.7%)

Number of Missing Observations: 0

TABLE 22: Nonengagement by AGE

Count	AGE			Row Total
	1.00	2.00	3.00	
NONENG	-----+			
1.00	5	7	2	14
				29.2
-----+				
2.00	6	19	3	28
				58.3
-----+				
3.00		6		6
				12.5
-----+				
Column	11	32	5	48
Total	22.9	66.7	10.4	100.0
Chi-Square	Value		DF	Significance
-----	-----		----	-----
Pearson	4.82045		4	.30622
Likelihood Ratio	6.57424		4	.16017
Linear-by-Linear	.66042		1	.41641
Association				
Minimum Expected Frequency - .625				
Cells with Expected Frequency < 5 - 6 of 9 (66.7%)				
Number of Missing Observations: 0				

TABLE 23 : TASK ENGAGEMENT IN RELATION TO LOOKING ENGAGEMENT

TASKENG			
ATLOOK	Count		
	Exp Val		
	Row Pct		
	Col Pct		Row
	Tot Pct		Total
	-----+-----+		
	1	10	775
		23.4	71.0%
		1.3%	
		30.3%	
		.9%	
	+-----+		
	2	11	189
		5.7	17.3%
		5.8%	
		33.3%	
	1.0%		
+-----+			
3	10	95	
	2.9	8.7%	
	10.5%		
	30.3%		
	.9%		
+-----+			
4	2	32	
	1.0	2.9%	
	6.3%		
	6.1%		
	.2%		
+-----+			
Column	33	1091	
Total	3.0%	100.0%	

Chi-Square	Value	DF	Significance
-----	-----	----	-----
Pearson	98.78018	15	.00000
Likelihood Ratio	94.60683	15	.00000
Linear-by-Linear Association	12.34270	1	.00044

Minimum Expected Frequency - .763
Cells with Expected Frequency < 5 - 8 of 24 (33.3%)
Number of Missing Observations: 164

TABLE 24 : The relationship between External, Internal and Social speech with Executive actions

SPEECH3 speech with combined categories by MBEH motor behaviour

SPEECH3	MBEH		
	Count		
	Row Pct		
	Col Pct		
	Tot Pct	10	Row Total
-----+			
1.00	231	231	
	100.0	40.2	
	40.2		
	40.2		
+-----+			
2.00	235	235	
	100.0	40.9	
	40.9		
	40.9		
+-----+			
3.00	109	109	
	100.0	19.0	
	19.0		
	19.0		
+-----+			
Column	575	575	
Total	100.0	100.0	

- - - - - Chi-Square Test

SPEECH3 speech with combined categories

Category	Cases		
	Observed	Expected	Residual
1.00	231	191.67	39.33
2.00	235	191.67	43.33
3.00	109	191.67	-82.67

Total	575		
Chi-Square		D.F.	Significance
53.5235		2	.0000

TABLE 25 : THE RELATIONSHIP BETWEEN EXECUTIVE ACTION AND SPEECH
AGE: 1.00

SPEECH3	MBEH		
	Count		
	Row Pct		
	Col Pct		Row
	Tot Pct	10	Total
-----+-----+			
1.00	76	76	
	100.0	43.7	
	43.7		
	43.7		
+-----+			
2.00	45	45	
	100.0	25.9	
	25.9		
	25.9		
+-----+			
3.00	53	53	
	100.0	30.5	
	30.5		
	30.5		
+-----+			
Column	174	174	
Total	100.0	100.0	

TABLE 26 : THE RELATIONSHIP BETWEEN EXECUTIVE ACTION AND SPEECH
AGE: 2.00

		MBEH		Page 1 of 1	
	Count				
	Row Pct				
	Col Pct			Row	
	Tot Pct	10		Total	
SPEECH3	-----+-----+				
	1.00	97	97		
		100.0	46.9		
		46.9			
		46.9			
	+-----+				
	2.00	81	81		
		100.0	39.1		
		39.1			
		39.1			
	+-----+				
	3.00	29	29		
		100.0	14.0		
		14.0			
		14.0			
	+-----+				
	Column	207	207		
	Total	100.0	100.0		

TABLE 27 : THE RELATIONSHIP BETWEEN EXECUTIVE ACTION AND SPEECH

TABLE 27:
AGE: 3.00

SPEECH3	MBEH		
	Count		
	Row Pct		
	Col Pct		
	Tot Pct	10	Row Total
1.00	-----+		
	58		58
	100.0		29.9
	29.9		
2.00	-----+		
	109		109
	100.0		56.2
	56.2		
3.00	-----+		
	27		27
	100.0		13.9
	13.9		
-----+			
Column	194		194
Total	100.0		100.0

AGE: 1.00

- - - - - Chi-Square Test

Category	Cases		Residual
	Observed	Expected	
1.00	76	58.00	18.00
2.00	45	58.00	-13.00
3.00	53	58.00	-5.00

Total	174		

Chi-Square	D.F.	Significance
8.9310	2	.0115

Age 2

Category	Cases		
	Observed	Expected	Residual
1.00	97	69.00	28.00
2.00	81	69.00	12.00
3.00	29	69.00	-40.00

Total	207		
Chi-Square		D.F.	Significance
36.6377		2	.0000

AGE: 3.00

- - - - - Chi-Square Test

SPEECH3 speech with combined categories

Category	Cases		
	Observed	Expected	Residual
1.00	58	64.67	-6.67
2.00	109	64.67	44.33
3.00	27	64.67	-37.67

Total	194		
Chi-Square		D.F.	Significance
53.0206		2	.0000

TABLE 28 : THE RELATIONSHIP BETWEEN SELF-, NON- AND TASK-ENGAGEMENT WITH TASK SUCCESS (AGE GROUP 1)

TLEVITS task level 1 success by MENG motor engagement combined
(diff=2, tasklev=1, age=1)

		MENG			Row Total	
Count		1.00	2.00	3.00		
Row Pct	Col Pct					
Tot Pct						
TLEVITS	1	7	3	20	30	
		23.3	10.0	66.7	9.9	
		35.0	27.3	7.3		
		2.3	1.0	6.6		
	2		1	45	46	
			2.2	97.8	15.1	
			9.1	16.5		
			.3	14.8		
	4	13	7	208	228	
		5.7	3.1	91.2	75.0	
		65.0	63.6	76.2		
		4.3	2.3	68.4		
Column		20	11	273	304	
Total		6.6	3.6	89.8	100.0	
Chi-Square		Value		DF	Significance	
-----		-----		-----	-----	
Pearson		22.09393		4	.00019	
Likelihood Ratio		19.12039		4	.00074	
Linear-by-Linear		5.37661		1	.02041	
Association						

Minimum Expected Frequency - 1.086
Cells with Expected Frequency < 5 - 4 of 9 (44.4%)

Number of Missing Observations: 0

TABLE 29 A : THE RELATIONSHIP BETWEEN SELF-, NON- AND TASK-ENGAGEMENT WITH TASK SUCCESS (AGE GROUP 2 , TASK LEVEL 2)

TLEV1TS task level 1 success by MENG motor engagement combined
(diff=2, task level=1, age=2)

		MENG				
		Count				
		Row Pct				
		Col Pct			Row	
		Tot Pct	1.00	2.00	3.00	Total
TLEV1TS	1	29	2	99	130	
		22.3	1.5	76.2	66.3	
		100.0	66.7	60.4		
		14.8	1.0	50.5		
	2		1	50	51	
			2.0	98.0	26.0	
			33.3	30.5		
			.5	25.5		
	4			15	15	
				100.0	7.7	
				9.1		
				7.7		
Column		29	3	164	196	
Total		14.8	1.5	83.7	100.0	
Chi-Square		Value		DF	Significance	
Pearson		17.62862		4	.00146	
Likelihood Ratio		26.87653		4	.00002	
Linear-by-Linear		11.69871		1	.00063	
Association						
Minimum Expected Frequency -		.230				
Cells with Expected Frequency < 5 -		4 of 9 (44.4%)				
Number of Missing Observations:		0				

TABLE 29 B : THE RELATIONSHIP BETWEEN SELF-, NON- AND TASK-ENGAGEMENT WITH TASK SUCCESS (AGE GROUP 2, TASK LEVEL 2)

TLEV2TS task level 2 success by MENG motor engagement combined

		MENG		Page 1 of 1	
Count					
Row Pct					
Col Pct				Row	
Tot Pct		1.00	2.00	3.00	Total
TLEV2TS	1	12	26	122	160
		7.5	16.3	76.3	73.1
		48.0	89.7	73.9	
		5.5	11.9	55.7	
	2		3	10	13
			23.1	76.9	5.9
			10.3	6.1	
			1.4	4.6	
	3	6		5	11
		54.5		45.5	5.0
		24.0		3.0	
		2.7		2.3	
	4	7		28	35
		20.0		80.0	16.0
		28.0		17.0	
		3.2		12.8	
Column		25	29	165	219
Total		11.4	13.2	75.3	100.0
Chi-Square		Value		DF	Significance
Pearson		33.37802		6	.00001
Likelihood Ratio		32.15707		6	.00002
Linear-by-Linear		2.62721		1	.10505
Association					
Minimum Expected Frequency -		1.256			
Cells with Expected Frequency < 5 -		6 of 12 (50.0%)			
Number of Missing Observations:		0			