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Vygotskyan inner speech and the reading process

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ABSTRACT

There is a paucity of Vygotskian influenced inner speech research in relation to the reading process. Those few studies which have examined Vygotskian inner speech from a reading perspective tend to support the notion that inner speech is an important covert function that is crucial to the reading process and to reading acquisition in general. However, Vygotskian notions on inner speech, in particular, syntactic and semantic aspects of inner speech (e.g., predication, word sense and agglutination), have not been investigated in relation to the study of the decoding aspects of silent reading. In this paper, an argument is presented that Vygotskian inner speech acts in two main ways to process text during silent reading, as a mechanism which condenses chunks of text into compact meaning units and as a subvocal rehearsal mechanism which elicits meanings when reading cognition becomes problematic. In addition to this, a Vygotskian inner speech reading model is also described.

Vygotysky (1986) states, "…the area of inner speech is one of the most difficult to investigate" (p. 226). This certainly holds true today as it did in Vygotsky's time. This "investigative difficulty" may provide an explanation as to why this phenomenon has yet to warrant the intensive investigation that such a crucial language function deserves. For example, inner speech has been documented as an important phenomenon associated with language learning, language usage and language development, yet remains a dramatically under researched area. Indeed, researchers, such as de Guerrero (1999), Schinke–Llano, (1993) and Upton and Lee-Thompson (2001), have been calling for future research into this phenomenon for a number of years, with regrettably, very little response. With a few notable exceptions, inner speech research is still a relatively under explored phenomenon.

Lev Vygotsky has been the single most influential theorist in regard to contemporary inner speech investigations. His seminal work (1978, 1986) has influenced a number of L1 and L2 researchers. Indeed, many of his theoretical perspectives on inner speech have been validated by recent research. For example, the cognitive role of inner speech in terms of problem solving, (e.g.,

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Anton & DiCamilla, 1999; Frawley & Lantolf, 1985; Appel & Lantolf, 1994; Roebuck, 1998; Sokolov, 1972); the developmental nature of inner speech (e.g., de Guerrero, 1994; 1999); and that inner speech is a crucial language acquisition device (e.g., de Guerrero, 2004; McQuillan & Rodrigo; 1995; Upton & Lee-Thompson, 2001; Ushakova, 1994). In addition to this, Positron Emission Tomography studies have associated the neural correlates of inner speech with Broca's area, the same region associated with social speech (McGuire, Silbersweig, Murray, David, Frackowiak, & Frith, 1996), which offers tentative support for Vygotsky's (1978, 1986) chief tenet that inner speech is social speech turned inwards.

In terms of the reading process, there are few studies, which have incorporated Vygotskian inner speech theory into their designs. Those studies, which have examined reading from a Vygotskian theoretical perspective (e.g., de Guerrero, 2004; Sokolov, 1972), have found that inner speech plays a number of crucial roles in reading. It is posited here that if reading research is to advance as a science, some fresh perspectives are needed to inform debate. Recently, scholars, such as Karmiloff-Smith (1992), have argued that theories involving cognition should also take into account developmental and constructivist perspectives. Specifically, Frawley (1997) argues that Vygotskian theory can play an important role in the advance of the cognitive sciences. Taking these suggestions on board, the incorporation of Vygotskian inner speech perspectives into the reading process can provide further insights into understanding reading on a number of different levels and has the potential to open the door for a new line of empirical investigation.

This paper has been divided into three main sections. It begins with an overview of Vygotskian sociocultural theory and inner speech. The next section provides a brief description of the reading process. In the final section, cognitive processes involved in reading are discussed as manifestations of Vygotskian inner speech.

Vygostskian Sociocultural Theory

Scholars, such as Wells (1999) and Wertsch (2000), warn against superficial interpretations of Vygotskian theoretical perspectives; therefore, a summary of Vygotskian sociocultural theory is needed here to provide a context from which this complex phenomenon of inner speech can be understood. Vygotsky (1978, 1986) believed that language was a psychological tool and that the usage of this tool invariably led to a series of inner or mental transformations such as the development of higher thought and concept development. This transformation in thinking is achieved through a process of internalization in which language is the key ingredient. The process of internalization is described by Vygotsky (1978) as an "…internal reconstruction of an external operation" (p. 56).

The process of internalization as described by Vygotsky (1978) has three levels of transformation. The first level occurs when an initial external operation is reconstructed as an internal one. The second level occurs when interpersonal processes are transformed into intrapersonal processes. On this level, the cultural traditions of the group become internalized in the individual. Vygotsky (1978) states,

> [e]very function in the child's cultural development appears twice: first, on the social level, and later, on the individual level. (p. 57)

Here, the quintessence of his theory of sociocultural development is defined, that is, that all the higher mental functions such as voluntary attention, logical memory, and concept formation, have their origins as a consequence of human interaction.

The third level occurs after a long series of development (the transformation of the interpersonal to the intrapersonal). Once internalization has been achieved, the particular inner functions that result follow their own systemic rules. During all three levels of transformation,

integral to the internalization process is language, which is perceived as essential to the internalization of cultural forms of behaviour (Vygotsky, 1978).

Inner Speech

The phenomenon of inner speech, arising from its social origins, as internalized social speech, can now be considered within its ontogenetic context. Vygotsky argues that communication is the driving force behind speech in both adults and children. In its earliest stages in children, speech is social. This has a singular purpose (communication) and is multifunctional. Later, it becomes differentiated into egocentric speech and communicative speech. Vygotsky, Luria, Leontiev and Levina (1929) conducted a series of experiments on the egocentric speech of children. It was found that egocentric speech was a function directly connected to thought and problem solving (Vygotsky et al., 1929). Egocentric speech occurs when the child transfers social behaviour patterns to his or her "…sphere of inner-personal psychic functions" (Vygotsky, 1986, p.35). Therefore, when children are placed in the position of having to think, they will think aloud, utilizing the social aspect of speech. This egocentric speech becomes inner speech, which eventually disappears at the age of seven or eight (Vygotsky, 1986).

Vygotsky (1986) perceives language development as a process which begins through social contact with others and then gradually moves inwards through a series of transitional stages towards the development of inner speech. Inner speech arises in a developmental fashion: first there is social speech, then comes the egocentric speech of children and finally inner speech is formed. Vygotsky (1986) states, "…inner speech is speech for oneself: external speech is for others" (p. 225). Therefore, inner speech is in fact an entirely separate speech function from external speech. Furthermore, there are syntactic differences between inner speech and external speech. Inner speech consists of predicates (the leaving out of the subject) and is highly abbreviated.

> Predication is the natural form of inner speech; psychologically it consists of predicates only. It is as much a law of inner speech to omit subjects as it is a law of written speech to contain both subjects and predicates. (Vygotsky, 1986, p. 243)

Vygotsky (1986) describes three main peculiarities of inner speech. First there is the prevalence of word sense [smysl] over word meaning [znachenie]. Borrowing from Paulhan (1928), word sense is described as "…the sum of all the psychological events aroused in our consciousness by the word" (Vygotsky, 1986, p. 245). Word sense is defined through the context in which it occurs, hence, it will fluctuate in different situations, whereas word meaning is static and unmoving. Word sense has many "zones", of which meaning is just one (Vygotsky, 1986, p.245).

For example, Vygotsky (1986) describes how word sense can change throughout the reading of a text with an example of Gogol's novel *Dead Souls*. The "souls" in the title refers to serfs or servants. The novel involves a charlatan who travels across 19th century Russia buying the deeds and titles of dead souls or servants in order to pass himself off as a member of the aristocracy. As the reader progresses through the novel, the title of *Dead Souls* begins to take on new associations such as a spiritual description of Russia as a desolate and empty wasteland, and the spiritual bankruptcy of its main characters. The sense of the title *Dead Souls* merges other aspects of the novel, e.g., the sense of the plot, the sense of Russia in the 19th century, the sense of the Russian people at the time, and provides a summary of the overall sense of the novel. In this summary, a myriad of meanings and semantic nuances can be brought to mind through the two words *Dead* and *Souls*.

Secondly, individual words can merge into a single word expressing a complex new idea as well as the meanings of its individual elements (also known as agglutination); and thirdly, that senses of words combine and flow into one another and influence each other (Vygotsky, 1986).

Therefore, inner speech has two main forms, a *syntactic* form (predication) and a more *meaning-centred* form through the development of word sense and agglutination.

In summary, inner speech, as a product of higher thought, arises through a series of developmental stages, going from the external world and travelling inwards, its genesis a result of an initial need to solve problems. This inner speech constitutes a separate language function that is centred on word sense and meaning and has its own syntactic structure. A brief summary of the reading process will now be described.

The Reading Process

It is generally accepted that reading, whether it be in a first language (L1) or a second language (L2), is an interactive process. In its simplest form, the interaction of the reading process can be depicted as an equation: $R=D$ x C, which translates as reading is equivalent to decoding times comprehension (Gough & Wren, 1999, p. 70). In other words, the written text must be analyzed from the interaction of two contrasting processes, i.e., the analytical particularistic evaluation (the decoding of individual units) in conjunction with broader, more global concerns (the use of context and inference to establish meaning). The degree to which each of these two contrasting perspectives (D or C) in the processing of written text is emphasized is a matter of contention among reading researchers. Some researchers argue a major role of comprehension/meaning over the decoding aspects of reading (e.g., Goodman, 1989 (L1); Carrell, 1989 (L2); Carrell & Eisterhold, 1989 (L2)), and some are in favour of a stronger role of decoding (e.g., Eskey, 1989 (L2); Gough & Wren, 1999 (L1)).

In order to read, the eye must first fixate on written text. What comes next in terms of decoding the letter, syllable, or character to retrieve meaning, however, is subject to much controversy and division among researchers (Jared, Levy & Rayner, 1999). In terms of recent research involving the decoding aspects of reading (e.g., orthographic, phonological and semantic processing), there is much debate over the role of phonology.

This debate among reading researchers can be broken down into two main areas (Perfetti, 1999). These two areas involve the role of phonological processes in regard to word identification, that is, whether phonological information helps access a word's meaning (*pre–lexical*), or whether its role is one of identification (*post–lexical*) (Perfetti, 1999). In other words, is written text translated into a speech code before a meaning is ascertained or is the meaning retrieved directly from the graphemic properties of the text? Put simply, how important is the sound of the word in the mind of the reader as s/he reads? In English reading, this debate has lasted a century (Jared et al., 1999).

In summary, reading is a complex process that involves the interaction of two levels of processing: decoding individual units and using text as a whole to establish broader meaning. In particular, the decoding aspect of reading is highly controversial territory for reading researchers.

Vygotskian Inner Speech and Cognitive Processes in Reading

Having revised Vygotskian sociocultural theory and briefly summarized reading as a process, the next section will argue that Vygotskian inner speech plays a number of key roles in silent reading. First, it will be argued that phonological activations in reading are not abstract sound codes but constitute inner speech phenomena per se. Next, it will be argued that the rehearsal of these phonological activations, also known as subvocal rehearsal, has a specific problem-solving function, which only emerges when unfamiliar or difficult to understand words are encountered during reading. The more difficult a word, the more inner speech "expands" as a subvocal rehearsal mechanism to extract these hidden meanings. It will then be argued that Vygotskian inner speech also functions to condense easy to read text into compact meaning units through

agglutination, predication and word sense. In this way, Vygotskian inner speech "contracts" to act as an efficient storage system for word meaning. Finally, a model is presented which explains the reading process as the interaction of inner speech expansion and contraction. The following argument has been organised into four main sections.

      (1) Phonological activations in reading can be considered inner speech per se
      (2) Inner speech expands as subvocal rehearsal to solve reading problems
      (3) Inner speech contracts to abbreviate text into easily stored meaning units
      (4) A Vygotskian inner speech reading model: expansion and contraction in reading

(1) Phonological activations in reading can be considered inner speech per se

One area that seems to have been ignored by inner speech reading researchers is the relationship between Vygotskian inner speech and graphophonic processes (retrieval of a speech code from an orthographic structure) utilized during silent reading. Relating the graphophonic reading process to Vygotskian inner speech, it could be argued that, at least in a literal sense, speech codes used during silent reading constitute Vygotskian inner speech per se, in that (1) they are a form of speech and (2) they are mental or covert. Indeed, speech codes used in silent reading have been known by many names "…including silent speech, inner speech, subvocalization, phonemic recoding, and acoustic recoding" (Kleiman, 1975, p. 323). However, it should be noted that Vygotsky (1986) did not investigate the role of inner speech in the reading process as such. His concerns were the relationship of inner speech to problem solving and the ontogenetic process. However, it seems reasonable to posit that the use of speech codes in the reading process is part of the same phenomenon of inner speech, which arises ontogenetically as described by Vygotsky (1978, 1986).

A number of studies have provided evidence that the phonological activation of words during silent reading acts in a similar way to overt speech (e.g., Abramson & Goldinger, 1997; Beggs & Howarth 1985; McCutchen & Perfetti, 1982). For example, in Abramson and Goldinger's (1997) study, it was found that during silent reading, the phonological activations of words mimicked overt speech in relation to the length of vowels and consonants. In two experiments utilizing a lexical decision task, participants were presented with a number of legal and illegal words and non-words controlled for vowel and consonant length. In experiment 1, target words were controlled for voiced and voiceless consonants which create a vowel length effect in spoken language. For example, the letter *t* usually results in a slightly shorter pronunciation of vowel *a* in the word *bat* than the vowel *a* preceding the letter *d* in the word *bad* (Abramson, & Goldinger, 1997, p. 1060). Here, *t* represents a voiceless consonant and *d* represents a voiced consonant. It was found that response times (RTs) were longer for words with voiced consonants and shorter for voiceless consonants. In experiment 2, Abramson and Goldinger (1997) examined the effects of initial consonant length and vowel length. In spoken English, some initial consonants are longer than others (e.g*., s, sh, ch, r, f* are long consonants and *p,k,t* are short consonants). Again, RTs were shorter for targets with short initial consonants and short vowels than for long initial consonants and long vowels. These experiments demonstrate, at least in the context of vowel and consonant length effects during lexical decision that phonological codes activated in silent reading mimic overt speech. Abramson and Goldinger (1997) state,

> The present data suggest that phonological representations activated in silent reading are best characterized as inner speech. (p. 1065)

Beggs and Howarth (1985) have argued that an important function of inner speech during silent reading is to provide access to prosodic elements such as rhythm, stress and intonation. In written text, prosodic elements are not explicitly stated (generally speaking). Therefore, when reading silently, inner speech can act as a way to "give voice" to these features. Beggs and Howarth (1985) argued that the use of prosodic features through inner speech can aid reading comprehension. In three experiments with children aged between 7 and 11 years of age and at

various reading levels, Beggs and Howarth (1985) demonstrated that inner speech plays an important role in reading. In the first two experiments, Beggs and Howarth (1985) examined children's recall of homophones and non-homophones in a short-term memory (STM) task. This task involved children being presented with sets of words written on cards. Some word sets were homophonic while others were not. The children had to recall the word sets in the correct serial order of their presentation. The assumption here was that, if the children were acoustically encoding the words in order to remember them, they would have greater difficulty with the homophone set than with the non-homophone set. It was found that children who were normal readers begin to acoustically encode written words at around 8 or 9 years.

In experiment 3, Beggs and Howarth (1985) investigated the effect of prosodically enhanced texts on children's reading comprehension. Children who were categorized as normal readers between the ages of eight and ten were presented with a number of short passages. Some of these passages were enhanced prosodically through markers, which identified stresses and pauses in the text. Children had to read these texts aloud and were then given comprehension questions to test their understanding of these short passages. It was found that when children read aloud the prosodically enhanced passages they performed significantly better on the comprehension questions than when they read aloud passages without prosodic enhancement. Therefore, when the elements associated with social speech, such as intonation, stress and rhythm are utilized in reading; children demonstrate a greater understanding of what is being read. Beggs and Howarth's (1985) study provides further support for the notion that inner speech in reading may be more of a case of inner *speech* than the mere access of abstract sound codes that assist word identification.

In summary, there is empirical evidence that links phonological activations in reading to inner speech per se. Having established that phonological activations in silent reading qualify as inner speech phenomena, the next part of this section will establish a connection between the rehearsal of phonological activations in the mind (subvocal rehearsal) and Vygotskian inner speech.

(2) Inner speech expands as subvocal rehearsal to solve reading problems

Leontiev, a colleague of Vygotsky's, argued that inner speech as a cognitive process has a direct memory function. Leontiev (1978) described inner speech as having two codes: a code to plan speech and to retain content in STM, and as a code to solve problems. In terms of retaining content in STM as a function of inner speech, there are many studies from cognitive psychology which support this claim. These studies have demonstrated that speech codes are used as a form of rehearsal (also known as subvocal rehearsal) to prevent decay or memory loss in STM (e.g., Baddeley, Thomson, & Buchanan, 1975; see Baddeley, 1986 for detailed review of these studies).

Baddeley (1986) describes the process of rehearsing information as a phonological code to prevent decay through his model of working memory. This model consists of a tripartite system involving a central executive processor and two slave systems. In these two slave systems, verbal information is stored in the phonological store and visual information is stored in the visual cache. Verbal information is rehearsed within the phonological store through a mechanism referred to as the phonological loop, which functions to prevent memory loss in STM or working memory (Baddeley, 1986).

Studies have shown that young children can store information as phonological codes but the actual silent rehearsal of this phonological information does not arise until around 7 years (e.g., Cowan & Kail, 1996; Flavell, Beach, & Chinsky, 1996). This provides an important link between subvocal rehearsal as a mechanism to retain verbal information in STM and Vygotskian inner speech. For example, Vygotsky (1986) argued that egocentric speech transforms into inner speech at around seven years of age. At the same age, children begin to subvocally rehearse words in their mind to remember them. This would infer that Vygotskian inner speech and subvocal rehearsal constitute the same multi-functional phenomenon; as a problem solver and as a

rehearser of verbal information in STM. This is consistent with Leontiev's (1978) dual code description of inner speech.

It is useful at this point to distinguish between two types of subvocal rehearsal: *maintenance* and *elaborative* (Craik & Watkins, 1973). Maintenance rehearsal constitutes the subvocalization of words in order to maintain them in STM, whereas elaborative rehearsal is a more complex process necessary for memory retention beyond the short term (Craik & Watkins, 1973). In a reading context, it is probable that both maintenance and elaborative subvocal rehearsal play important roles in processing written text.

Subvocal rehearsal has been associated with word storage in English reading (e.g., Kleiman, 1975; Pollatsek, Lesch, Morris & Rayner, 1992). For example, Pollatsek et al. (1992) link phonological coding in word identification to phonological coding in STM. Pollatsek et al. (1992) state that there is general agreement among reading researchers that phonological coding helps readers retain information in STM. Using the "moving window" paradigm of McConkie and Rayner (1975) as a basis, Pollatsek et al. (1992) conducted a series of experiments at both the word and sentence level to examine the role of phonological codes in reading. The "moving window" paradigm involves a 'window' of text situated in relation to the letter that is being focused upon by the reader. When the reader moves along to another letter, the window also moves. Outside of this window, text appears mutilated and obscure (Pollatsek et al., 1992). Pollatsek et al. (1992) argue that phonological coding as an aid in word recognition and phonological coding as a means of storing information in STM may be intertwined. In Pollatsek et al.'s (1992) study, a type of maintenance subvocal rehearsal is described, which holds words in STM as the eye moves across saccades of text.

An example of elaborative subvocal rehearsal can be found in Baddeley and Lewis's (1981) study, which involved readers holding complex sentences in working memory and making meaning based judgements on theses complex sentences. Baddeley and Lewis (1981) have shown that subvocalization affects the accuracy of processing complex written text. For example, in a reading experiment utilizing a sentence verification task, subjects were presented with long complex sentences, some of which were semantically meaningful and some of which were not. Sentences, which were not semantically meaningful, were similar to the semantically meaningful sentences except that they contained an anomalous word. For example, *She doesn't mind going to the dentist to have fillings, but she doesn't like the pain [rent] when he gives her the injection at the beginning* (Baddeley & Lewis, 1981, p.113). The semantically meaningfully sentence would contain the word *pain* while the semantically nonsensical word would contain the anomalous word *rent* (Baddeley & Lewis, 1981).

These sentences were presented to the subjects visually. The verification task was to determine whether or not each complex sentence was meaningful. During the verification tasks, subjects were required to count repeatedly from 1 to 6 to impair phonological processing (this technique is known as *articulatory suppression*). Baddeley and Lewis (1981) found that while the time it took subjects to perform the sentence verification task was not affected, the accuracy of task performance was significantly impaired by articulatory suppression. Therefore, during the reading of complex sentences, subvocal rehearsal serves an important function in the accurate retrieval of meaning from complex written text. It is likely that elaborative subvocal rehearsal is being described here because cognitive processing involves more than just STM storage.

So far it has been argued that subvocal rehearsal is a manifestation of Vygotskian inner speech and that elaborative subvocal rehearsal is a phenomenon crucial to extracting meaning from complex sentences during reading. In the next part of this section, elaborative subvocal rehearsal will be discussed as a problem-solving mechanism that emerges when written text is difficult to process.

Elaborative subvocal rehearsal and problem solving. Researchers, such as Pollatsek et al. (1992), suggest that phonological access of words during reading aids the retrieval of a word's meaning and effectively stores it in STM as the window of text is absorbed by the moving eye.

Pollatsek et al.'s (1992) reading paradigm infers that words, which are encountered automatically, trigger a phonological code which then serves to store the word in STM. Now, when reading, not all words encountered by the moving eye are equal in regard to complexity, frequency or familiarity. There is a large body of evidence that suggests that high frequency words are processed more quickly and efficiently than low frequency words (Rayner & Clifton, 2002). For example, in terms of lexical decision tasks, low frequency words take an average of 100 – 150 ms longer than high frequency words to process (Rayner & Clifton, 2002). This is significant because lexical decision tasks involve reading. The fact that high frequency words take less time to process than low frequency words in a reading context suggests that either (1) the same process is taking place but the process takes much longer for low frequency words or (2) that there may be two different processes involved, one for high frequency words and one for low frequency words. Evidence for the latter position comes from studies which exclusively link the retrieval of phonological codes during silent reading to low frequency words. For example, in a series of six experiments on adult readers, Jared et al. (1999) found that phonological processes were only activated during the reading of low frequency words.

The problem-solving component of Vygotskian inner speech may offer an explanation for why low frequency words result in the access of phonological codes during silent reading. For example, when cognition is challenged in reading, arising through exposure to a word that is unusual, inner speech as elaborative subvocal rehearsal may resurface to assist in the retrieval of meaning from this unknown or rare word. Vygotsky (1986) described the ontogenetic development of inner speech of children through the need to solve problems. In silent reading, the cognitive challenge of encountering an unusual word may result in the usage of the social device of speech in order to determine or elicit a meaning from the presented unfamiliar or low frequency word. Recall the aforementioned studies (e.g., Abramson & Goldinger, 1997; Beggs & Howarth, 1985), which have strongly associated social speech with inner speech.

The adult reader, when confronted with an unfamiliar word, may need to rely on old and tested methods of social speech to elicit meaning or to resolve a reading problem. Through the ontogenetic process, this social speech has been internalized and now surfaces as a mechanism to elicit a meaning from an unknown or unfamiliar word through inner speech as elaborative subvocal rehearsal. Here, the phonological aspects of the word are necessary and brought to the fore in order to extract thought or meaning. It can be compared to the egocentric speech of children whereby to solve a problem, speech is uttered as a means of thought extraction. The words are spoken first and then thought is extracted from these spoken words. In a similar fashion, the adult, when confronted with a problem or unusual word, needs to inwardly "hear" the word through accessing its phonological component.

Evidence for this can be found in Baddeley and Lewis's (1981) study whereby elaborative subvocal rehearsal was necessary for processing complex sentences. It may be that this elaborative rehearsal acts in a manner as described by Beggs and Howarth (1985), in that inner speech functions to manifest the prosodic qualities of the printed text in order to elicit hidden meanings.

Sokolov (1972) provides strong empirical evidence that during reading, inner speech becomes reduced or abbreviated when familiar text is encountered and that, conversely, when more complex text is encountered, inner speech becomes more expanded. In Sokolov's (1972) study, he equated movement of the mouth musculature as a measure of inner speech. A series of experiments were conducted in order to measure the amount of muscle activity connected with speech (tensions in the tongue and lower lip) during complex reading tasks (as well as a number of non-reading tasks). These reading tasks consisted of text in the subjects' native language and texts in a foreign language (chosen at a proficiency level above that of the subjects). The muscle activity was detected through a measure of electrical activity (in oscillograms).

The findings revealed that strong motor speech impulses were detected during the reading of foreign language texts when the subjects' mastery of the foreign language was insufficient and

when the subjects read texts in their own language during complex phrases in these texts. It was also discovered that when the difficulty level of the task was reduced, the levels of speech musculature were also reduced. Another interesting finding of this study was that when subjects' mouths were clamped shut, i.e. when movement of the speech musculature was severely restricted, the subjects' ability to complete tasks was greatly reduced. In particular, it was found that the simpler the text, the more abbreviated or reduced was the inner speech of the participant. When participants read more complex or unfamiliar texts the more expanded or "unfolded" their inner speech becomes (Sokolov, 1972). Referring to inner speech and reading simple and complex text, Sokolov (1972) stated,

> This is a description of the process of understanding an abstract text by repeating individual phrases and generalizing them to a single idea. This process required that words be articulated in an unfolded manner...the simpler the text the more abbreviated would be its reproduction. Only a few generalizing words, a brief textual scheme, are fixed when a text is simple. This is not enough when a difficult text is to be understood; a more unfolded form of its reproduction is required here (p.115).

Sokolov's (1972) study provides empirical evidence for the notion that inner speech becomes abbreviated during reading tasks, which are familiar or do not pose a cognitive challenge, and that inner speech becomes expanded when cognition is challenged. The notion of inner speech expansion can be explained through *elaborative* subvocal rehearsal. That is, when a word is encountered which is unfamiliar, inner speech through elaborative subvocal rehearsal conjures up prosodic elements of the text to elicit hidden meanings drawing upon top-down information from the printed text.

In the next part of this section, it will be argued that the syntactic features of Vygotskian inner speech, as well as word sense, functions as a semantic storage mechanism during silent reading.

(3) *Inner speech contracts to abbreviate text into easily stored meaning units*

Yaden (1984) has argued that Vygotskian inner speech as a predicated structure may reduce meaning to its most essential unit and hence facilitate rapid reading. This predicated nature of inner speech, as a device for rapid reading, also implies an economical way of storing units of meaning. Consider the phenomenon of agglutination, whereby a number of individual words merge into a single word expressing a complex new idea as well as the meanings of its individual elements. In terms of Vygotsky's (1986) notions on inner speech, whole words and even passages can merge or be agglutinated into singular meanings. This agglutination could act in the manner of an efficient STM storage device. However, unlike STM which utilizes the acoustic or phonological components of words and subvocally rehearses them in order to prevent memory loss as described by Baddeley (1986), agglutination could act as a *meaning* specific STM device in reading. It is possible that a STM device, which agglutinates many meanings into few, may constitute a more effective storage facility than maintenance subvocal rehearsal. For example, STM studies have demonstrated that purely verbal or acoustic memory has a range of approximately seven items (e.g., Miller, 1956; Zhang & Simon, 1985) whereas up to 20 items can be retained effectively in STM in whole sentences which have a coherent meaning (Wingfield & Butterworth, 1984). This evidence strongly suggests that semantic memory is more efficient and effective than a purely acoustic or phonologically based memory system.

Furthermore, studies have shown that inner speech is a highly efficient and effective generator of language. For example, inner speech can be generated at a much faster rate than overt speech (Anderson, 1982; Mackay, 1981) and that this difference in speed is of the order of 15% - 25% (Coltheart, 1999). Hence, inner speech far exceeds the capability of overt speech production. In terms of the reading process, it would make sense that the most efficient STM system would be utilized during silent reading. By this, I posit that semantic STM (as Vygotskian inner speech) would provide a faster and better way of storing information during reading than

the speech based maintenance subvocal rehearsal mechanism as suggested by researchers such as Pollatsek et al. (1992). If readers store every word in STM as a phonological code as they process saccades of text then the reading process would take a lot of time. For example, in an early study by Baddeley, Thomson and Buchanan (1975), temporal measures of subvocal rehearsal for a number of words respective to word length were recorded (as sound waves). It was demonstrated that long words such as *cyclone, coerce* and *tycoon* had an average of .77 seconds whereas short words (e.g., *ember, wicket*) had a duration of .46 seconds (Baddeley et al., 1975). Therefore, subvocal rehearsal would seem a cumbersome mechanism as a STM storage facility for words during silent reading. If a short word takes approximately half a second to subvocally store and rehearse in STM, then the average abstract (150 words) of an article would require approximately over a full minute, just in terms of *storage time*. This is not counting the temporal cognitive demands of other reading-related processes, (e.g., top-down factors), which would have to be accounted for.

Therefore, in terms of silent reading, it is reasonable to argue for a memory mechanism that favours a more semantically orientated storage mechanism than a purely phonologically based one. In other words, Vygotskian inner speech, which predicates and agglutinates chunks of text into efficient and easily retainable meaning units may provide a more effective and efficient system of information storage during silent reading than maintenance subvocal rehearsal. It may be that the storage of words in STM during the processing of saccades of text becomes predicated and agglutinated through transposition into Vygotskian inner speech, whereby the number of words that would need to be stored is greatly reduced. In this way, the cognitive load in STM could be substantially reduced and enable chunks of text to be stored without maintenance subvocal rehearsal. Vygotsky (1986) states,

> [i]n inner speech, one word stands for a number of thoughts and feelings, and sometimes substitutes for a long and profound discourse. (p. 248)

In terms of graphophonic processing, this would suggest a direct route reading approach. That is, word meaning is retrieved from the orthographic structure directly, bypassing the need for the triggering of phonological codes. However, this does not completely rule out the usage of phonological codes to retain words in STM during reading. It is argued here that the two systems act in an interactive manner, dependent on the complexity or familiarity of the text being processed. This Vygotskian interpretation of inner speech, when combined with graphophonic processes involved in silent reading, fits nicely with the notion that both the direct and indirect routes are utilized during silent reading, a perspective which many reading researchers share (Jared et al., 1999). That is, when familiar words are encountered during reading they are immediately predicated and agglutinated into meaning units (the direct route) but when less familiar words are encountered, print to sound codes are triggered (the indirect route) and subvocal rehearsal mechanisms are activated (either maintenance or elaborative or both).

Vygotskian inner speech has been described thus far as having a dual role in the reading process; as a problem solver through elaborative subvocal rehearsal when difficult to read text is encountered and as a storage mechanism which condenses chunks of text into meaning units when words are easy to understand. In the last part of this section, a Vygotskian inner speech reading model will be proposed to explain the mechanics of reading cognition.

(4) A Vygotskian inner speech reading model: expansion and contraction in reading

Merging the features of Vygotsky's (1986) inner speech with Pollatsek et al.'s (1992) interpretation of the moving window paradigm, a model of reading can now be posited. The moving eye begins to encounter saccades of written text. As common or high frequency words appear within the moving window view, their semantic association is retrieved via the direct route from the printed word. This information is then predicated and abbreviated and finally,

agglutinated into condensed meaning units. However, as top-down factors emerge from the text, the *sense*s of words begin to take shape. As meanings merge into each other, word sense begins to develop and this development is steered by top down processes and more global aspects of the text. Vygotsky (1986) states,

> A word derives its sense from the sentence, which, in turn, gets its sense from the paragraph, the paragraph from the book, the book from all the works of the author (p245).

Word sense also acts as a way of abbreviating and agglutinating text. Whole paragraphs and chapters can be reduced to the sense of just a few words.

As a low frequency or unfamiliar word is encountered, this process is halted as the predication, agglutination and the development of word sense process is impeded. Because the semantic cannot be easily retrieved in the fashion of common, high frequency words, inner speech abbreviation, as an effective meaning processing and storage facility, cannot accommodate this new stimulus. Therefore, the semantic of this unfamiliar word must be attained via other methods such as elaborative subvocal rehearsal. Here, this new word is rehearsed subvocally until a meaning can be extracted from context clues. This constitutes the usage of expanded or unfolded inner speech to elicit the hidden meanings. This may involve the conjuring of prosodic elements to aid in this process of meaning attainment. In terms of context clues, episodic memory would come to the fore here, integrating the previous experience of the reader in order to either predict the meaning of the problem word or guess its meaning from the sense of context developed thus far from the text. When an appropriate meaning is attained, it can then be predicated and agglutinated into a condensed meaning unit and stored as such. These agglutinated meaning units in turn would fluctuate and be steered by top down reading factors to elicit word sense and the sense of the text as a whole.

Therefore, the difficulty or familiarity of the text would, to a large extent, determine the dominance of either the direct or indirect reading route and the extent to which predication, agglutination and word sense (inner speech abbreviation) or subvocal rehearsal (inner speech expansion) would be utilized. This process would help to explain why low frequency words warrant the retrieval of a phonological code during silent reading and would also explain the interactive roles of both the direct route and indirect route in silent reading.

In this way, inner speech functions both as a mechanism to reduce chunks of text into single units of meaning through predication, agglutination, and the development of word sense and to provide a means of attaining unfamiliar or unknown elements within a text through elaborative subvocal rehearsal as a mechanism for solving reading problems. Here, the syntactic and semantic structural features of inner speech work together with its problem-solving component (elaborative subvocal rehearsal) as part and parcel of the same ontogenetic phenomenon, all acting together to process the written word during the complex psychological act of reading.

It should be noted that this tentative reading model has not been posited as a serious challenge to established reading models (e.g., Sadoski & Paivio, 2001; Stanovitch, 1980). However, this theoretical description does serve to illustrate how Vygotskian inner speech notions can be woven into contemporary perspectives on reading cognition. The crucial point here is that Vygotskian inner speech theory can potentially provide a fresh perspective on some of the more controversial aspects of reading theory, such as the pre-lexical and post-lexical debate. It is hoped that the theoretical stance posited in this paper elicits some future debate on the merits of adopting a Vygotskian inner speech framework and applying it to the scientific study of reading.

Conclusion

Few reading studies have been influenced by a Vygtoskian inner speech theoretical framework. Those that have tend to support the notion that inner speech plays a crucial role in the

reading process. However, Vygotskian notions on inner speech, in particular, syntactic aspects of inner speech (e.g., predication), have not been investigated in relation to the study of cognitive processes in silent reading. In order to illustrate the potential of adopting a Vygotskian inner speech framework to a reading context, a tentative reading model was presented. This reading model consisted of two main inner speech functions of text processing; as an abbreviation mechanism (e.g., predication, agglutination, the development of word sense) to condense chunks of text into manageable meaning units and as an expansion mechanism (elaborative subvocal rehearsal) related to problem solving. These two inner speech reading functions acted interactively and were triggered subject to conditions of textual complexity such as word frequency. It was posited that future research, which combines Vygotskian notions on inner speech, may provide clues into cognitive processes utilized during silent reading.

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