Accessing word meaning: Semantic word knowledge and reading comprehension in Dutch monolingual and bilingual fifth-graders
Cremer, M.

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Chapter 2

Word knowledge and reading: theories and empirical insights

This chapter presents and discusses the theoretical and empirical background to this thesis and presents the research questions addressed in the studies presented in Chapters 3 to 5. In section 2.1 word knowledge as a multidimensional construct is discussed; section 2.1.1 explains the difference between semantic and associative relations between words, followed by a discussion of the development of semantic word knowledge in section 2.1.2. In section 2.2 findings from word association studies are reviewed. Section 2.3 discusses how semantic word knowledge is accessed and processed; section 2.4 moves from the fine-grained processes of word processing to the higher-level process of reading. The relevance of components of word knowledge for reading comprehension is discussed. In section 2.4.1 bilingual minority children are discussed as a group of special interest. Finally, section 2.5 summarises remaining issues and presents the research questions that are addressed in this thesis.

2.1 What’s in a word?

Word knowledge has for a long time been regarded as a one-dimensional, single construct, assessed by means of a traditional vocabulary size test. Viewing words as
separate, countable items allows for estimates of vocabulary size: eight-year-olds acquiring English as their L1 are estimated to have a vocabulary of around 6,000 words (Biemiller, 2005) with a figure of around 45,000 words for an average high school senior in the US (Nagy & Anderson, 1984). Research conducted by Vermeer (2001) among large numbers of elementary school children in the Netherlands, suggests that 12-year old native speakers of Dutch already have a receptive vocabulary of 16,000 words. However, learning words is more than acquiring an item yes or no: there is growing evidence that lexical knowledge is a multi-dimensional construct, or actually that it comprises multiple constructs.

The complexity of lexical knowledge was already discussed by Cronbach (1942) and is nicely summed up by Nagy and Scott (2000) who state that word knowledge is gradient, multidimensional, multiple-layered, interrelated and heterogeneous. The dichotomy between vocabulary breadth and depth (Anderson & Freebody, 1985; Verhallen & Schoonen, 1998) or quantity and quality of word knowledge was already mentioned in section 1.2. Breadth refers to the number of words a language learner is familiar with, while depth relates to how well words are known. Put differently, while breadth refers to how many words have meaning for the individual, depth refers to how much meaning the words have for the individual. Depth of word knowledge can be defined broadly, ranging from knowledge of a word’s spoken and written form, its meaning, the words it collocates with, the grammatical patterns it occurs in, to the derivatives that can be made from it, and so forth (Henriksen, 1999; Nation, 1990; Nation, 2001; Richards, 1976). Importantly, depth is a gradual concept. At the most basic level, a word can be recognised but not well defined. As it is learned more in depth, the word can be defined in greater detail. Finally, relations can be made between the word and other words, several meanings of a word can be learned and the word can be used in different contexts (Tannenbaum, Torgesen, & Wagner, 2006). Several word-knowledge continuum frameworks have been proposed to illustrate the notion of degree of word knowledge, ranging from partial to full-fledged representations (see e.g., Henriksen, 1999; Schwanenflugel, Stahl & McFalls, 1997; Wesche & Paribakht, 1996; Wolter, 2001). An example of how knowledge of depth can be assessed is Wesche &
Paribakht’s (1996) Vocabulary Knowledge Scale instrument which measures depth of word knowledge using a five-point scale ranging from complete unfamiliarity, through recognition of the word form and some idea of its meaning, to the ability to use it with grammatical and semantic accuracy in a sentence.

Depth of word knowledge can also be more narrowly defined in terms of core meanings and semantic relations (Schoonen & Verhallen, 2008; Verhallen, 1994). Semantic depth has been measured by having test takers generate definitions or sentences containing target words, or by assessing a test taker’s ability to link words to – and distinguish them from – related words. An example of the latter approach is Read’s word-associates format (1993). Read used a multiple-choice test format which provides a practical way of assessing how well particular words are known. In the task, university students are presented with a stimulus word (e.g., *team*) and have to identify related words from a set of eight words. The relations are meaning-based (*group*), collocational (*sport*) or analytic/definitional (*together*). The researcher found differences between students in how well familiar words were known. Qian (1999) tested young adult Chinese and Korean ESL learners in Canada, using a similar format to Read’s. He found that the learners’ depth scores were correlated to vocabulary breadth and to reading comprehension. Another example of qualitative word knowledge testing is a study by Schmitt and Meara (1997) who tested Japanese students’ word association knowledge and verbal suffix knowledge of English and found those to be related to vocabulary size and general language proficiency.

The multidimensional conception of word knowledge is well-illustrated by the ‘lexical space’ formulated by Daller, Milton and Treffers-Daller (2007). In this model, word knowledge consists of vocabulary breadth, depth of word knowledge, and fluency (accessibility). As Figure 2.1 below shows, breadth, depth and fluency may develop independently and reach different levels for different words and different learners. Moreover, the three dimensions may have interdependent thresholds for growth, such that depth may grow only when a certain level of vocabulary breadth has been acquired, or that fluency may quickly improve as word knowledge deepens.
Although the dimensions of breadth and depth of word knowledge are inherently related (Meara & Wolter, 2004), several studies have shown that they are distinct constructs. Despite the substantial correlation between depth and breadth, measures of depth make a unique contribution to explaining variance in reading performance, beyond vocabulary size (Ouellette, 2006; Qian, 1999, 2002; Schoonen & Verhallen, 1998).

2.1.1 Semantic and associative relations between words

Theoretically, depth of word knowledge is distinct from breadth because depth of word knowledge reflects the degree to which concepts and contexts are linked together. This interrelatedness of words in the mental lexicon is expressed in the widely used network metaphor (Aitchison, 2003). The denser the network a word is in, the deeper or greater the knowledge of that word (Nagy & Herman, 1987). Lexical networks illustrate the intricate link between breadth and depth. When a new word is learned, this influences the whole system as a result of the item’s connectedness with other items (Meara & Wolter, 2004).
Connections between words are formed, strengthened or weakened as a function of their co-occurrence in language use (cake - candles) or due to overlap in meaning or semantic features (dog - bear). The former are commonly referred to as associative relations, the latter as semantic relations. Association strength of two words varies depending on how frequently they co-occur or how common it is for people to associate them; semantic relatedness varies depending on the degree of semantic overlap between two words. Since associative relations are based on real-world co-occurrence they are generally context-bound and sometimes subjective. Yet, for many words, association norms can be established (e.g., black – white, table - chair). Whereas associative relations may emerge between entire words, semantically related words can be said to be connected in terms of certain features. For instance, the words dog and bear overlap in the sense that they are both hairy, belong to the category animals, and have four legs. The words dog and cat share those features too and in addition both belong to the category pets. The more features two words share, the stronger they are related. At the same time, not all meanings can be described through features. What are the features of red? Can that word have meaning without reference to other colours or to objects of that colour? Lyons (1963: 59) posits that the meaning of a word is not locally contained in the lexical unit itself, but rather is determined by its relations with other words. This thesis focuses on depth as indicated by knowledge of (abstract) semantic relations between words.

2.1.2 The development of semantic word knowledge

Connections in the mental lexicon develop from idiosyncratic or context-bound associations into more abstract, semantic word knowledge such as category coordinate or superordinate relations, so that the lexicon contains both associative and semantic relations. In adults, knowledge of basic meanings and facts is assumed to have a hierarchical taxonomic structure (Medin, Ross, & Markman, 2005). Nelson (1996) reported that hierarchical category organisation is not well established until the early school years. Children’s word knowledge is built up continuously on the basis of words they encounter in particular contexts (dog – leash
walk) (see also Frishkoff, Perfetti, & Collins-Thompson, 2011). From their initial, context-bound knowledge, children are assumed to gradually abstract and refine category information (dog – animal) (Nelson, 1977). As their understanding of the world increases, children’s personal meanings develop into conceptual ‘core’ meanings (Nelson, 1974) or more conventional and ‘shared meanings’ (Nelson, 2007). As Mandler (1983) noted, taxonomic categories, such as subordinates and superordinates, are based on shared meaning and, unlike contextual or thematic categories, are atemporal, nonspatial, and hierarchical in format. Petrey (1977) showed that in free word association tasks, young children are more likely to respond to cue words with contextually related words (example from a medical context: examine – needle) than with abstract, semantic associations (examine – look at, check). She describes this development as a shift in children’s word knowledge from episodic to semantic: “[y]oung children associate primarily to the stimulus word's perceived contexts, older subjects to its abstract semantic content” (p. 57). As such, children’s conceptual and linguistic development is intertwined (Gopnik & Meltzoff, 1992). Understanding of variation in (the development of) semantic relations between words in the mental lexicon is not only of theoretical importance, it has also been linked to reading performance (Nation & Snowling, 1999; Qian, 1999; Schoonen & Verhellen, 1998). Below, I will discuss a number of studies that have investigated the development of abstract, semantic word knowledge.

It has been shown that young children’s categorizations are initially idiosyncratic and that their category boundaries become reliably less fuzzy with age. Alexander and Enns (1988) asked 3-, 4-, 5-, and 24-year-old participants to categorise a continuum of puppets. There was more agreement among five-year-old children than among three-year-olds, and the five-year-olds were more consistent across different categorisation tasks (free sorting, selection from a set of distractors and naming). When subjects were asked to explain their categorisations, younger children gave primarily idiosyncratic and unclassified responses (“they are all friends”; “he wants to be [an X]”), whereas older children referred mainly to specific visual properties of the puppets.
In a speeded category verification task, Jerger and Damian (2005) tested the recognition of exemplar pictures that were more or less related to the category of clothing by 4-14-year-olds and adults. Whereas adults were equally accurate in classifying typical (pants) and a-typical category objects (glove), children were more accurate with typical category objects. Children were also significantly less accurate than adults in classifying out-of-category related items (necklace). The authors found more pronounced age-related improvement in accuracy for atypical objects than for typical objects and for related out-of-category objects than for unrelated out-of-category objects, which may ‘reflect children’s increasing specification of the properties characterizing a category’ (Jerger & Damian, 2005: 67). Similar results were found in an experiment with printed words with adults, indicating that typicality and relatedness effects did not reflect merely picture-related processes.

In category generation tasks, young children are better at generating words that fit a certain context or script than words that fit abstract, taxonomic categories. They seem to prefer experience-based categories, which are also referred to as thematic or slot-filler categories. For example, cereal is a slot-filler item in the child’s category or script of [foods I eat for breakfast]. Nelson and Nelson (1990) used a category-generation task in which children name items within different categories. Kindergartners generated comparable numbers of items in the contextually constrained slot-filler condition (e.g., name foods that you eat for breakfast) and in the taxonomic condition (e.g., name foods), whereas second-graders (age 8 years) generated many more items in the taxonomic condition than in the slot-filler condition. Given these findings, Nelson and Nelson (1990) emphasized the role of development and experience in the shift from a slot-filler to a taxonomic strategy as the preferred strategy for categorizing vocabulary between ages five and eight. This shift in salience from thematic to taxonomic organisation seems to hold up across languages and industrialized and schooled societies. For example, Yu and Nelson (1993) compared monolingual Korean-speaking five- and eight-year-olds’ performance on a category-generation task. Similar to English-speaking children, young Korean-speaking children produced comparable numbers of items in the slot-filler and taxonomic conditions, whereas older children produced more items in the
taxonomic condition. Peña, Bedore and Zlatic-Giunta (2002) found similar qualitative changes in category generation for bilingual children. Although younger Spanish-English bilingual children ($M$ age = 5;1) generated approximately equal numbers of items in both conditions, older Spanish-English bilingual children ($M$ age = 6;5) were beginning to demonstrate a taxonomic bias.

Both context-bound and taxonomic relations between words are basic organizational principles of the lexicon. Although thematic relations have frequently been found to be the basis of children’s but not adults’ classification, Lin and Murphy (2001) found that when thematic relations are meaningful and salient, they have significant influence on adults’ category construction (sorting), inductive reasoning, and verification of category membership. After a series of ten experiments, the authors conclude that concepts function closely with knowledge of scenes and events and that this knowledge has a role in adults’ conceptual representations. Because thematic associations show a strong real world contiguity, they may sometimes co-activate each other more strongly than taxonomic relations in lexical tasks. For example, when asking people to come up with the first word that comes to mind the association between cake and candles may be stronger than the logical semantic relation between cake and bread.

The studies discussed above show that classifying on the basis of abstract, taxonomic relations becomes increasingly prevalent across tasks up to the preteen years (for an elaborate discussion, see Bjorklund, 2005). Education is said to promote knowledge of taxonomic or hierarchical categories (Nelson & Nelson, 1990). An early study in a non-industrialised society showed that farmers who received little education were more likely than secondary school students to use context-bound relations rather than taxonomic ones to categorise entities (Scribner, 1974). Taxonomic knowledge becomes especially important as children start using more abstract reasoning, for example in reading comprehension. By the end of elementary school (around the age of 11) children may be expected to have both a firmly rooted context-bound knowledge of words and a well-developed context-independent, semantic knowledge of words.
2.2 Word associations as a reflection of semantic networks

Many researchers have investigated differences between children in knowledge of semantic relations between words by using word associations. In the free word association task language users are presented with a set of stimulus words one-by-one and are asked to produce the first word that comes to mind. Reported associations are assumed to reflect connections between words in their respondent’s lexicon. As such, they may reflect the semantic representation of words (De Groot, 1989). Word associations are assumed to spring both from conceptually related representations and from representations that commonly co-occur in language use. Word association studies have compared different groups of learners such as younger versus older or native versus nonnative speakers. We might expect adult and native speaker networks to be denser and more highly organised than similar networks generated by children or L2 learners. However, consistent differences in word associations between learner groups have been hard to pin down, as the following discussion of association studies will show.

In the 1960s and 1970s, word association behaviour was used to study the developmental organisation of the L1 lexicon (e.g., Entwisle, 1966; Ervin, 1961; Nelson, 1977). Some L1 association research had shown that between 6-8 years of age a shift from syntagmatic responses (cold - outside) to paradigmatic responses (cold - hot) occurs (Cronin, 2002; Entwisle, 1966). Syntagmatic responses usually belong to a different grammatical class and occur with the stimulus word in a syntactic sequence; paradigmatic responses belong to the same grammatical class as the stimulus word. Syntagmatic responses have been said to be given before many semantic features have been acquired, whereas paradigmatic responses have been taken as indicative of a more developed semantic system (see e.g., Clark, 1970). What is often overlooked in the literature on this topic is that Entwisle (1966) also found that so-called late syntagmatic responses are typical of adults, although these seem different from children’s syntagmatic responses.

The syntagmatic-paradigmatic distinction has often been critised for being a distinction based merely on word class (Fitzpatrick, 2006; Namei, 2004; Petrey, 1977), a researcher-imposed distinction. Petrey (1977) has shown that syntagmatic
responses could spring from either semantic or episodic storage. For example, when presented with the word *add*, children gave the episodic responses *flour* (syntagmatic) and *cook* (paradigmatic); these would be classified differently in S-P terminology even though they are related in the same way to *add*: they come from the same situation or script. Petrey proposed distinguishing between episodic and semantic responses. Recent studies have used semantic-based classification of word association responses, distinguishing responses that are more or less meaning-related to the stimulus word (Namei, 2004; Fitzpatrick, 2006). For example, Fitzpatrick (2006) distinguished a meaning-based, position-based, form-based, and an erratic category with 17 subcategories.

L2 word association studies have shown that L2 learners have quite distinctive associations from native speakers (Riegel, Riegel, & Meyer, 1967; Riegel & Zivian, 1972). Some studies have claimed that the L1 mental lexicon is organized mainly on a semantic basis, while the organization of the L2 mental lexicon in the early stages of development is phonologically based, with phonological responses indicating less profound lexical knowledge (Meara, 1983). However, Nissen and Henriksen (2006) found what they called “a surprising majority” of syntagmatic responses in the L1 word association test they administered to 25 Danish 17-18-year-olds (p. 389), while they had expected a higher proportion of semantic responses. Namei (2004) found that phonological links occur also at advanced levels of proficiency, both in the L1 and L2, depending on degree of word knowledge: words that are barely known may elicit phonological associations, whereas well-known words are connected to other words mainly on a semantic basis (see also Wolter, 2001). Unclear is whether differences between L1 and L2 children and adults have to do with cognitive or linguistic development.

Namei (2004) found evidence for an age-related semantic shift in word associations. She compared free word associations of 100 Persian-Swedish bilingual students (age 6-22) to a Swedish and a Persian L1 control group. All bilinguals were socialized in Persian before they were exposed to Swedish to any meaningful degree. About half of the bilinguals were introduced to Swedish before age three. The latest age of onset for Swedish was age 15. The majority of the students rated
their proficiency to be higher in Swedish than Persian. Namei operationalised paradigmatic responses as semantically related to the stimulus word (bitter - taste), and syntagmatic responses as associations that form a phrase with the stimulus word (nice – dog; table - cloth); she also distinguished form-based responses. Semantic responses increased between the ages of six and ten in all groups, even though bilinguals are exposed to much less input in their languages, especially their mother tongue. The Swedish and Persian L1 and L2 groups showed roughly the same developmental response pattern with more semantic, as well as more abstract, low frequency syntagmatic (referred to by Namei as late syntagmatic) responses (deep – hole; moon – distant) with increasing age. Namei describes this age-related, cross-linguistic increase in semantic responses as “a function of cognitive development during the same period, which indicates that the development of logical and semantic relationships takes place as children grow older and gradually come to a better understanding of implicit relationships such as contrast, synonymy, hyponymy and meronymy, in addition to gaining knowledge about syntactic relations” (p. 381). At the same time, overall, L1 groups gave significantly more semantic responses and more abstract syntagmatic responses than the bilingual group in each of their languages. Also, these responses appeared at a younger age for the L1 speakers than for the bilinguals and for the bilinguals these appeared earlier in Swedish than in Persian. The bilinguals lagged behind the respective comparison groups three school years in the development of late syntagmatic associations in each language. Namei attributes these dissimilarities to the lower amount of language input for the bilinguals, especially in the mother tongue (Persian). Possibly, the cognitive development and corresponding semantic shift happen somewhat later in the bilinguals resulting in a lexical delay.

In the development of their semantic networks, bilinguals can be influenced by the levels of proficiency they have in their second language as well as the age at which they acquired the language and the way they learned and use it. Some L2 studies used the association task as a test of native(like)ness or proficiency in the L2, comparing L2 learners’ responses with those of native speakers (Kruse, Pankhurst, & Sharwood Smith, 1987; Schmitt, 1998; Sökmen, 1993). It has proved difficult to
establish stereotypical responses and to use word associations as a measure of proficiency (e.g., Wolter, 2002). When confined to first responses, reliability is generally high for words with smaller sets of associates and stronger primaries. Also, highly frequent words tend to elicit predictable words, especially among native speakers. But this homogeneity tends to disappear when words are less frequent (Fitzpatrick, 2007).

Li, Zhang and Wang (2011) tested bilingual students’ awareness of thematic and taxonomic relations in relation to their proficiency. A word association and forced-choice categorisation task showed equal awareness of taxonomic relations in L1 and in L2. Interestingly, however, students were more aware of thematic than taxonomic relations in L1, but less aware of thematic than taxonomic relations in L2. In a similar vein, Fitzpatrick and Izura (2011) found very few collocational associations (sheep – black, through the idiom black sheep) in the L2 compared with the L1 but a higher proportion of semantic associations (sheep – animal) in the L2 compared with the L1. These findings might suggest that the lexical-semantic organisation of the L2 is more guided by conceptual constraints and less by the conventional use of the language. Additionally, association responses in the L1 are generally faster than in the L2 (Fitzpatrick & Izura 2011; Namei 2004).

The empirical studies reviewed suggest that lexical acquisition and storage are likely to be affected by different factors for monolinguals and bilinguals and for a speaker’s L1 and L2. In (late) L2 learners the cognitive development that boosts semantic word knowledge is already complete and their developing L2 lexicon builds on the already well-formed L1 lexicon. Moreover, the setting and the way in which the L1 and L2 are learned affect their development. For child bilinguals, on the other hand, cognitive and lexical development are intertwined and may well be expressed in both the first and second language. Studies into associative behaviour have produced data that are largely inconclusive. The idea of semantic development is well-established, but an increase in semantic association responses has not been shown unanimously. It is still unclear to what extent word associations of younger and older L1 and L2 learners differ systematically (Fitzpatrick & Izura, 2011; Namei, 2004; Nissen & Henriksen, 2006). At the same time, the value of word
association responses as a reflection of semantic capacities remains unclear. Do word associations reflect semantic relations, lexical co-occurrence or associations between words recently used by the speaker? The association process may simply reflect some active bit of knowledge, rather than the quality or extent of a person’s knowledge. Semantic responses signal semantic knowledge, but when speakers do not produce (many) semantic responses this may not necessarily mean that they do not have much semantic knowledge.

2.3 The accessibility of word knowledge

Measures of vocabulary depth are typically concerned with declarative knowledge, which learners can consciously access and report in a vocabulary test, rather than the more implicit procedural knowledge that underlies word recognition, proficient listening comprehension or fluent conversational speech (Read, 2004). The ease with which language users use their vocabulary skills is fundamental to fluent speaking, listening, reading and writing. In fluent conversation we retrieve two or three words per second from a lexicon that contains tens of thousands of items (Levelt, Roelofs, & Meyer, 1999). Written words can be recognized in around 200 ms (Sereno & Rayner, 2003). In order to understand a word, we need to process the form or sound of that word, recognize the word itself and activate its meaning as well as related meanings. In his Verbal Efficiency theory Perfetti (1985) postulated that meaning access and related processes need to be fluent to save up time and cognitive resources to devote to the higher order interpretation processes such as reading. Several studies have shown differences between learners in the speed and automaticity with which they can access their word knowledge.

Word naming tasks show that words can be read out loud without accessing the lexicon. A direct mapping between spelling and sound, at least in regular words, allows for the pronunciation to be ‘read off’ the word, without necessarily identifying that word in the lexicon. This is shown by the fact that participants can read aloud both words and non-words: the orthographical and phonological processes involved do not require access to the lexicon, although of course such processes themselves are based on regularities in the lexicon. At the same time,
naming times have been found to be shorter for words than for nonwords, and for high frequency words shorter than for low frequency words, indicating that a lexical search procedure is also involved (Forster & Chambers, 1973). Exception words, with irregular spelling patterns, are generally assumed to be named with lexical support (Nation & Cocksey, 2009).

For word recognition, language users need to access their lexicon. In lexical decision tasks speed of access is measured, that is, the time needed to identify a stimulus word as an existing word or not. For this they need to find a match in their lexicon. The meaning of the word need not be activated. It has been argued that lexical decision does not require semantic processing (Shelton & Martin, 1992). Other research has shown that lexical decision responses are influenced by meaning integration processes, since lexical decision performance is inhibited by incongruous sentence contexts and facilitated by congruous sentence contexts (De Groot, 1985).

For word meaning to be activated, tasks require processing at the semantic level, such as category decision tasks (e.g., is the stimulus animate, does it denote an entity bigger than the screen you are looking at, is it fast or slow). For a semantic decision, in addition to recognising the word, its semantic network must be activated. In a rich semantic network, there are many relations and interconnectedness is high. For example, the word teeth may readily activate semantically related words such as bite, mouth, jaw, eat. It may also activate contextual associations such as tooth ache, false, dentist, grandma. The density of the lexical-semantic network surrounding a word influences how fast it is accessed or recognised. Tasks requiring semantic processing generally take longer than mere lexical tasks (Bueno & Frenck-Mestre, 2008; De Groot, 1990). The time course of the different processing levels is still subject of debate. Although semantic processing is probably completed after lexical identification, there is some indication that basic semantic information (e.g., is something good or bad; strong or weak) is involved in the recognition process from the start (Wurm, Vakoch, & Seaman, 2004).

Several studies have reported semantic feature effects on the speed of word recognition and semantic processing in young adults. Pexman and colleagues have
reported faster lexical decision and naming responses (Pexman, Lupker, & Hino, 2002) and faster semantic categorisation and self-paced reading times (Pexman, Holyk, & Monfils, 2003) for words for which participants could list many semantic features, as opposed to words for which participants could list fewer features. Experiments by Buchanan, Westbury and Burgess (2001) indicate that a large semantic neighbourhood (the number of words that could appear in similar lexical contexts) facilitates lexical decision and naming performance. However, in their study the lexical decision task seemed more reliant on semantic processing than naming. In addition, Pexman, Hargreaves, Siakaluk, Bodner and Pope (2008) showed that number of semantic neighbours, number of semantic features and contextual dispersion (the content areas in which words have been experienced) were related to lexical decision and semantic categorization performance. Higher values on each of the three semantic richness measures were correlated to faster responses in both tasks. Moreover, the three measures were significant predictors of responses in at least one task (lexical decision and/or semantic categorisation). The three measures were only modestly correlated, suggesting they do not all tap the same construct. These findings indicate that richness of semantic word knowledge influences word recognition and semantic processing.

Data from a timed association study suggest that degree of relatedness speeds up processing. Fitzpatrick and Izura (2011) found that adults’ free association responses were faster when stimulus and response were related in more than one way, for example by form and by meaning (postman – postbox) or by meaning and by collocation (spider – web) as opposed to only meaning related words. Responses that co-occur in the language and have a meaning relation with the cue word (meaning and collocation) were produced significantly faster than any other response type. In their association experiment, Fitzpatrick and Izura further distinguished between two types of semantic responses: responses whose meaning is equivalent (sofa – couch, prince – king) and responses whose meaning is related but not equivalent to the cue word (party – celebrate). The latter type of response took significantly longer to produce than the former. These results suggest that words with a direct semantic connection to the cue word or connected by more than one
route (form and meaning, meaning and collocation) are quickly and strongly activated.

Differences have been found between adults and children in semantic word knowledge and categorisation speed. The category verification study by Jerger and Damian (2005) discussed earlier showed not only that younger participants were less accurate at categorising objects as clothing but also that they were slower. Across the board, participants were faster at categorising typical objects (pants) and unrelated out-of-category objects (soup) than atypical (glove) and related out-of-category objects (necklace). However, younger participants were slower at responding to atypical category members and to related out-of-category objects. This suggests that for younger participants semantic category knowledge is less well developed, resulting in slower responses.

The works discussed above concern tasks that require conscious processing (categorise, list features, etc.). As such they do not directly tell us about language users’ underlying semantic representations. Priming studies can provide us with such information. Priming occurs when a target word (e.g. nurse) is recognised faster because of the preceding presentation of a related item, the prime (e.g. doctor) (Meyer & Schvaneveldt, 1971). The assumption is that “activation of the prime causes the target to be activated faster. Conversely, if a target word is activated faster (primed), you can be sure that the priming word must have been activated” (Altman, 1997: 71-72). The temporary facilitation observed in priming tasks is commonly attributed to the automatic spread of activation among semantically related elements in a memory network (Anderson, 1983; McNamara, 1992). Alternative explanations have also been put forward (Masson, 1995; Plaut & Booth, 2000; Ratcliff & McKoon, 1988). Some evidence suggests that semantic priming may not always be as short-lived as previously thought (Becker, Moscovitch, Behrmann & Joordens, 1997; Joordens & Becker, 1997). In a study with undergraduate students, Becker and colleagues demonstrate a semantic priming effect spanning many intervening items and lasting much longer than a few seconds (Becker, Moscovitch, Behrmann & Joordens, 1997). In a continuous animacy decision task, students were presented with a list of 15 prime words followed by a
list of 30 target words, with a two-minute pause in between. There was one prime per target. All words were preceded by an on-screen fixation cross which lasted one second. The set up resulted in an average lag of 21.5 items between a given prime and the corresponding word in the target list. On average, students were 35 ms faster at making semantic decisions for primed words than for unprimed words. Regardless of the exact nature of the underlying mechanisms or the duration of priming effects, semantic priming appears to reflect cognitive processes that depend on the interconnectedness or embedding of lexical knowledge in memory.

Words that are not only semantically related but also commonly associated have been found to show a significant increase in the size of the priming effect: the so-called associative boost (Lucas, 2000; Moss, Ostrin, Tyler, & Marslen-Wilson, 1995). To avoid this additional effect, several researchers have tried to dissociate semantic and associative effects by devising non-associated prime-target pairs (Shelton & Martin, 1992). Some researchers have claimed there is no evidence of priming based purely on association (Lucas, 2000) and that there is always some degree of featural overlap. McDonough & Trofimovich (2009) posit that differences between learners in semantic priming may provide a window into differences in lexical-semantic organisation.

Several researchers have connected semantic priming benefits to children’s developing semantic networks throughout childhood (Nakamura, Ohta, Okita, Ozaki, & Matsushima, 2006; Nation & Snowling, 1999). Perraudin and Mounoud (2009) compared children and adults’ instrumental and categorical knowledge to investigate the development of conceptual organisation. In a priming paradigm, they tested the automatic activation of instrumental and categorical relations, using a naming task and a categorical decision task. The results showed that on both types of task, adults and 9-year-old children showed instrumental and categorical priming effects. However, five-year-old children showed mainly instrumental priming effects while categorical effects remained marginal. Furthermore, the magnitude of the instrumental priming effects decreased with age. These processing differences suggest that young children’s word knowledge, in terms of semantic category knowledge and abstract semantic relations between words, is not yet fully
developed.

The studies reviewed above indicate that rich semantic word knowledge is needed for fluent word recognition and processing. Fast word recognition in adults seems to depend on the quality of underlying word representations. Semantic processing skills appear to be still in development in young children as they are less sensitive to semantic category information. It is unclear to what extent individual differences between children with regard to speed of word recognition and sensitivity to semantic priming are related to differences in language proficiency, in particular reading comprehension.

2.4 The role of word knowledge in reading comprehension

The relevance of lexical knowledge and skills for reading comprehension seems self-evident (cf. Mancilla-Martinez & Lesaux, 2010; Nakamoto, Lindsey, & Manis, 2008; Proctor et al., 2005). Words carry meaning and hence are fundamental for understanding text. Yet, the exact nature of the relationship between word knowledge and reading is not altogether clear. The sheer quantity of words known (breadth) is strongly predictive of reading comprehension, yet little is understood about how quality of word knowledge (depth) affects comprehension. To what extent do processing components of word knowledge affect reading? Is it sufficient that semantic word knowledge can be accessed consciously, or can readers only benefit from semantic word knowledge when it is activated automatically?

According to the simple view of reading (Gough & Tunmer, 1986) reading comprehension is the product of word decoding and general language comprehension. Vocabulary knowledge is subsumed under language comprehension. Word decoding could be viewed as a prerequisite for reading: words need to be decoded, before they can be comprehended. It has been stressed that the automatization of word decoding skill contributes to fluent reading levels (Perfetti, 1992; Stanovich, 2000). Decoding skill becomes less correlated to reading comprehension as children progress through elementary school (Sticht & James, 1984; Verhoeven, 1990; Verhoeven & Van Leeuwe, 2008), in contrast to vocabulary knowledge.
The importance of vocabulary size for reading comprehension has been well established in L1 research (Anderson & Freebody, 1981; Anderson & Freebody, 1983), L2 research (Laufer, 1992; 1996), and L1 and L2 research (Van Gelderen, Schoonen, De Glopper, Hulstijn, Simis, Snellings & Stevenson, 2004). Laufer (1992; 1996) showed correlations of up to .75 between vocabulary size and reading comprehension in English as a second language for first-year university students in Israel. There are indications that the relation between word knowledge and reading comprehension in L1 grows with age (Snow, 2002; Van Gelderen, Schoonen, Stoel, De Glopper & Hulstijn, 2007). Torgesen, Wagner, Rashotte, Burgess and Hecht (1997) found that vocabulary was a significant factor in the prediction of reading comprehension: second-grade vocabulary explained 24% of the variance in fourth-grade reading, whereas third-grade vocabulary explained 43% of the variance in fifth-grade reading comprehension. De Jong and Van der Leij (2002) found additional contributions of vocabulary size and listening comprehension to third-grade reading comprehension, after word decoding and first-grade reading comprehension had been taken into account. They state that the additional effect, after the autoregressive effect was controlled for, might reflect the outcome of a process of reciprocal causation since vocabulary and listening comprehension do not develop independently from reading comprehension. The reciprocity of the relationship is intuitively plausible: vocabulary enables comprehension, while comprehending what you read allows for meanings of words in the text to be inferred. It has indeed been shown that skilled (adult) readers are better than less skilled readers at learning new word meanings (Perfetti, Wlotko, & Hart, 2005).

The quality of word knowledge has also been shown to affect reading comprehension. In a longitudinal study using structural equation modelling, Verhoeven & Van Leeuwe (2008) found a substantial effect on reading comprehension of scores on a (receptive) word meaning test in which children had to identify the correct meaning from four possible meanings. Throughout the grades, knowledge of word meanings was related reciprocally to reading comprehension. This is in line with earlier research (Muter, Hulme, Snowling, & Stevenson, 2004; Snow, 2002). In a study with young adult readers, Braze, Tabor, Shankweiler and
Mencl (2007) showed that orally assessed word knowledge (comprising receptive vocabulary knowledge and expressive knowledge of word meaning) captured unique variance in reading comprehension after decoding skill and listening comprehension were taken into account. The contribution of word knowledge overlapped considerably with the contributions of decoding and listening comprehension, but was not wholly contained within them.

Ouellette (2006) investigated the unique contributions of vocabulary breadth and depth to reading performance. He assessed depth with a definition and a synonym task. Results showed that semantic depth made a significant contribution to reading comprehension even when vocabulary breadth and decoding skills were controlled. In addition, the variance in reading comprehension accounted for by receptive and expressive vocabulary breadth was shared in all hierarchical regression models tested, suggesting that the inclusion of only one of these measures of breadth is sufficient in the analysis of reading comprehension. Overall, vocabulary breadth and depth together explained 28.5% of the variance in reading comprehension. In a study with nine-year-old children, Nation and Snowling found that poor comprehenders were weaker on tasks of both receptive and expressive vocabulary (recognize synonyms, match figurative usage to meaning, define words, provide multiple meanings) than controls matched for decoding ability (Nation & Snowling, 1998). In line with this are outcomes from studies using a multiple-choice, word association format, based on Read (1993) which showed that success at identifying abstract meaning aspects of stimulus words was a unique contributor in the prediction of reading comprehension levels, in addition to the prediction afforded by vocabulary size scores (adults: Qian, 1999; children: Schoonen & Verhallen, 1998). Facility with decontextualized language has further been shown to be related to children’s reading ability.

There is strong evidence that breadth and depth of word knowledge overlap. Vermeer (2001) found correlations between breadth and depth to be so high that he concluded there is no conceptual distinction. Several studies use composite measures to create stronger predictors of reading (cf. Braze et al., 2007). Qian (2002) assessed the contributions of three vocabulary measures to reading
comprehension: a vocabulary depth measure (a word associates format measuring knowledge of synonymy, polysemy and collocation), a breadth measure (Vocabulary Levels test, Nation, 1983) and a TOEFL vocabulary (breadth) measure (measuring knowledge of synonyms). Qian reported that the three measures were similarly useful in predicting performance on a TOEFL reading comprehension test. When breadth and depth were entered in succession, vocabulary depth predicted 13% of variance in reading beyond the Vocabulary Levels measure and 14% of variance beyond the TOEFL measure.

Tannenbaum, Torgesen and Wagner (2006) stress the importance of considering fluency in the study of word knowledge. They examined the roles of three dimensions of word knowledge, breadth, depth and fluency, in third-grade reading comprehension. For breadth, receptive vocabulary and knowledge of word definitions were measured. Depth was assessed using a multiple meanings and an attributes test both of which involve word definitions. Fluency was measured using the Word Use Fluency subtest (Good & Kaminski, 2002) and a semantic category fluency task. Structural equation modeling revealed that a 2-factor model of breadth and depth/fluency provided the best fit to the data indicating that the three dimensions of word knowledge were not completely distinguishable. In the model, breadth was a significant predictor of reading comprehension, but the depth/fluency factor was not. A confirmatory factor analysis did reveal strong and significant correlations between reading comprehension and the breadth and depth/fluency factors respectively (.79 and .71). When combining standardized scores for the breadth measures and standardized scores for the four depth/fluency measures into a composite breadth and a composite depth/fluency score, Tannenbaum and colleagues did find a significant contribution of depth/fluency to reading comprehension in a regression analysis. The magnitude of the variance unique to depth/fluency was small (2%). The study also showed that over half of the variance in reading comprehension that was explained by the vocabulary measures was variance that the two vocabulary factors had in common. Tannenbaum and colleagues posit that depth of knowledge about meaning is highly associated with fluency of accessing a word’s meaning. These results show that the exact roles of
depth and accessibility of semantic word knowledge in reading comprehension are not quite clear.

Other studies have compared the semantic processing speed - or fluency - of differently skilled reader groups. Children with comprehension weaknesses were found to be slower and less accurate at deciding whether two spoken words are synonyms, especially for low-imageability items (Nation & Snowling, 1998a). At the same time, these children’s rhyme judgements did not differ significantly. These results indicate semantic but not phonological deficits. Weak comprehenders also produced fewer words in a speeded semantic category generation task, but not in a rhyme fluency task. A third experiment showed that poor comprehenders were slower at reading words with irregular spelling patterns and low-frequency words. These findings indicate that poor comprehenders have problems reading words that are typically read with support from semantics. In line with this are findings of oral vocabulary weaknesses in eight to ten year olds (Ricketts, Nation, & Bishop, 2007). Ricketts and colleagues found that children with poor reading comprehension were less able to verbally define words and read fewer exception words correctly. In spite of these outcomes it remains unclear to what extent individual differences in the accessibility of semantic knowledge help predict differences in reading comprehension.

Limitations in word knowledge have been suggested to be causally related to reading comprehension failure (Cromley & Azevedo, 2007). Vocabulary training studies reflect the importance of fast access to semantic word knowledge for reading comprehension. An experiment by Beck and colleagues (2002) revealed that instruction that involves multiple repetitions helps improve the speed of accessing the word’s meaning. According to Beck and colleagues good instruction helps children develop knowledge of the core concept of the word and how the word is used in different contexts to develop flexible knowledge about a word that contributes to reading comprehension. In studies that provided this rich vocabulary instruction, learners showed gains in both word knowledge and comprehension of text containing the words taught (Beck, McCaslin, & McKeown, 1980; Beck & McKeown, 1983; McKeown, Beck, Omanson, & Perfetti, 1983). Vocabulary that
does not produce sufficient fluency of access was found to not generalize to reading comprehension (cf. Jenkins, Pany, & Schreck, 1978).

The interrelationships among semantic word knowledge, lexical processing speed and reading comprehension are well captured in Perfetti’s verbal efficiency theory (1985) and in the lexical quality hypothesis (Perfetti and Hart, 2001, 2002). It proposes that the quality of lexical representations influences the ease with which those representations can be accessed. Quality here refers to the degree of orthographic, phonological and syntactic-semantic information and their integration. It is claimed that fast access to (semantic) word knowledge supports efficient word recognition as well as comprehension. High-quality word representations allow for automatic word processing, which enables children to use their mental resources for the comprehension of text, allowing them to use reading as a tool to acquire new concepts and information (Perfetti, 1998; Samuels & Flor, 1997). This again reflects the recurrent nature of the interaction: word knowledge allows for comprehension, comprehension allows for reading practice, reading practice strengthens word knowledge, and so forth.

There are indications that not only the speed of access but also the automatic activation of semantic word knowledge – as reflected by semantic priming – benefits reading comprehension. Nation and Snowling (1999) tested 11-year-old children and found that, although both good and poor comprehenders showed priming for function-related words (e.g. *broom – floor; shampoo – hair*), poor comprehenders only showed priming for words related through semantic categories (e.g. *cat – dog; airplane – train*) if these pairs were also strongly associated. Betjemann and Keenan (2008) also found evidence of semantic processing weaknesses in poor comprehenders. They assessed priming in children with reading disability and in age-matched controls (mean age 11;5), in visual and auditory lexical decision tasks. In the visual task, children with reading disability were found to have deficits in semantic (*ship – boat*), phonological/graphemic (*goat – boat*), and combined (*float – boat*) priming. The same pattern of semantic priming deficits also occurred in auditory lexical decisions, suggesting that the semantic deficits are a general semantic problem and not confined to the visual modality.
Moreover, the children with reading disability did not show greater priming in the combined condition than in the phonological/graphemic condition alone, suggesting that they are not getting any additional benefit from the semantic relatedness in the combined primes. The poor comprehenders also showed less priming than reading-age matched controls, suggesting that their priming deficits are not simply due to a lower reading level but are due to the reading disability in particular. These semantic deficits may contribute to both word reading and comprehension problems seen in children with reading disability.

Although most studies compare groups of proficient and less proficient readers on measures of semantic knowledge, Larkin, Woltz, Reynolds and Clark (1996) related individual differences in semantic priming to differences in reading comprehension. They administered measures of repetition priming and semantic priming to a sample of 60 sixth-graders. The children had to decide whether the two words in a word pair were synonyms or were unrelated. Priming could occur between consecutive pairs with up to three intervening pairs. There could be a like or positive match (e.g., \textit{big huge} as the prime followed after zero, one, or two intervening items by \textit{large giant} as the target) or a different or negative match (e.g., \textit{child city} as the prime item followed after zero, one, or two intervening items by \textit{kid town} as the target). The researchers report an average semantic priming effect of 75 ms across conditions, with more facilitation for positive compared to negative match items, which approached significance. There was no systematic effect of lag on priming. The semantic priming measure was found to account for 26% of the variance in reading comprehension. The repetition priming measure did not correlate significantly with reading. Larkin and colleagues conclude that individual differences in the spread of activation during verbal processing may underlie differences in some aspects of reading ability.

Weekes, Hamilton, Oakhill and Holliday (2008) had 32 children aged from nine to eleven study spoken words that were semantic associates (e.g., \textit{bed}, \textit{rest}, and \textit{awake}) or phonological associates (e.g., \textit{pole}, \textit{bowl}, and \textit{hole}) followed by free recall and a recognition test containing non-studied critical words (e.g., \textit{sleep} and \textit{roll}). Results showed reduced recall and recognition of critical words in the semantic
condition but not in the phonological condition for poor comprehenders, which shows that the tendency to infer themes from studied words in the semantic task is reduced in children with comprehension difficulties. Weekes and colleagues conclude that poor comprehenders are less sensitive to abstract semantic associations between words because of reduced gist memory. Gist traces represent interpretations of concepts (meanings, relations, and patterns) that are retrieved as a result of connecting the meaning across events. In this way, the gist is remembered, not the exact information (Kintsch & Yarbrough, 1982). Gist processes are generated automatically during text reading as a result of activation spreading across associative connections between words (Reyna & Kiernan, 1994).

In sum, although the importance of word knowledge for reading comprehension has been shown (cf. Mancilla-Martinez & Lesaux, 2010; Nakamoto et al., 2008; Proctor, Carlo, August, & Snow, 2005), the precise nature of the relationship and the components of word knowledge involved are not well understood. Empirical studies investigated participants from grade 1 up to adulthood and employed different operationalisations of depth ranging from knowledge of definitions and abstract category knowledge to combined depth/fluency measures. The distinguishability of breadth, depth and fluency is still unclear and a unique contribution of semantic word knowledge to reading comprehension has not been shown unanimously (see Vermeer 2001). There is research that suggests that also the automatic activation of semantic word knowledge – as reflected by semantic priming – explains variance in reading scores (Larkin et al., 1996). Differences between good and poor comprehenders in automatic activation of semantic word knowledge may suggest a delay in word knowledge development for poor readers. However, most studies concern group comparisons with reading-impaired children and controls. Research is needed to establish to what extent individual differences in semantic priming contribute to individual differences between children in reading.

2.4.1 **Word knowledge and reading in monolingual and bilingual children**

The link between vocabulary development and reading comprehension and by
extension academic achievement has been shown for both L1 (Snow, Porche, 
Tabors, & Harris, 2007) and L2 learners (Droop & Verhoeven, 2003; Proctor et al.,
2005; Schoonen & Verhallen, 1998). However, in some learning contexts young L2 
learners may not reach sufficient levels of word knowledge and reading to be able to
achieve academically. One such group are bilingual learners from a minority 
background. Numerous studies have shown that bilingual children who are exposed
to less input at home in the society’s main language fall behind their monolingual 
peers in language proficiency. Differences are well-established for vocabulary 
breadth (Appel & Vermeer, 1998; August, Carlo, Dressler, & Snow, 2005; 
Verhoeven & Vermeer, 1996). For example, Umbel and colleagues found that first-
grade, bilingual Hispanic children in Miami in the US have poorer receptive 
knowledge of second language (L2) English words (PPVT-R) than their (English) 
both English and Spanish at home (ESH) outperformed children speaking only 
Spanish at home (OSH) with the ESH group scoring low to average compared to 
monolingual norms.

In addition, significant delays in reading comprehension have been reported 
for bilingual minority children, despite the fact that these children have received the 
same education as monolingual children. In a research review, August and 
colleagues report that children speaking English as a second language who 
experience slow vocabulary development are less able to comprehend text at grade 
level than their English-only peers (August, Carlo, Dressler & Snow, 2005). Large 
and persistent gaps between the reading comprehension of language-minority and 
English-only children are mentioned as a result (see also Proctor et al., 2005). Droop 
and Verhoeven (2003) compared low SES Dutch third and fourth graders to the 
skills of low SES minority third and fourth graders from a Turkish or Moroccan 
background living in the Netherlands. The minority children were found to lag 
behind the Dutch children in reading comprehension and oral language proficiency. 
Furthermore, the oral Dutch skills of the minority children played a more prominent 
role in the explanation of their reading comprehension skills than the oral-language 
skills of the Dutch children, however. Delays in vocabulary and reading
comprehension have been shown to persist throughout elementary school (Aarnoutse, Van Leeuwe, Voeten, & Oud, 2001; Biemiller, 2005). Farnia and Geva (2007) show that even after years of schooling ethnic minority children do not catch up with their Canadian monolingual peers.

There is ample research that shows that bilingual children do not fail in decoding skills such as spelling and word reading, but lag behind in comprehension skills such as reading comprehension and vocabulary (Droop & Verhoeven, 2003; Smits & Aarnoutse, 1997; Verhoeven & Van Leeuwe, 2012). In a study with Spanish-speaking English language learners in fourth grade, Proctor and colleagues found that decoding played a less predictive role in reading comprehension than tests of oral vocabulary knowledge and listening comprehension. They conclude that given adequate L2 decoding ability, L2 vocabulary knowledge is crucial for improved English reading comprehension outcomes for English language learners (Proctor et al., 2005). Nakamoto, Lindsey and Manis (2007) conducted a longitudinal study with Hispanic English language learners and found that the children’s reading comprehension but not their word decoding began to fall behind the native English-speaking sample, starting in grade three (~nine years old). Similarly, in a large-scale study in the Netherlands on word knowledge, reading and writing literacy, Verhoeven en Vermeer (2006) found major delays in reading skills of ethnic minority groups in comparison to their native peers, while decoding differences between children were small. When Verhoeven and Van Leeuwe (2012) compared the reading comprehension performance, word decoding and listening comprehension skills of Dutch L1 and L2 learners (N= 1,293 and 394 respectively) throughout the primary grades, they found that the levels of word decoding were more or less equal in the two groups, whereas the L2 learners stayed behind their L1 peers in listening as well as reading comprehension. Linear structural models were computed separately for the early (1-2), intermediate (3-4) and upper grades (5-6). At each grade level the model was the same for the L1 and L2 learners. With progression of grade, the impact of word decoding on reading comprehension decreased, while the impact of listening comprehension showed an increase to the same extent in the two groups of learners. Indeed, it has been suggested that bottom-
up skills such as decoding largely drive the reading process in younger children (seven-nine years old) (Shankweiler, Lundquist, Katz, Stuebing, Fletcher, Brady, Fowler, Dreyer, Marchione, Shaywitz, 1999). So, despite delays for L2 learners in listening and reading comprehension, the relationships between decoding, listening and reading comprehension can be modeled in the same way for L1 and L2 learners.

Although bilingual children’s delays regarding reading comprehension and vocabulary breadth are now well established, differences between children in vocabulary depth are less well investigated. Vermeer (2004) compared Dutch monolingual and bilingual minority children in second grade (seven years old) on measures of lexical richness, definition skill and vocabulary breadth. He reported significant delays for bilingual children for all three measures. Lexical richness was operationalized as word variation and word frequency in the children’s spontaneous speech. Correlations between both lexical richness and definition skill ($r = 0.71$) and vocabulary breadth ($r = 0.50$) were substantial. In another study, Vermeer (2001) notes the danger that verbal definition tasks measure not just vocabulary, but also definition or abstract description skill. Cross-sectional data from the US, collected from fourth-grade Spanish-speaking and English-only children from four schools, also point to differences between L1 and L2 children (Carlo, August, McLaughlin, Snow, Dressler, Lippman, Lively & White, 2004). Two tasks examined children’s understanding of word meaning in production and comprehension: a polysemy task and a word association task (Schoonen & Verhallen, 2008). The results showed that English language learners not only know fewer English words but that their in-depth knowledge of word meaning is lacking as well.

Two studies explicitly looked at differences in children’s meaning assignment to words. Beside differences in reading skill, Verhoeven and Vermeer (2006) found that Mediterranean minority children’s competence in meaning assignment to written words increasingly lags behind those of their native Dutch peers with a delay of two to three school years by grade four (~ten years old). Verhallen (1994) investigated children’s semantic word knowledge as reflected by meaning assignment to words in an extended definition task. She interviewed 40 monolingual Dutch and 40 bilingual Turkish children (ages nine and eleven) about
the meaning of simple Dutch words like *book*, *nose* and *hair*. The analyses of the children’s associations and definitions showed that the bilingual children consistently mentioned fewer meaning aspects and came up with more syntagmatic and idiosyncratic associations than their monolingual Dutch peers, who provided more paradigmatic and context-independent meanings. For example, for the question ‘What is a nose?’ a typical bilingual response would be ‘With a nose you can smell’, whereas a typical monolingual response would be ‘A nose is a body part you can smell and breathe with’. Such differences in depth have been called hidden differences, since they are not obvious on the surface, as all children seem to more or less ‘know’ such simple words. When the researchers used a standardised, multiple-choice word association format, differences in meaning assignment between the learner groups persisted (Schoonen & Verhallen, 2008). In the Word Association Test (WAT), Schoonen and Verhallen asked children to identify the three words related to a target word. Children were required to make a distinction between words that are closely semantically related to the stimulus word and words that are associated with the word in a more incidental, context-bound way. The task is designed to have children consciously analyze and select appropriate meaning relations (see Figure 2.2). Findings showed that Dutch bilingual minority children were significantly worse at identifying related words for a given target word. Schoonen and Verhallen posit that this may signal a delay in semantic organization of the lexicon of these bilinguals. In a regression analysis, it was shown that depth scores obtained from the WAT contributed to children’s reading comprehension scores (Schoonen & Verhallen, 1998). It is not exactly clear what this contribution of depth to reading comprehension means. The depth scores may reflect differences in children’s underlying representations of word meaning and thus relate to reading performance. However, it may also be that monolingual children outperform bilingual minority children on the WAT simply because they are better problem solvers, rather than that there are differences in the children’s underlying semantic representations.
In contrast with the above is the study by Vermeer (2001) mentioned in section 2.4 who compared the breadth and depth of word knowledge of monolingual and bilingual minority kindergartners (mean age 5;6). For breadth, he used a receptive picture vocabulary task and a word description task (scored on a three-point scale); for depth, he used a structured interview task similar to the one used by Verhallen (1994). Monolingual children obtained higher breadth scores and in the interviews they mentioned more characteristics; however, there were no differences in the types of associations given in the interviews. Vermeer found high correlations between the breadth and depth measures for both monolingual and bilingual children, which lead him to question the conceptual distinction between vocabulary breadth and depth. He states that “the denser the network around a word, the richer the set of connections around that word, the greater the number of words known, and the deeper the knowledge of that word” (p. 231). The absence in this study of an empirical difference between breadth and depth does not mean that a theoretical distinction does not exist. They are useful as separate constructs, when contrasting for example a speaker who knows a large number of words to a limited degree with
a speaker with a small vocabulary but an in-depth, interconnected knowledge of the words he or she knows. If breadth and depth could be trained separately, uneven profiles could result.

The relation between children’s word knowledge and reading comprehension may be different for monolingual and bilingual minority learners. Verhoeven (2000) compared native Dutch-speaking children and minority children in the first two grades of elementary school on tasks of vocabulary knowledge, word decoding, word spelling and reading comprehension. He found word decoding to be highly comparable for the two groups, but the minority children were found to be less efficient on spelling and reading comprehension than their monolingual Dutch peers. A structural model of reading comprehension showed that vocabulary knowledge had a stronger impact for monolingual than for bilingual children. This is in line with Droop and Verhoeven (2003) who found that the oral skills of bilingual children contributed more to reading comprehension than was the case for their monolingual peers. Verhoeven (2000) concludes that children learning to read in a second language should be helped to build their word knowledge and that reading instruction should be matched to this knowledge.

Proctor, Uccelli, Dalton and Snow (2009) suggest that the role of depth of vocabulary knowledge in reading comprehension may depend on children’s levels of oral comprehension. In a study focusing on deep vocabulary intervention, they had a group of 35 bilingual and monolingual fifth-grade children working on developing depth of knowledge of eight words, culminating in an activity in which the children produced captions for images related to each word. The researchers scored the captions using a four-point depth scale. Results indicated a significant additional effect of depth of word knowledge (3%) in predicting reading comprehension after decoding and oral comprehension, particularly for children with average to strong oral language skills (Proctor et al., 2009).

Some remarks regarding the language background of bilingual minority children are in place here. These learners differ in a number of respects from so-called ‘balanced’ bilinguals. They are learners with less input and less varied input than their monolingual peers: research shows that bilingual minority children have
delays in comparison to their monolingual peers when exposure to the second language is limited (Hancin-Bhatt & Nagy, 1994; Vermeer, 1992). Children’s vocabulary development in the first language has been strongly related to parents’ socioeconomic background and education and to amount and quality of language exposure (Weizman & Snow, 2001). Some researchers emphasize that sufficient exposure to both languages may help bilingual learners in catching up with their monolingual peers (Umbel & Oller, 1994; Vermeer, 2001). Because of this unfavourable situation, it has been suggested that bilingual children acquire abstract semantic word knowledge later (Schoonen & Verhallen, 2008: 231). In the Dutch case, lexical delays of bilingual children have been shown to hold not only for Dutch but also for the home language (see Verhallen, Özdemir, Yuksel, & Schoonen, 1999), also with respect to vocabulary size (Appel & Schaufeli, 1990). Bilingual minority children are often faced with the complex task of learning to read in a language they are not accustomed to speak before they enter primary education. Even if they do speak the home and the majority language, often one of the languages appears to be significantly weaker than the other (depending on the domain) (Meisel, 2007). Research has shown that problems with the spoken second language may have an impact on reading processes, especially in the domain of reading comprehension skills (Geva & Verhoeven, 2000; Verhoeven, 2000).

The literature reviewed indicates a clear gap between monolingual and bilingual minority children in word knowledge and reading proficiency. There is some evidence that vocabulary differences pertain to semantic depth and knowledge of semantic word relations and associations. Most studies that focus on vocabulary depth use off-line measures. Little is known about the extent to which bilingual minority children fall behind in processing components of word knowledge such as the accessibility of semantic word knowledge, in terms of speed of access and semantic priming. Research is needed to investigate whether semantic priming differences, as have been found for good and poor comprehenders (Nation & Snowling, 1999), exist between Dutch monolingual and bilingual minority children and whether these differences can explain the differences in reading performance between these groups. Moreover, the relation between semantic word knowledge,
semantic processing and reading comprehension may be different for Dutch monolingual and bilingual children (Droop & Verhoeven, 2003; Verhoeven, 2000, Proctor et al., 2009).

### 2.5 Open issues and focus of the present work

The literature reviewed shows that there are differences between children in their abstract, semantic knowledge of words and in the accessibility of that knowledge. Children’s word knowledge develops from initially context-dependent to more context-independent or abstract. Differences between children and adults in abstract knowledge of word meaning have been reported. One line of research investigates differences in word associations between monolingual and bilingual learners of different ages and proficiency levels. However, association studies fail to show consistent patterns. Research is needed to investigate to what extent word knowledge and word associations of monolingual and bilingual children differ systematically (Fitzpatrick & Izura, 2011; Namei, 2004; Nissen & Henriksen, 2006). Also, the value of word associations as a reflection of semantic word knowledge needs to be addressed.

One limitation of previous work examining individual differences in children’s semantic knowledge is that off-line tasks requiring conscious processing have mostly been used (see also Read, 2004). For example, in the study by Braze, Tabor, Shankweiler and Mencl (2007), expressive vocabulary was measured by asking children to define words. It is possible, therefore, that the poor comprehenders’ lower performance was due to difficulties verbalizing concise definitions for words, rather than a reflection of deficient understanding. Thus, outcomes from such tasks do not allow for claims about the status of children’s underlying semantic representations.

The research reviewed indicates a link between rich semantic word knowledge and fast access to lexical and semantic information. Adults’ knowledge of word meaning seems to be related to fast performance in lexical and semantic tasks (e.g., Pexman, Lupker & Hino, 2002). Semantic processing skills appear to be still in development in young children as they have been found to be less sensitive to
semantic category information (Perraudin & Mounoud, 2009). However, it is unclear to what extent there are individual processing differences between children in terms of speed of access to lexical and semantic information and sensitivity to semantic priming.

Previous studies show a relation between reading performance and both speed of access and the activation of semantic word knowledge – as reflected by semantic priming. Important here is that most studies concern group comparisons and do not relate individual differences in processing skills to individual difference in reading comprehension. It needs to be investigated to what extent individual differences in speed of access to lexical and semantic information and semantic priming can account for individual differences in reading comprehension.

The literature indicates a clear gap between monolingual and bilingual minority children in word knowledge and reading proficiency. Unclear is whether bilingual children fall behind in processing components of word knowledge, such as its accessibility in terms of speed of access to lexical and semantic information and in terms of semantic priming. Research needs to address whether semantic priming differences, as have been found for good and poor comprehenders (Nation & Snowling, 1999), exist between Dutch monolingual and bilingual minority children and whether these differences can explain the differences in reading performances between these groups.

In sum, the respective roles of semantic word knowledge, speed of access to lexical and semantic information and the activation of semantic information in reading comprehension deserve further investigation. Dutch bilingual minority children are included in this thesis because they are the children at risk with respect to (lack of) ‘deep’ and accessible word knowledge.

This review leads us to the following research questions that are addressed in the subsequent chapters:

1. Are there structural differences between Dutch monolingual and bilingual minority children and adults in the heterogeneity of their word association responses to simple words? (Chapter 3)
2. To what extent do age and language background play a role in the patterns of word associations of Dutch monolingual and bilingual minority children and adults? (Chapter 3)

3. Do Dutch monolingual and bilingual minority children differ in the availability of their semantic word knowledge? (Chapters 4 and 5)

4. Do Dutch monolingual and bilingual minority children differ in the speed with which they access lexical and semantic information about (individual) words? (Chapters 4 and 5)

5. Do Dutch monolingual and bilingual minority children show different priming effects for semantically related words? (Chapter 5)

6. Do availability of semantic word knowledge, speed of access and sensitivity to semantic priming explain individual differences in reading comprehension between Dutch monolingual and bilingual minority children? (Chapters 4 and 5)

The study reported on in Chapter 3 was set up as a preparatory study to generate association norms for the studies in Chapters 4 and 5. The data allow for an investigation of research questions 1 and 2. A comparison of word associations of monolingual and bilingual minority children from two distinct age groups pinpoints cognitive and lexical differences and addresses the role of word associations in the assessment of word knowledge. We hypothesize that deep vocabulary knowledge as reflected in semantic word knowledge is more prominent and hence more easily accessible in the mental lexicon of Dutch monolingual children than in the lexicon of Dutch bilingual minority children and that a preference for semantic word associations shows in monolingual children’s word association responses (research question 1). If differences in word associations between monolinguals and bilinguals hold for children and for adults, then they are most likely due to lexical differences (too little exposure to the words to come up with native-like associations); if differences ‘disappear’ with age, then they most likely spring from semantic, conceptual differences (research question 2).
Chapter 4 assesses children’ semantic word knowledge and speed of access (research questions 3 and 4) with an offline semantic word knowledge task and a speeded categorization task. We predict significant differences between monolingual and bilingual minority children in the availability of their semantic word knowledge as well as in speed of access to word knowledge. We expect these differences to contribute to differences between the children in reading comprehension (research question 6).

Chapter 5 investigates differences in children’ semantic word knowledge (research question 3) as well as in their speed of accessing lexical and semantic information (research question 4) on the basis of a lexical decision and a semantic classification task. Research question 5 is addressed through the semantic priming component in those tasks. We expect differences between monolingual and bilingual minority children in semantic word knowledge, in speed of access and in the activation of abstract, semantic word knowledge as reflected in semantic priming. On the basis of regression models of reading comprehension, Chapter 5 addresses research question 6. We expect differences in availability of semantic word knowledge, speed of access and sensitivity to semantic priming to contribute to explaining variance between the children in reading comprehension.

In sum, the empirical studies in Chapters 3 to 5 assess differences between Dutch monolingual and bilingual minority children with respect to word knowledge and reading, and they investigate the relation between word knowledge and reading comprehension. This research thus contributes to understanding some of the mechanisms underlying individual differences in reading comprehension between these children.