DOCUMENT RESUME

ED 373 305 CS 011 804

AUTHOR	Booth, James R.; Hall, William S.
TITLE	Relationship of Reading Comprehension to the Cognitive Internal State Lexicon. Reading Research Report No. 14.
INSTITUTION	National Reading Research Center, Athens, GA.; National Reading Research Center, College Park, MD.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE	94
CONTRACT	117A20007
NOTE	44p.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Higher Education; Intermediate Grades; Reading Achievement; *Reading Comprehension; Reading Research; Secondary Education; Vocabulary Development; *Word Recognition
IDENTIFIERS	District of Columbia; University of Maryland

ABSTRACT

A study compared students' cognitive word knowledge of the cognates of "think" and "know" within a theoretical framework focused on hierarchical levels of meaning. Subjects were 31 fifth, 32 seventh, and 21 tenth graders attending single-gender private schools in the Washington, D.C. metropolitan area, and 70 college undergraduate students in an introductory psychology course at the University of Maryland. Cognitive words form a category within the internal state lexicon and may be central to accessing, monitoring, and transforming internal states, all of which seem to be processes critical to reading comprehension. Cognitive word knowledge was positively correlated with achievement scores. The correlations with cognitive word knowledge were higher for verbal (vocabulary and reading comprehension) than quantitative achievement scores, and cognitive word knowledge increased with age. However, the order of acquisition of cognitive words depended on a complex interaction between the frequency of the cognitive word in established word frequency counts, the level of meaning as determined by the conceptual difficulty hierarchy, and whether the cognitive word was a cognate of "think" or "know." (Contains 61 references, 6 tables, and 3 figures of data. The cognitive word task is attached.) (Author/RS)

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The work reported herein is a National Reading Research Project of the University of Georgia and University of Maryland. It was supported under the Educational Research and Development Centers Program (PR/AWARD NO. 117A20007) as administered by the Office of Educational Research and Improvement, U.S. Department of Education. The findings and opinions expressed here do not necessarily reflect the position or policies of the National Reading Research Center, the Office of Educational Research and Improvement, or the U.S. Department of Education.

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Universities of Georgia and Maryland
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Spring 1994

Relationship of Reading Comprehension to the Cognitive Internal State Lexicon

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Abstract. The authors compared fifth-, seventh-, and tenth-graders, and college undergraduates' cognitive word knowledge of the cognates of *think* and *know* within a theoretical framework focused on hierarchical levels of meaning. Cognitive words form a category within the internal state lexicon and may be central to accessing, monitoring, and transforming our internal states, all of which seem to be processes critical to reading comprehension. Cognitive word knowledge was positively correlated with achievement scores. The correlations with cognitive word knowledge were higher for Verbal (vocabulary and reading comprehension) than Quantitative achievement scores, and cognitive word knowledge increased with age. However, the order of acquisition of cognitive words depended on a complex interaction between the frequency of the cognitive word in established word frequency counts, the level of meaning as determined by the conceptual difficulty hierarchy, and whether the cognitive word was a cognate of *think* or *know*.

Cognitive words such as *think* and *know* form a category within the internal state lexicon (Hall & Nagy, 1986) and may be central to accessing, monitoring, and transforming our internal states (Scholnick & Hall, 1991). Many cognitive words are polysemous and can be defined along a hierarchy from simple *perception* to complex *planning* (Frank & Hall, 1991; Hall, Scholnick, & Hughes, 1987). According to this hierarchy, the higher the level of meaning— the more conceptually demanding— the more internal processing is required. We argue that cognitive words may be centrally involved in the development of skilled reading comprehension.

Cognitive words can provide a medium that makes it possible to engage in metacognitive acts relevant to the reading process, such as generating a goal for reading, communicating the intended meaning of a text, and evaluating one's level of understanding. Similarly, cognitive words can equip the reader with a vehicle by which to evaluate different comprehension strategies critically or to reflect on the logical organization and interdependence of the components of a text. Our elaborated cognitive word lexicon allows us to make fine-grained distinctions between cognitive states. Cognitive words "convey shades of meaning which add succinctness and precision to the lexicon" and supply us with "a greater capacity for description and definition" (Corson, 1985, p. 61). While skilled reading comprehension requires the use of all of the aforementioned skills, direct empirical evidence for the claim that cognitive word knowledge is central to the development of reading comprehension is sparse (see Olson & Torrance, 1986, 1987).

The present study sought to remedy this situation by providing an empirical test of the hypothesized relationship between cognitive word knowledge and reading comprehension. In pursuit of this aim, a task was designed to measure knowledge of the cognates of *think* and *know* while simultaneously varying the dimensions of established frequency in the English language (Carroll, Richman, & Davies, 1971) and the level of meaning difficulty (Frank & Hall, 1991). The degree of children's knowledge of these cognitive words was expected to correlate highly with reading achievement scores.

Certain cognitive words, such as *think* and *know*, appear very early in a child's lexicon. Children begin to use cognitive words at about three years of age (Bretherton & Beeghly, 1982), but their use remains infrequent and limited primarily to pragmatic functions. For example, Shatz, Wellman, and Silber (1983) found that the earliest use of cognitive words is for pragmatic or conversational purposes, such as in directing the action. By the end of their third year, children begin to use cognitive words in a way that suggests semantic understanding (Shatz et al., 1983), but they do not understand the distinctions between many cognitive words, such as *remember*, *know*, and *guess*, until approximately four years of age (Johnson & Wellman, 1980). At around five years of age, children can differentiate between *know* and *think* (Johnson & Maratsos, 1977; Moore, Bryant, & Furrow, 1989), *know* and *guess* (Miscione, Marvin, O'Brien, & Greenberg, 1978; Moore et al. 1989), and *remember* and *forget* (Johnson, 1981).

Fine-grained distinctions between other cognitive words are not learned until later. Seven-year-olds' judgment of the truth of the complement of the cognitive words *pretend*, *know*, and *think* are determined primarily by the plausibility of the complement and only secondarily by the factivity of the verb (Olson & Torrance, 1986); the *think* and *guess* distinction is not attained until children are eight years old (Moore et al., 1989). Furthermore, children do not understand *believe*, which can be both factive and nonfactive, until after age seven (Abbeduto & Rosenberg, 1985), and even high school and college students have incomplete knowledge of more complex cognitive words such as *predict*, *interpret*, *infer*, *conclude*, and *assume* (Astington & Olson, 1990).

All cognitive words are not acquired simultaneously, in part because certain cognitive words differ semantically in specific but subtle respects. For example, *know*, *remember*, *forget*, and *guess* refer to the accessibility of knowledge (Hall et al., 1987); *pretend*, *guess*, and *know* involve presuppositions of disbelief, uncertainty, and belief (Macnamara, Baker, & Olson, 1976); *see* and *know* refer to internal versus external experience (Wellman & Estes, 1987). The development of the internal state lexicon is a gradual, incremental process that depends on the particular cognitive words to be learned. An example of this dependence is that many cognitive words are polysemous, that is, they have more than one meaning. This polysemy imposes a constraint on children's acquisition of cognitive words.

Hierarchy of Meaning of Cognitive Words

Frank and Hall (1991) proposed that certain cognitive words have a hierarchy of level of meaning characterized by increasing abstractness and conceptual difficulty (see also Hall et al., 1987). They proposed that the cognitive internal state lexicon adheres to a structure that involves the following levels: (1) registering an experience perceptually; (2) determining the familiarity of an experience and embedding it in a factual network; (3) understanding interconnections among concepts; (4) making one's presuppositions about the experience explicit; (5) commenting on how internal processing is being done; and (6) assessing future intention, which implies an understanding and integration of past events. They referred to these levels as *perception, memory, understanding, evaluation, metacognition*, and *planning*, respectively. It was proposed that *perception* is the least complex and requires a limited amount of internal processing, while *planning* is the most complex and demands the greatest amount of internal processing. The middle levels of meaning follow a hierarchy of increasing conceptual difficulty between these endpoints. Frank and Hall (1991) hypothesized that the higher the level of meaning for a word, the less it is likely to be used in discourse. Indeed, they found that as the level of meaning increased, the frequency decreased for both adult and child verbal frequency of the cognitive word *know*. Although, the levels of *perception, memory*, and *understanding* were statistically differentiated, the levels of *evaluation, metacognition*, and *planning* were not. Hughes (1985) obtained similar results in a comprehension task assessing cognitive word knowledge in three-, six-, and nine-year-old children.

Frank and Hall (1991) then tried to incorporate the cognitive word *think* into their level of meaning hierarchy. They found that *evaluation* was used most often and that the other five levels of meaning were statistically undifferentiated for both children and adults. On the basis of these findings, they proposed that cognitive words are organized hierarchically, but that different cognitive words may have a different organization of levels that depends on both conceptual difficulty and prototypicality. According to their hypothesis, prototypical meanings will be acquired first, but cognitive words whose prototypical meanings are of a lower level will be semantically mastered earlier than words whose prototypical meanings are of a higher level. This claim is supported by findings from an analysis of young children who used *know* before *think* more frequently in natural discourse (Hall, Nagy, & Linn, 1984). *Know* may have a lower level prototypical meaning than *think*.

Certain cognitive words have several pragmatic as well as semantic functions, and this may encourage children to develop metalinguistic knowledge. A semantic use of a cognitive word occurs when it contributes directly to the intended meaning of an utterance, such as "Sally *knows* the answer." In contrast, a pragmatic use contributes indirectly, if at all, to the meaning of an utterance; it might be a hedge, a conversational device, an indirect request, or an attention-getting device such as "You *know*, I need to go to the store" (Hall & Nagy, 1986). Cognitive words appear to have more meanings and functions than words that name objects, events, or situations. Because the contexts in which people use cognitive words vary, exposure to cognitive words may be particularly advantageous in the development of metalinguistic abilities. For example, when a child realizes that a word is only a symbol for its referent, that context determines the polysemous nature of words, and that language can be an object of thought, his or her linguistic ability is advanced considerably. Also, children are likely to generalize this knowledge of multiple meanings to other lexical domains and compare different levels of meaning within and between lexical domains. Knowing more about the different meanings of one cognitive word and the relationships between the meanings of different cognitive words may make children more aware of distinctions they make and how they make them. This may lead to mastery of their knowledge system. All of these processes seem to be critical for high-level text understanding.

Developmental Course of Cognitive Word Acquisition

Clark's (1983) theory of semantic development provides valuable insights about the developmental course of cognitive words. She asserts that the order of meaning acquisition is a function of the interaction between both the *relative complexity* of the meaning of a word and *nonlinguistic strategies* with the linguistic environment during meaning acquisition. The relative complexity of the meaning is a function of the number of meanings, the degree of overlap between meanings, and the number of possible applications of an individual meaning. Polysemous words such as *think* and *know* may be difficult for children to acquire because they must develop hypotheses appropriate to each possible application of a word's meaning, as well as contrast all the meanings of this word with all the meanings of other words.

According to Clark (1983), meaning acquisition also depends on nonlinguistic strategies. Nonlinguistic strategies refer to a particular conceptual organization possessed by a child that coincides with and therefore makes the acquisition of certain word meanings easier (see Clark, 1980). For example, Clark (1973) claims that children acquire locative (*in*, *on*, and *under*) terms in a regular developmental sequence. Consequently, children may acquire certain cognitive words comparatively late because of their own conceptual organization. Objects, situations, and relations are directly observable; therefore, acquisition of words referring to these concepts is probably influenced directly by nonlinguistic strategies. In contrast, most cognitive words are verbs, and verbs have a more abstract and indistinct mental representation than nouns (see Huttenlocher & Lui, 1979; Anglin, 1986). Children may be more able to use nonlinguistic strategies in learning simple and concrete cognitive words, such as *perceive* and *remember*, but not in learning complex and abstract cognitive words, such as *reflect* and *evaluate*. At the more complex levels, cognitive words refer to very abstract, inaccessible, and subtle mental states; therefore, it is unlikely that cognitive words are mapped onto pre-existing conceptual categories. Instead, language (cognitive words) probably influences the development of children's concepts of complex mental states in very important ways (Scholnick & Hall, 1991).

Since cognitive words are relatively complex and may not benefit from nonlinguistic strategies, a child's acquisition of cognitive words may be highly dependent on linguistic input. Similarly, Scholnick and Hall (1991) conclude that "conscious awareness of mental states and the refinement of that awareness is made possible by socialization into the folk psychology of a culture through language" (p. 444). Unfortunately, children are rarely exposed to cognitive words either spoken (Hall et al., 1984; Smith & Meux, 1970) or written by parents or teachers (Carroll et al., 1971; Thorndike & Lorge, 1944).

For example, Astington (1991) found that junior high-school science texts rarely contain cognitive words and speech act verbs such as *claim*. Epistemic verbs such as *define*, *explain*, *hypothesize*, *infer*, and *interpret* are absent, and *believe* occurs only once. This deficiency is particularly disturbing since many text-based academic skills require the cognitive monitoring that cognitive words label (Hall et al., 1987). "What schooling appears to provide is competence in talking about text, about questions, about answers, in a word, competence with a metalanguage" (Olson & Astington, 1990, p. 563).

Research suggests that the cognitive word lexicon may develop late in children because the necessary linguistic input is deficient. The role of linguistic input in the development of cognitive word knowledge is uncertain; only two studies have compared children's and adults' use of cognitive words. The few studies that have been conducted have found a significant relationship. For example, in a study of 13- to 28-month olds, Beeghly, Bretherton, and Mervis (1986) found that the numbers and kinds of internal state utterances by the mother were positively correlated with the child's spoken frequency of different internal state words, of internal state words referring to self and other, and of decontextualized internal state words. Similarly, Hall et al. (1987) found a significant correlation between child use (4 years 6 months to 5 years) and parental use in both levels of meaning and the diversity of cognitive words used. These studies suggest that a child's development of cognitive word knowledge is highly dependent on adult frequency of verbal use.

Several studies also suggest that exposure to text may facilitate cognitive word learning. The different contexts in which a cognitive word appears in text may refine its definitions and functions (Olson & Astington, 1986; Robinson, Goelman, & Olson, 1983; Olson & Hildyard, 1981). Similarly, a child probably masters the different meanings of *know* and *think* through reading, as the difference between two cognitive words may be highlighted when they appear in the same sentence (Robinson, 1980). Taken together, this research suggests that cognitive word knowledge emerges from verbal and written exposure to these words, but cognitive word knowledge also appears to be an essential prerequisite for high-level text understanding.

Despite the research suggesting a strong relationship between cognitive words and high-level text understanding, only three studies have investigated that relationship empirically (Olson & Torrance, 1986, 1987; Astington & Olson, 1990). In one experiment, Olson and Torrance (1987) found that justifying answers by referring to the text was significantly correlated with cognitive word knowledge for third-graders but not for first-graders. In another experiment, Olson and Torrance (1987) found cognitive word knowledge in third-graders to be significantly correlated with a listening comprehension score that measured inferences drawn from the story. In addition, Olson and Torrance (1986), in a longitudinal study of children from 5 years 6 months to 7 years 6 months, found a total combined score on four cognitive word tasks to be correlated significantly with vocabulary ability, conversation ability, and reading ability. These three lines of evidence suggest that reading comprehension and cognitive word knowledge are strongly related.

Our thinking is in accord with this evidence because an understanding of the semantic and pragmatic uses of cognitive words enhances a reader's knowledge base — a key element in text understanding. Furthermore, knowledge of cognitive words seems to be centrally involved in reading comprehension. For example, differentiating between what a character *thinks* and *knows* is essential for the interpretation of a text. Cognitive words can provide a medium through which a character's mental states can be interpreted, as well as through which the past, present, and future goals and motives of that character can be analyzed. Cognitive words allow the reader to designate and reflect on what is true or false, real or unreal, and ambiguous or unambiguous in text. Thus, cognitive words have special salience in understanding and evaluating written language.

In summary, children have difficulty in mastering the cognitive word lexicon for at least three reasons. First, since the cognitive word lexicon is very intricate, subtle contrasts and comparisons must be learned in order for cognitive words to be used appropriately (Hall & Nagy, 1986; Frank & Hall, 1991). Second, since cognitive words are abstract and elusive and deal with the inner workings of the mind, they may not benefit easily from nonlinguistic strategies (Clark, 1983). Third, even though exposure to cognitive words appears to be essential for their efficient acquisition (Beeghly et al., 1986; Olson & Astington, 1986), many children are exposed to cognitive words in written or oral form infrequently (Astington & Olson, 1990; Carroll et al., 1971). In addition, since cognitive word knowledge appears to be strongly related to high-level text understanding due to the pertinent content knowledge it provides, this deficient linguistic environment is especially troubling.

Specific Aims of Research

First, we wanted to test the hypothesis that cognitive word knowledge is highly related to high-level text understanding as measured by reading comprehension achievement scores. We predicted that cognitive word knowledge would (a) correlate positively with all achievement scores; (b) correlate more highly with Verbal than with Quantitative achievement scores; (c) correlate more highly with Vocabulary than with Reading Comprehension achievement scores; and (d) that there would be a lower correlation between high-frequency cognitive words with achievement scores than would be found for low-frequency cognitive words.

Second, we wanted to investigate the hierarchical taxonomy of cognitive words proposed by Frank and Hall (1991) in order to study its relationship to reading comprehension. In this connection we made several predictions: (a) cognitive word knowledge would increase with age; (b) the acquisition of cognates of *think* would be earlier than the acquisition of cognates of *know*; and (c) high levels of meaning would be acquired after low levels of meaning.

METHOD

Subjects

Subjects represented elementary, middle-, and high-school, and college levels. The grade-school subjects attended different single-gender private schools in the Washington, DC metropolitan area. There were 31 fifth-grade students, (M age = 11.3; SD = 0.5); 32 seventh-grade students, (M age = 12.7; SD = 0.4); and 21 tenth-grade students, (M age = 15.6; SD = 0.5). The mean ages of the males and females within grades were not significantly different; their data are combined for presentation. The 70 undergraduate students, (M age = 19.9; SD = 1.6) attended the University of Maryland and participated in the study to fulfill an Introductory Psychology requirement. All except two of the grade-school students and all of the undergraduates completed the study.

Materials

Standardized Achievement Scores. The latest Educational Records Bureau (ERB) independent school norm percentiles were obtained from the school records of the grade-school subjects. The ERB subscores included Verbal (combined Vocabulary and Reading Comprehension) and Quantitative scores. All scores were obtained by a method ensuring anonymity and confidentiality. The undergraduate students supplied their subscores on the Scholastic Aptitude Test (SAT) and their grade point average (GPA) along with documentation such as an academic transcript and an SAT score stub. The SAT subscores included Verbal (combined Vocabulary and Reading Comprehension) and Quantitative scores.

Cognitive Word Task. The cognitive word task was modeled after Astington and Olson (1990) and consisted of 24 short stories (four to seven sentences). Each cognitive word passage was syntactically and semantically simple in order to ensure the assessment of cognitive word knowledge primarily, not reading comprehension. Twelve stories contained the cognitive word *think*, and twelve contained the cognitive word *know*. Of those, two stories characterized each of the six levels of meaning for *think* and *know* (Frank & Hall, 1991). Of those two stories, there was one story with a low-frequency and one with a high-frequency replacement cognitive word (see Appendix A). Each replacement cognitive word was contained within one of four multiple-choice sentences following the story. The subject was asked to read the story and to then choose the

Table 1. High- and Low-Frequency Replacement Cognitive Words for Each Level of Meaning for *Think* and *Know*

	THINK	
Level	High-Frequency	Low-Frequency
Perception	notice	concentrate
Memory	forget	remind
Understanding	realize	apprehend
Evaluation	doubt	infer
Metacognition	consider	contemplate
Planning	intend	predict

	KNOW	
Level	High-Frequency	Low-Frequency
Perception	observe	perceive
Memory	recognize	recall
Understanding	understand	comprehend
Evaluation	conclude	hypothesize
Metacognition	reflect	analyze
Planning	expect	anticipate

sentence containing the replacement cognitive word that accurately represented the level of meaning of *think* or *know* in the story.

Know and *think* were chosen as the polysemous words in this study for several reasons. First, several studies have focused on the acquisition of *know* and *think* (Macnamara et al., 1976; Johnson & Maratsos, 1977; Johnson & Wellman, 1980; Olson & Torrance, 1986; Astington & Olson, 1990). Second, *know* and *think* have been shown to be the most frequently used cognitive words in a child's lexicon (Shatz et al., 1983; Hall et al., 1984; Beeghly et al., 1986). Third, the levels of meaning of *know* and *think* have already been defined and studied (Hall et al., 1987; Hughes, 1985; Frank & Hall, 1991). Fourth, both *know* and *think* lend themselves to multiple meanings that can be inferred from their context of use.

The replacement cognitive words for *know* and *think* that were included in the list of choices were selected from previous studies of cognitive words (Hall & Nagy, 1986; Astington & Olson, 1990) as well as by reference to

Roget's *Thesaurus*. Cognitive words were divided into the six levels of meaning according to three independent raters' judgments of their typical use. The three raters were graduate students familiar with the Frank and Hall (1991) level of meaning hierarchy. If the three raters did not agree on the level assigned to a particular cognitive word, that word was discarded from the list. Frequencies of these prospective cognitive words were collected from the Hall et al. (1984) spoken language corpus, the Thorndike and Lorge (1944) written word corpus, and the Carroll et al. (1971) school textbook corpus.

The low- and high-frequency replacement cognitive words were randomly chosen from a cognitive word list created in the following manner: The most and least frequent words in each level of meaning were considered outliers and were eliminated. Then, each level was divided in half by the median frequency cognitive word (based on Carroll et al., 1971) and this median frequency was eliminated. High-frequency cognitive words were defined operationally as similar if they had a frequency difference of less than 1,000 words per 5 million words. Low-frequency cognitive words were defined operationally as similar if they had a frequency difference of less than 150 words per 5 million words. Two groups, one low- and the other high-frequency, separated by the median, were formed.

The distractor items were also chosen randomly from the cognitive word list. For each question, distractor frequency matched correct answer frequency according to the above operational definitions of frequency similarity. For the four middle levels of meaning, one distractor item was chosen randomly from the level of meaning immediately below, and two distractor items were chosen randomly from the level of meaning immediately above. For the lowest level of meaning, two distractor items were chosen randomly from the level of meaning immediately above, and one distractor item was chosen randomly from two levels of meaning above. For the highest level of meaning, two distractor items were chosen randomly from the level of meaning immediately below, and one distractor item was randomly chosen from two levels of meaning below. All prospective distractor cognitive words were evaluated to determine whether they fit syntactically within the distractor sentence; if they did not, they were discarded. Table 1 contains a list of the levels of meaning of *think* and *know* and the appropriate replacement cognitive words.

The order of the passages in the cognitive word task began with low-frequency and there were four alternating blocks (six passages each) of high- and low-frequency; within each block the level of meaning increased from *perception* to *planning*. This organization was chosen over randomization because this structure provided simplicity. By having the cognitive word task begin with high-frequency and low level of meaning, the reader was not discouraged initially by unsuccessful performance. In addition, having low- or high-frequency cognitive word passages clustered together allowed for symmetry in the distractor items. The distractor items were similar among same-frequency cognitive word passages; therefore, the subject was not unnecessarily confused by the multitude of distractor items. After all, the purpose of the cognitive word task was to

Table 2. Reliability of the Cognitive Word Task Subscales

	Reliability	
Subscale	Alpha[a,b]	Inter-Item Correlation
Perception	.292	.093
Memory	.331	.110
Understanding	-.303	-.062
Evaluation	.409	.148
Metacognition	.440	.164
Planning	-.032	-.008
Low-Level	.535	.126
High-Level	.543	.129
Think	.605	.145
Know	.555	.111
High-Frequency	.437	.079
Low-Frequency	.652	.158
Cognitive Word Total[c]	.722	.120

Note. [a]Unstandardized alpha was used because we added raw scores to form a composite score before standardization; [b]each score was subtracted from the mean of its age group before alpha calculation because mean differences between ages can inflate this coefficient; [c]alpha reliability was calculated with the level of meaning subscales.

assess cognitive word knowledge, not reading comprehension or test-taking strategies.

PROCEDURE

The cognitive word task was administered to groups of fifth-, seventh-, and tenth-grade students in their regularly scheduled classes and to the undergraduate students in a group setting at the University of Maryland. The experimenter read the instructions aloud — these were printed on the first page of the task booklet (see Appendix A) — and answered all questions the students asked. The task took a maximum of 25 minutes to complete. All subjects finished within the allotted time.

Because the cognitive word task was developed for this project, its reliability had to be determined. To do that, alpha and item-total correlations were computed for total and subscores. (A reliability of a = .60 or greater is recommended for basic research with broadband instruments [Nunnally, 1978].) The overall reliability of the cognitive word task was high, a = .72. Furthermore, five out of the six reliability coefficients for the main effects were greater than a = .53. Because of the exploratory nature of this research, the reliability lower limit was set at a = .15, which allowed us to include most of the subscales in the analysis. Unfortunately, the levels of *understanding* (a = -.30) and *planning* (a= -.03) were not sufficiently reliable to include in further analyses (see Table 2 for reliability coefficients of the main effect variables). Reliability coefficients were not computed within each grade due to the small number of subjects. However, Cochran's *C*-test for the homogeneity of variance for cognitive word total was insignificant across age classes, suggesting equal error of measurement within each grade level (for extensive information regarding the establishment of reliability and validity of the cognitive word task, please contact the authors).

RESULTS

We will discuss the results in terms of the two research aims: (1) to investigate the relationship between cognitive word knowledge and text understanding as revealed through reading achievement scores, and (2) to apply a model of the development of the internal state lexicon to cognitive word knowledge as measured by a multiple-choice task.

Cognitive Word Knowledge and Reading Comprehension Scores

In order to confirm the strong relationship we hypothesized between cognitive word knowledge and reading comprehension, a correlation matrix was computed using cognitive word total, high-frequency cognitive words, and low-frequency cognitive words with achievement scores (see Table 3). There were significant correlations of the cognitive word total with achievement scores suggesting that the cognitive word task was validly measuring both the construct of verbal ability and the academic achievement. Correlations between cognitive word total and achievement scores were tested for significant differences using Steiger's *t*-test for dependent *r*'s (1980). For all grade-schoolers, the correlation of cognitive word total was higher (but not significant) for Verbal (r = .33, $p < .01$) than for Quantitative (r = .22, $p < .05$) and higher (t = 1.56, $p < .1$) for Vocabulary (r = .49, $p < .001$) than for Reading Comprehension (r = .35, $p < .001$). For undergraduates, the correlation of cognitive word total was higher (t = 1.74, $p < .05$) for Verbal (r = .55, $p < .001$) than for Quantitative (r = .36, $p < .01$), and about the same for Vocabulary (r = .45, $p < .01$) and Reading Comprehension (r = .47, $p < .01$). Convergent/discriminant construct validity was revealed by the fact that cognitive word total correlated higher with Verbal than with Quantitative achievement scores for the undergraduates and higher with Vocabulary than with Reading Comprehension achievement scores for the grade-school subjects. Furthermore, the correlations with cognitive word total were higher for low than for high-frequency cognitive words (see Table 3 for these correlations). Note that the correlations were typically lower for the seventh-graders. This relative lack of association may be attributed to the less-than-ideal testing conditions for the seventh-grade males, as there were many environmental disturbances during their testing session.

In summary, our predictions that cognitive word total would correlate significantly with achievement scores, and that cognitive word

Table 3. Correlation of Total, High-Frequency, and Low-Frequency Cognitive Words with Standardized Achievement Scores by Grade

	Grades/Level				Means	
Subscale	5	7	10	College	Grades	All Groups
Cognitive Word Total						
Verbal	.47**	.15	.34	.55***	.33**	.42***
Quantitative	.33*	.13	.16	.36**	.22*	.28***
Vocabulary	.74***	.17	.55**	.45***	.49***	.47***
Reading Comprehension	.54***	.21	.25	.47***	.35***	.39***
GPA				.12		
High-Frequency						
Verbal	.31*	.26	.16	.33**	.25*	.28***
Quantitative	.25	.11	-.08	.19	.12	.15*
Vocabulary	.61***	.08	.44*	.28*	.39***	.35***
Reading Comprehension	.58***	.12	-.05	.34**	.27**	.29***
GPA				.12		
Low-Frequency						
Verbal	.48**	.15	.36	.51***	.32**	.41***
Quantitative	.31*	.11	.30	.35**	.23*	.29***
Vocabulary	.62***	.18	.44*	.40**	.40***	.40***
Reading Comprehension	.30*	.26	.41*	.38**	.31**	.34***
GPA				.08		

Note. $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$. Grades Means and All Groups Means adjusted for mean differences between age classes. Since cognitive word total was significantly different between grades, pooling the different age classes may lower its correlation coefficient with the achievement scores variables; therefore, the cognitive word mean of each age class was subtracted from the individual scores within it.

total would correlate more highly with Verbal than Quantitative achievement scores, and more highly with Vocabulary than Reading Comprehension achievement scores were supported. Moreover, our prediction that low-frequency cognitive words would correlate higher than high-frequency cognitive words with achievement scores was supported.

Taxonomy of Cognitive Words Proposed by Frank and Hall (1991)

Since the academic ability of each age level was statistically similar, subject selection biases could not account for any developmental differences found in the current research. One-way ANOVAs with Verbal, Quantitative, Vocabu-

Table 4. Means and Standard Deviations by Grade for Student Standardized Achievement Scores

	Grades/Level			
Subscale	5	7	10	College
Verbal	49.68[a] (29.5)[b]	55.07 (24.9)	53.80 (30.7)	530.2 (80.9)
Quantitative	52.74 (30.7)	61.72 (24.0)	52.00 (31.3)	600.1 (90.4)
Vocabulary	49.68 (30.0)	60.24 (19.9)	51.95 (31.1)	540.7 (80.9)
Reading Comprehension	53.10 (31.6)	57.80 (21.6)	51.00 (25.8)	540.2 (90.9)
Grade Point Average				2.66 (.76)

Note. [a]mean; [b]standard deviation. Grade-schoolers' scores are ERB independent school norm percentiles; undergraduate scores are SAT-scaled scores. GPA is on a 4-point scale.

lary, and Reading Comprehension achievement scores revealed no age differences in achievement scores. The grade-schoolers' ERB scores and the undergraduate SAT scores were converted to z-scores to allow statistical comparison. Table 4 displays the means and standard deviations by grade for the independent school norm percentiles for the grade-school students, and the SAT-scaled scores for the undergraduate students.

Furthermore, the reading difficulty of the cognitive word passages did not confound any of the observed differences in cognitive word knowledge. Four 2 (Frequency) × 2 (Think/Know) × 2 (Level of Meaning) ANOVAs with the Readability Index, the Fog Index, the average number of syllables per word, or the average number of words per sentence as dependent variables revealed no significant differences. (The Right Writer computer program was used to compute these dependent variables.) In addition, the reading difficulty of cognitive word passages could not account for the mean percent-correct difference observed between cognitive word passages. Correlations between the mean percent-correct for the cognitive word passages and the above reading difficulty indices for those passages were insignificant within each age level and across all age levels. Therefore, all age, frequency, *think* or *know*, and level of meaning differences must be accounted for by cognitive word knowledge, and not the reading difficulty of the passages. (However, the reading comprehension abilities necessary for reading these passages may account for some of the variance explained in achievement scores by the cognitive word task).

As mentioned previously, the cognitive word passages were intentionally very simple in order to assess only cognitive word knowledge. The readability indices of 16 of the cognitive word passages were less than the fifth-grade level — the youngest age group in our study. These low readability indices suggest that reading comprehension abilities, as opposed to cognitive word knowledge, were a minor factor in the students' performance on these passages. Furthermore, the readability indices for all of the cognitive passages were below the eighth-grade level, suggesting that reading comprehension abilities were even less of a factor in the performance of the tenth-graders and undergraduates.

Regarding cognitive word acquisition, we predicted that proficiency in cognitive words would increase with age, low-frequency cognitive words would be acquired after high-frequency cognitive words, high level of meaning would be acquired after low level of meaning, and cognates of *know* would be acquired after cognates of *think*. In order to confirm our prediction of these age, frequency, *think* or *know*, and level of meaning differences in cognitive word acquisition, a 4 (Grade) × 2 (Frequency) × 2 (Think/Know) × 2 (Level of Meaning) ANOVA was computed. For this ANOVA, the *perception* and *memory* levels were combined to form the low level of meaning category and the *evaluation* and *metacognition* levels were combined to form the high level of meaning category in order to attain at least four cognitive word passages per comparison group necessary for sufficient reliability. The means and standard deviations by grade for cognitive word task subscales are presented in Table 5. We subtracted 0.33 for each wrong answer to correct for guessing; negative scores were counted as zero (see Astington & Olson, 1990). In addition, all of the subscales scores were reduced to percent-correct to enable the comparison of subscales that had different numbers of passages within them.

All main effects were significant. Percent-correct for low level of meaning (M = .66) was significantly greater ($F(1,156) = 34.42$, $p < .001$) than percent-correct for high level of meaning (M = .52). Percent-correct for high-frequency cognitive words (M = .64) was significantly greater ($F(1,156) = 20.94$, $p < .001$) than low-frequency cognitive words (M = .50). Percent-correct for *think* (M = .65) was significantly greater ($F(1,156) = 26.11$, $p < .001$) than *know* (M = .53). Post hoc one-way ANOVAs with Scheffe range comparison ($p < .05$) between grades revealed the following: (a) fifth- and seventh-graders scored significantly lower than tenth-graders and undergraduates on high level of meaning, *know*, low frequency, and cognitive word total; (b) fifth-, seventh-, and tenth-graders scored significantly lower than undergraduates on low level of meaning and *think*; (c) fifth-graders scored significantly lower than tenth-graders on low level of meaning, *think*, and high-frequency; and (d) fifth- and seventh-graders scored significantly lower than undergraduates on high-frequency. Our expectations that developmental differences would exist in cognitive word acquisition, that low-frequency would be acquired after high-frequency, that high level of meaning would be acquired after low level of meaning, and that cognates of *think* would be acquired after cognates of *know* were supported.

Table 5. Means and Standard Deviations by Grade of Percent-Correct for Cognitive Word Task Subscales

	Grades/Level			
Subscale	5	7	10	College
Perception	.42[a] (.32)[b]	.53 (.32)	.62 (.32)	.79 (.22)
Memory	.45 (.29)	.55 (.25)	.70 (.28)	.84 (.23)
Understanding	.44 (.25)	.36 (.29)	.48 (.20)	.30 (.23)
Evaluation	.26 (.25)	.42 (.27)	.63 (.34)	.75 (.26)
Metacognition	.29 (.31)	.36 (.33)	.65 (.25)	.64 (.29)
Planning	.74 (.22)	.75 (.25)	.85 (.25)	.78 (.25)
Low-Level	.44 (.25)	.54 (.22)	.66 (.21)	.82 (.17)
High-Level	.25 (.21)	.39 (.21)	.63 (.27)	.69 (.22)
Think	.44 (.23)	.52 (.21)	.68 (.27)	.84 (.16)
Know	.31 (.18)	.40 (.24)	.64 (.21)	.67 (.21)
High-Frequency	.46 (.23)	.58 (.19)	.69 (.23)	.79 (.15)
Low-Frequency	.29 (.18)	.35 (.22)	.63 (.26)	.72 (.23)
Cog. Word Total	.37 (.17)	.47 (.18)	.66 (.21)	.75 (.15)

Note. [a]mean; [b]standard deviation

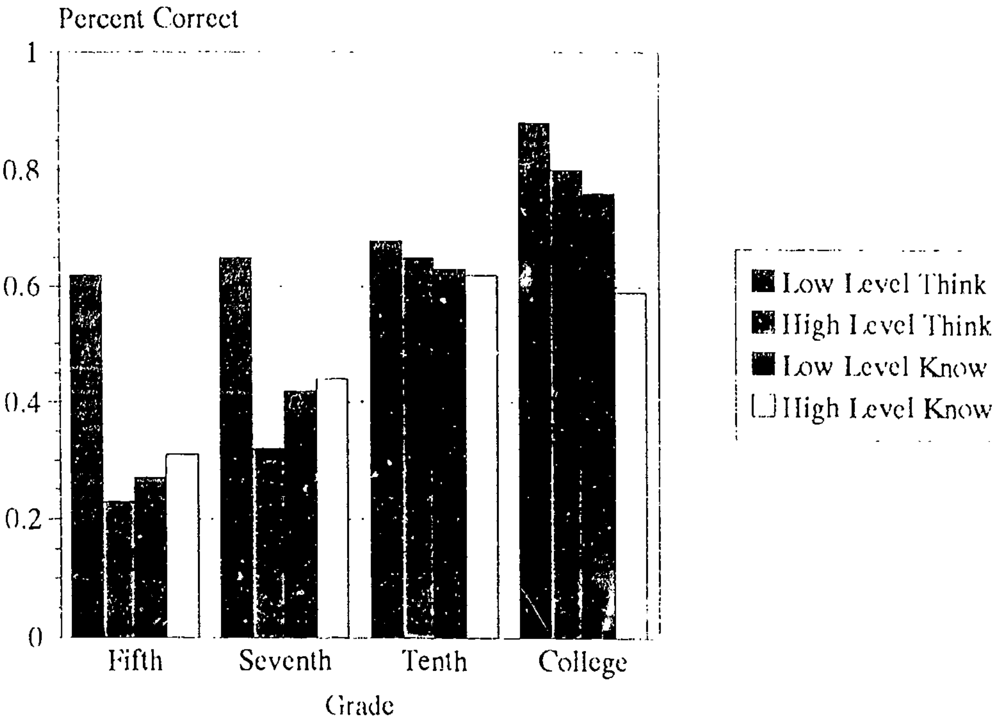

Figure 1. Three-way interaction of *Think* or *Know*, Level of Meaning, and Grade. *Note*: Low or High Level (level of meaning), *Think* (cognate of *think*), *Know* (cognate of *know*).

No predictions were made regarding cognitive word subscale interactions. There were three significant two-way interactions (but no significant two-way interactions including Grade), and three significant three-way interactions, all of which were the significant two-way interactions with the addition of the Grade variable. Post hoc t-tests ($p < .05$) were computed in order to compare the different cells in the two-way interactions, while post hoc one-way ANOVAs with Scheffe range comparison ($p < .05$) were computed between and within grades for each of the three-way interactions.

The significant *Think/Know* × Level of Meaning interaction ($F(3,156) = 7.51, p < .01$) revealed that for *think*, low level of meaning ($M = .76$) was significantly greater in percent-correct than high level of meaning ($M = .62$; $p < .001$), while for *know*, high ($M = .56$) and low ($M = .51$) level of meaning did not significantly differ in percent-correct ($p > .05$). In other words, *think* or *know* did not significantly affect percent-correct for high level of meaning ($p > .15$), but for low level of meaning, *know* significantly lowered percent-correct as compared to *think* ($p < .001$).

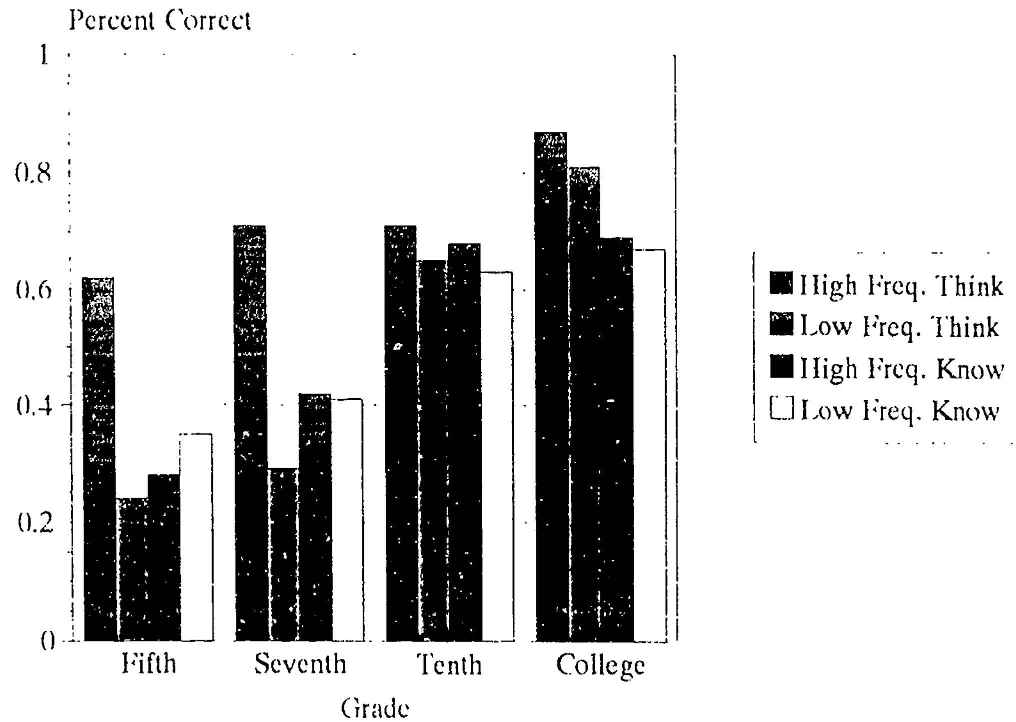

Figure 2. Three-way interaction of Think or *Know*, Frequency, and Grade. Note: High or Low Freq. (frequency in written language), *Think* (cognate of *think*), *Know* (cognate of *know*).

For the *Think/Know* × Level of Meaning × Grade interaction ($F(23,156) = 10.03$, $p < .001$; see Figure 1), between grades analyses revealed: fifth- and seventh-graders scored significantly lower than undergraduates on low level of meaning *think* and *know* and high level of meaning *think*; and fifth- and seventh-graders scored significantly lower than tenth-graders and undergraduates on high level of meaning *know* ($p < .05$). In sum, there was a developmental trend of increasing cognitive word knowledge with a period of accelerated cognitive word acquisition after seventh-grade and before the undergraduate level. Within grade analyses indicated: (a) for fifth-graders, low level of meaning *think* was answered correctly significantly more often than the other three; (b) for seventh-graders, low level of meaning *think* was answered correctly significantly more than high level of meaning *think*; (c) for tenth-graders, no significant differences were found; and (d) for undergraduates, low level of meaning *know* was answered incorrectly significantly more than the other three ($p < .05$). In sum, low level of meaning *think* appeared to be easier for the fifth- and seventh-graders, and

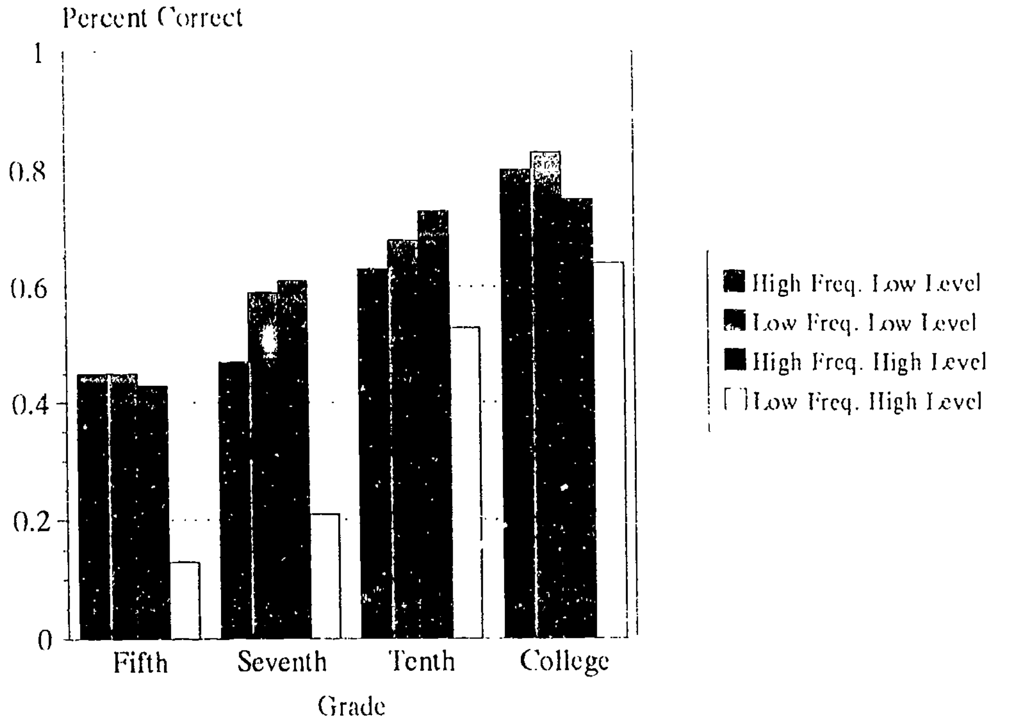

Figure 3. Three-way interaction of Frequency, Level of Meaning, and Grade. Note: High or Low Frequency (frequency in written language), Low or High Level (level of meaning).

high level of meaning *know* appeared to be harder for undergraduates, while all combinations appeared to be equal in difficulty for tenth-graders (see Figure 1).

The *Think/Know* × Frequency interaction ($F(3,156) = 13.74$, $p < .001$) revealed that at high frequencies, *think* ($M = .74$) was significantly greater in percent-correct than *know* ($M = .56$; $p < .001$), while at low frequencies *think* ($M = .56$) and *know* ($M = .52$) did not significantly differ in percent-correct ($p > .60$). In other words, different frequencies did not significantly affect percent-correct for *know* ($p > .90$), but for *think*, low-frequency significantly lowered percent-correct as compared to high-frequency ($p < .001$).

For the *Think/Know* × Frequency × Grade interaction ($F(23,156) = 7.71$, $p < .001$, see Figure 2), between grades analyses revealed: fifth- and seventh-graders scored significantly lower than the tenth-graders and undergraduates on low-frequency *think* and *know*, and high-frequency *know*; and fifth- and seventh-graders scored significantly lower than undergraduates on high-frequency *think* ($p < .05$). In sum, there was a developmental trend of increasing cognitive word knowledge with a period of accelerated cognitive word acquisition after seventh and before tenth grade. Within grade analyses indicated: (a) for fifth- and seventh-graders, high-frequency *think* was answered correctly significantly more than the others; (b) for tenth-graders, no significant differences were found; and (c) for undergraduates, high- and low-frequency *think* were answered correctly significantly more than high- and low-frequency know ($p < .05$). In sum, high-frequency *think* appeared to be easier for fifth-graders, seventh-graders, and undergraduates, but not for tenth-graders.

The Frequency × Level of Meaning interaction ($F(3,156) = 37.29$, $p < .001$) revealed that at high frequencies, high ($M = .64$) and low ($M = .64$) levels of meaning did not significantly differ in percent-correct ($p > .80$), while at low-frequency, high level of meaning ($M = .40$) was significantly lower in percent-correct than low level of meaning ($M = .68$; $p < .001$). In other words, whether the word was high- or low-frequency did not significantly affect percent-correct for low level of meaning ($p > .25$), but for high level of meaning, low-frequency cognitive words significantly lowered percent-correct as compared to high-frequency cognitive words ($p < .001$).

For the Frequency × Level of Meaning × Grade interaction ($F(23,156) = 3.60$, $p < .05$; see Figure 3), between grades analyses revealed a complex pattern of grade differences. There was a developmental trend of increasing cognitive word knowledge with a period of accelerated cognitive word acquisition after seventh and before tenth grade. Within grade analyses indicated that for fifth-graders, seventh-graders, and undergraduates, low level of meaning low-frequency cognitive words were answered incorrectly significantly more than the others, while for tenth-graders, there were no significant differences ($p < .05$). In sum, all grades, except tenth, appeared to have difficulty with high level of meaning low-frequency cognitive words.

We predicted that cognitive word knowledge would significantly increase with age and that all levels of meaning would be significantly different with the lower levels of meaning being acquired earlier than the higher levels of meaning. Since the limited number of passages in the cognitive word task prevented the analysis of all four levels of meaning with frequency and *think/know*, a 4 (Grade) × 4 (Level of Meaning) ANOVA was computed; the data were collapsed across frequency and according to whether the word was *think* or *know*. This analysis revealed significant main effects for grade, $F(3, 156) = 71.71$, $p < .001$, and level of meaning, $F(3, 156) = 12.20$, $p < .001$. There was no significant interaction.

Post hoc one-way ANOVAs with Scheffe range comparison ($p < .05$) were computed. Between level of meaning analyses indicated that *perception* ($M = .63$) was significantly greater in percent-correct than *metacognition* ($M = .49$), and *memory* ($M = .68$) was significantly greater in percent-correct than *evaluation* ($M = .55$) or *metacognition* ($M = .49$). Between grade analyses indicated that fifth- ($M = .37$) and seventh-graders ($M = .45$) scored significantly lower in percent-correct than tenth-graders ($M = .66$) and undergraduates ($M = .75$). Then, post hoc one-way ANOVAs with Scheffe range comparison ($p < .05$) were calculated between grades for each level of meaning. For *perception*, *memory*, and *evalua-*

tion fifth- and seventh-graders scored significantly lower than undergraduates, and for *memory* and *evaluation*, fifth-graders scored significantly lower than tenth-graders. Contrary to expectations, seventh-graders scored significantly lower for *metacognition* than fifth-graders and undergraduates. Our two predictions that cognitive word acquisition would significantly increase with age and that all levels of meaning would significantly differ, with the lower levels of meaning being acquired earlier than the higher levels of meaning, were partially supported.

SUMMARY OF RESULTS

Cognitive word knowledge increased with age; low level of meaning cognitive words were acquired before high level of meaning cognitive words; high-frequency cognitive words were acquired earlier than low-frequency cognitive words, and cognates of *think* were acquired before cognates of *know*. However, the order of acquisition of cognitive words depended on a complex interaction between frequency of the cognitive word in established word frequency counts, the level of meaning as determined by the Frank and Hall (1991) conceptual difficulty hierarchy, and whether the cognitive word was a cognate of *think* or *know*. More specifically, high-frequency *think* and low level of meaning *think* were acquired earlier, and high level of meaning low-frequency cognitive words were acquired later. Furthermore, cognitive words were positively correlated with achievement scores, and the correlations were higher for Verbal than Quantitative and higher for Vocabulary than Reading Comprehension.

DISCUSSION

Several issues ensue from the findings reported here concerning the relationship between cognitive word knowledge and reading comprehension. The first has to do with the validity of the cognitive word assessment. The second turns on the nature of the development of the child's understanding of cognitive words. The third issue has to do with the relationship between reading comprehension and cognitive word knowledge. We discuss these issues in turn.

Experimental Design Issues

The design of our study was important to the expansion of our knowledge of the relationship between cognitive words and reading comprehension for several reasons. First, most research on cognitive word comprehension has employed children under eight years of age (except Astington & Olson, 1990); therefore, we know little about cognitive word knowledge in older children and adults. Second, despite the voluminous research on internal state words, only two studies have assessed knowledge of more than three cognitive words at one time (Astington & Olson, 1990; Olson & Torrance, 1986). It is essential to assess a wide variety of cognitive words to uncover the impact of the mental state lexicon on cognitive development. Third, only three studies have related cognitive words to reading comprehension empirically (Olson & Torrance, 1986, 1987; Astington & Olson, 1990). Fourth, we used a questionnaire to assess cognitive words, so we were not dependent on frequency of expression as the measure of conceptual difficulty. Frequency of expression is susceptible to misinterpretations (see Frank & Hall, 1991). Our comprehension task gives a more accurate measure of a child's cognitive word knowledge because young children can often understand a word before they can produce it (Clark & Hecht, 1982; Benedict, 1978; Goldin-Meadow, Seligman, & Gelman, 1976) and observational studies of production may unfairly attribute more or less proficiency to children than deserved (Clark, 1983).

Finally, the use of abstract words to develop theories of word meaning (e.g., Frank & Hall, 1991; Hall et al., 1987) is unique, as most experimental investigations of word meaning have employed concrete nouns to test psychological theories of word meaning (for an exception see Miller & Johnson-Laird, 1976). Yet, many theories do not generalize easily to other types of words, such as abstract nouns, verbs, adjectives, and function words (Garnham, 1985). "The meaning of different words may be of different types: a single analysis of concepts may well not suffice" (Carey, 1982, p. 360). Therefore, the semantically complicated lexicon of cognitive words may itself require an equally intricate theory of acquisition (Scholnick, 1987).

Cognitive Word Acquisition: Conceptual Difficulty and Prototypicality

As reviewed earlier, Frank and Hall (1991) developed a level of meaning hierarchy of increasing abstractness and conceptual difficulty, ranging from *perception* through *memory*, *understanding*, *evaluation*, and *metacognition* to *planning*. This hierarchy adequately described both adult and child verbal frequency of the cognitive word *know* (Hall et al., 1984); as the level of meaning increased, the frequency decreased. Furthermore, the levels of *perception*, *memory*, and *understanding* were statistically differentiated, but the levels of *evaluation*, *metacognition*, and *planning* were not. Frank and Hall (1991) then tried to incorporate the cognitive word *think* into their cognitive word hierarchy. They found that *evaluation* was used most often and that the other five levels of meaning were statistically undifferentiated for both children and adults.

The present study provided some support for the Frank and Hall (1991) level of meaning hierarchy, as all of the level of meaning differences were in the hypothesized direction. More specifically, *perception* was significantly greater in percent-correct than *metacognition*, and *memory* was significantly greater in percent-correct than *evaluation* and *metacognition*. Furthermore, when *perception* and *memory* were combined into a low level of meaning category and *evaluation* and *metacognition* were combined into a high level of meaning category to allow for sufficient reliability, we found that low level of meaning was answered correctly significantly more than high level of meaning. A more reliable measure of cognitive words would undoubtedly differentiate statistically between all levels.

The present study also provided support for the developmental differences in level of meaning acquisition found among children (Hughes, 1985), and between children and adults (Frank & Hall, 1991; Hall et al., 1987). In general, cognitive word knowledge increased with age, and developmental differences were observed in all cognitive word subscales. For example, younger children scored significantly lower in percent-correct than older children in low level of meaning, high level of meaning, *think*, *know*, high-frequency, low-frequency, and cognitive word total. More specifically, for *perception*, *memory*, and *evaluation*, fifth- and seventh-graders scored significantly lower than undergraduates, and for *memory* and *evaluation*, fifth-graders scored significantly lower than tenth-graders. For *metacognition*, seventh-graders scored significantly lower than undergraduates. Contrary to expectations, for *metacognition*, seventh-graders scored significantly lower than fifth-graders, probably because the fifth-grade girls were enrolled in a study skills development class, thereby enhancing their knowledge of metacognitive words.

Frank and Hall (1991) proposed that cognitive words are hierarchically organized, but that different cognitive words may have a different organization of levels that depends on both conceptual difficulty and prototypicality. They further hypothesized that prototypical meanings will be acquired first, but cognitive words whose prototypical meanings are lower level will be semantically mastered earlier than words whose prototypical meanings are higher level. This hypothesis was supported by the fact that children in the Hall et al. (1984) study acquired *know* before *think*. *Know*'s prototypical level of meaning may be at the *perception* level while *think*'s prototypical level of meaning is at the *evaluation* level.

In contrast, our results indicate that *think* was answered correctly significantly more often than *know*. But a linguistic analysis of *think* and *know* may provide the answer. Very simply, it is easier to know what another person *thinks* rather than what another person *knows*, given veridical self-report of that person. According to Webster's *Unabridged Dictionary of the English Language* (1989), *know* means "to perceive with certainty; to understand clearly; to be sure of or well-informed about; as we *know* the facts . . . to have a firm mental grasp of . . . to have clear and certain perception," while *think* means "to form or have in the mind . . . to bring the intellectual facilities into play; to use the mind for arriving at conclusions, making decisions, drawing inferences etc.; to perform any mental operation; to reason." From reflection on the preceding definitions, it is clear that to *know* means to have a definite, veridical understanding of something, whereas to *think* merely means to reflect about something, probably with an indefinite, uncertain understanding. In short, knowing what another person *thinks* is much easier than knowing what another person *knows*. Our discrepancy with Frank and Hall (1991) may also be accounted for, in part, by the fact that our study measured comprehension while theirs measured word production. However, Hughes (1985) found the correlation between production and comprehension of cognitive words to be rather high ($r = .66$).

The two-way *Think/Know* × Level of Meaning and three-way *Think/Know* × Level of Meaning × Grade (see Figure 1) interactions also illuminate the Frank and Hall (1991) conceptual difficulty and prototypicality hypothesis. Closer analysis of Figure 1 reveals that the two-way interaction appears to hold only for fifth- and seventh-graders; that is, low level of meaning *think* is easier than high level of meaning *think*, and high and low level of meaning *know*. In contrast, there appear to be no significant differences in tenth-graders, and only the two main effects exist in undergraduates. Again, Frank and Hall (1991) suggest that *think* has a prototypical meaning at a higher level of meaning than *know* and that is why it is learned later. Our only significant differences were that children learned the low level of meaning *think* earlier than high level of meaning *think*, low level of meaning *know*, and high level of meaning *know*. According to the Frank and Hall (1991) hypothesis, this indicates, at least for the fifth- and seventh-graders, that the prototypical level of meaning of *think* may be at the lower and not the higher level of meaning, and that *know* may not have a prototypical level of meaning. Further research must address this question.

The two-way *Think/Know* × Frequency and three-way *Think/Know* × Frequency × Grade interaction (see Figure 2) revealed high-frequency *think* to be easier than low-frequency *think*, low-frequency *know*, and high-frequency *know* for fifth-graders and seventh-graders. There appeared to be no significant differences in tenth grade, and only the main effects of frequency and level of meaning appeared to exist in undergraduates. The interactions suggest that frequency of exposure to cognitive words, especially to cognates of *think*, is very important in cogniti word acquisition, suggesting that linguistic input is essential for enhancing lexical development in this domain. This finding supports previous research that reports a high correlation between adult and child use of cognitive words (Hall et al., 1987; Beeghly et al., 1986).

The Frequency × Level of Meaning interaction and the Frequency × Level of Meaning × Grade interaction (see Figure 3) revealed that all grades except tenth appeared to have difficulty with high level of meaning low-frequency as compared to low level of meaning low-frequency cognitive words, and high and low level of meaning high-frequency cognitive words. In other words, the probability of getting a certain level of meaning correct depended on the frequency of the word. If the cognitive word was low-frequency, low level of meaning was answered correctly more than high level of meaning, but if the cognitive word was high frequency, children were equally likely to answer it correctly regardless of its level of meaning. In sum, frequency appeared to be very important in cognitive word acquisition (high-frequency even overcame the level of meaning effect) suggesting that linguistic input is essential for efficient cognitive word acquisition.

The important question then became whether there was a *Think/Know* × Level of Meaning × Frequency interaction. The 4 (Grade) × 2 (Frequency) × 2 (Think/Know) × 2 (Level of Meaning) ANOVA revealed a nonsignificant interaction. Even if this interaction were significant, it would be meaningless; two cognitive word passages per cell does not allow for sufficient reliability. Nevertheless, from the previously described three two-way interactions it appears that the high-frequency and low level of meaning *think* are relatively easy at least for fifth- and seventh-graders, while low-frequency high level of meaning appears to be difficult for all subjects. On the basis of these findings, we predict that future studies may find that frequency and level of meaning will have little effect on percent-correct for *know*, while only high-frequency combined with low level of meaning will increase percent-correct for *think*.

Frequency of exposure to cognitive words could account for the above interactions. More specifically, children may be exposed to low level of meaning *think* more often than low level of meaning *know*, but they may receive more equal exposure to high level of meaning *think* and high level of meaning *know*. This would account for the Level of Meaning × *Think/Know* interaction (see Figure 1). In addition, children may be exposed to high-frequency *think* more often than high-frequency *know*, but they may receive more equal exposure to low-frequency *think* and *know*. This would account for the Frequency × *Think/ Know* interaction (see Figure 2). These predictions will be tested empirically in future studies.

In summary, all three-way interactions revealed a developmental trend of increasing cognitive word knowledge, and a period of accelerated cognitive word acquisition after seventh and before tenth grade. Younger children have difficulty in mastering the cognitive word lexicon for many reasons. First, children's exposure to written and spoken cognitive words is seriously deficient (Astington, 1991; Hall et al., 1984; Carroll et al., 1971; Smith & Meux, 1970; Thorndike & Lorge, 1944), yet adult/child correlations of cognitive word use are very high (Hall et al., 1987; Beeghly et al., 1986). Second, the cognitive word lexicon is very intricate and many words within it are polysemous, thus the appropriate use of cognitive words requires a recognition of the subtle contrasts and comparisons between them (Hall et al., 1987). Third, cognitive words are abstract and elusive because they deal with the inner workings of the mind; therefore, acquisition cannot benefit easily from nonlinguistic strategies such as mapping language onto pre-existing conceptual categories (Clark, 1983). Given that a period of accelerated cognitive word acquisition exists and that linguistic input may be essential for this rapid period of growth to occur, children's oral environments and reading materials should be enhanced by higher frequencies of cognitive words if their intellectual development is to be accelerated.

In support of this hypothesis, Corson (1985) observed that most cognitive words are usually encountered late and learned later in life. Access to them and use of them are further restricted by their introduction in literature or textbooks, not through dialogue or discourse. Corson (1985) calculated the frequency of cognitive words and speech act verbs in 43 types of text and found their frequency to vary substantially, for example, from 40% in philosophy of education to 0% in five- to six-year reading age children's fiction (see Table 6). Thus, the period of accelerated development between the seventh grade (M = 12.7) and tenth grade (M = 15.6) children in our study may be a product of increased exposure to cognitive words in high school texts and other reading material. This increased exposure to cognitive words may determine the convergence of cognitive word knowledge in tenth grade (see three-way interactions, Figures 1, 2,

Table 6. Literature Ranked According to Graeco-Latin Content

Literature	% Content G-L
Philosophy of Education	40
Linguistic Philosophy	40
History of Religion	37
Theology	36
Sociology	38
Science Education	33
Psychology	32
Physics	31
Music	29
Mathematics	28-29
English Literature	16-24
Newspaper	5-24
Children's Fiction:	
12 years R.A.	10
9-11 years R.A.	7
10-11 years R.A.	4
9-12 years R.A.	4
7-8 years R.A.	3
7-11 years R.A.	2
5-6 years R.A.	0

Note. Based on random passages of 100 words (Corson, 1985). R.A. = Reading Age.

& 3). The lack of convergence in the under graduates may be due to the diverse academic ability levels at the University of Maryland as compared to the homogeneous population of students in the private high schools.

Cognitive Words and Reading Comprehension

Children's ability to assign meanings to words is a developmental process involving both cognitive and linguistic skills in interaction with contextual constraints. The current educational literature on reading shows conclusively that the development of word knowledge in children is essential for high-level text understanding (e.g., Stanovich & Cunningham, 1992; Stahl, Hare, Sinatra, & Gregory, 1991; Eldredge, Quinn, & Butterfield, 1990; Stahl, Jacobson, Davis, & Davis, 1989; Dixon, LeFevre, & Twilley, 1988). Furthermore, several successful direct vocabulary instruction programs have shown beneficial effects on children's high-level comprehension of text (e.g., McDaniel & Pressley, 1989; Reutzel & Hollingsworth, 1988). Unfortunately, the role of the domain of "states" — the temporary or permanent properties of objects and situations — in high-level text understanding has received little attention, compared to the domain of objects, situations, or events (see Clark, 1983).

Only three investigations of the relationship of cognitive word knowledge to reading comprehension have been conducted. Our study supports the importance of cognitive word knowledge for skilled reading comprehension. For all grade-schoolers and undergraduates, adjusted for mean differences, the correlation of cognitive word total was higher for Verbal ($r = .42, p < .001$) than for Quantitative ($r = .28, p < .001$) and higher for Vocabulary ($r = .47, p < .001$) than for Reading Comprehension ($r = .39, p < .001$). To a greater extent than knowledge of other vocabulary words, knowledge of cognitive words seems to be centrally involved in reading comprehension. For example, differentiating between the subtle differences in mental and motivational states of the protagonist or his or her adversary is essential for the interpretation of a literary text. Cognitive words provide the reader a vehicle by which to analyze the past, present, and future actions and goals of a character with precision even when presented with ambiguous information. Similarly, Corson (1985) describes cognitive words as allowing people "to order thought where such ordering of thought might not occur without the words themselves" (p. 61) and to increase their "capacity to deal with expectations and hypotheticals" (p. 48).

Future research should consist of studies in which children's cognitive word knowledge is enhanced, and subsequent observation is taken of his or her high-level text understanding and metalinguistic acquisition in a variety of learning environments. The rationale of this assertion is supported in part by Paul and O'-Rourke's (1988) suggestion that teachers must be more aware of these multimeaning words, and perhaps include direct vocabulary instruction in their programs (see Paul & O'Rourke, 1988). We make several predictions regarding the role of cognitive word knowledge in development of high-level text understanding and metalinguistic knowledge. We suggest that children with high cognitive word knowledge, as compared to those with low cognitive word knowledge, may be more likely to extract, process, and recall in an organized way the metalinguistic information they encounter in texts (see McDaniel & Einstein, 1989; Alexander & Judy, 1988; Recht & Leslie, 1988). Because this metalinguistic information is more effectively gleaned from reading, children may learn reading strategies faster and earlier. Furthermore, children may be more likely to maintain and generalize these reading strategies because cognitive words allow children to describe under what conditions metalinguistic activities are successful, why they are successful, and how they may be used in solving different problems. These issues await further research.

Author Notes. This research was supported by grant #01-4-32735 from the Office of Educational Research and Improvement, U.S. Department of Education, to William S. Hall and James R. Booth of the National Reading Research Center. We thank David R. Olson, Linda Baker, and two anonymous reviewers for very helpful critical comments on earlier versions of this manuscript. We also thank the administrators at Landon School and Holton-Arms School for their organizational assistance, and their students for volunteering to participate in this investigation.

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APPENDIX A

COGNITIVE WORD TASK

Instructions

After the cognitive word test booklet was handed out, the experimenter read the instructions. The instructions, which were on the first page of the booklet, read:

> The words *think* and *know* are very commonly used in our language and they have many meanings. The meaning of *think* and *know* depends on the context that they are used in. Other words can describe a particular meaning of *think* and *know*. Sometimes another word can more accurately or narrowly define what is meant by *think* or *know*.

For example, the statement (1) "Mike *knows* the clock is on the wall in front of him" may be more specifically stated by (2) "Mike *sees* the clock on the wall."

The purpose of this test is to see if you know what other words can be used to describe what is meant by *think* and *know* in a certain context. You will be asked to read a short story that tells of a person who *thinks* or *knows* something. After the story, there are four possible sentences containing words that may describe what is meant by *think* or *know*. Circle the letter of the sentence that contains the replacement word that goes along with the context of the story the *best*. There are 24 stories. You have exactly 25 minutes to complete this Cognitive Word Task. If you finish early, please go over your answers. Are there any questions?

Cognitive Word Passages

Perception: "Notice"

1. Jeanne just poured herself a bowl of cereal for breakfast. She put the cereal box back into the cupboard. Her mom sees her eating cereal at the kitchen table. Her mom asks, "I am going to the food store to shop. How much cereal is left? Do we need more cereal?" Jeanne says, "I was *thinking* of something else, when I was pouring my cereal."

   A. Jeanne did not *recognize* the cereal was getting low.
   B. Jeanne did not *understand* the cereal was getting low.
   C. Jeanne did not *notice* the cereal was getting low.
   D. Jeanne did not *realize* the cereal was getting low.

Perception: "Concentrate"

2. Suzanne is studying in her bedroom for a test tomorrow. The test is going to be very easy. Her brother Tim is playing loud music on his stereo. Usually Suzanne can study with music in the background, but she is not interested in what she is studying. Suzanne cannot *think* about her homework.

   A. Suzanne cannot *recall* the material.
   B. Suzanne cannot *comprehend* the material.
   C. Suzanne cannot *apprehend* the material.
   D. Suzanne cannot *concentrate* on the material.

Perception: "Observe"

3. The other day, Jane was exploring in the woods. A large bird flew right in front of her face while she was walking. She kept her eyes open because she wanted to see this large bird up close. When talking to her friend Sally later, she told Sally about the bird. Sally denied that Jane saw a bird. Jane said, "I *know* a large bird flew in front of my face."

   A. Jane *observed* the large bird.
   B. Jane *recognized* the large bird.
   C. Jane *understood* it was a large bird.
   D. Jane *realized* it was a large bird.

Perception: "Perceive"

4. Jeff just received a new dog and dog whistle for his birthday. Whenever Jeff blows the whistle, his dog comes to him. The whistle is so high-

pitched that Jeff cannot hear it. Dogs can hear high-pitch sounds that people cannot hear. Dogs have better ears than people. The dog *knows* when the whistle blows.

A. The dog *comprehends* when the whistle blows.
B. The dog *recalls* when the whistle blows.
C. The dog *apprehends* when the whistle blows.
D. The dog *perceives* when the whistle blows.

Memory: "Forget"

5. Sally and Joni just finished watching a movie at the movie theater. They were talking about the movie on their walk home. Sally asked Joni the name of the hero in the movie. During the movie, Joni thought the hero had a neat name. Now, she cannot *think* of his name.

A. Joni *realizes* the name of the hero in the movie.
B. Joni *forgets* the name of the hero in the movie.
C. Joni *notices* the name of the hero in the movie.
D. Joni *understands* the name of the hero in the movie.

Memory: "Remind"

6. Adam and Tony are riding their bikes around the neighborhood on a late Sunday afternoon. Adam sees a neighbor mowing his lawn. Adam had told his parents that he was going to mow the lawn on Sunday afternoon. Adam's parents are gone for the weekend. Adam *thinks* he has to mow the lawn now.

A. Adam *perceives* he has to mow the lawn.
B. Adam *comprehends* he has to mow the lawn.
C. Adam was *reminded* he has to mow the lawn.
D. Adam *apprehends* he has to mow the lawn.

Memory: "Recognize"

7. Last week in class Mr. Smith reviewed the states in America and their major products. Today, John has a multiple-choice test on that topic. One of the questions asks: "What is the major product made by Wisconsin?" After reading only the question, John cannot answer it. Lucky for John that there are four choices. After reading the choices, John *knows* that the choice "major product is dairy goods" is the correct answer.

A. John *recognized* that their major product is dairy goods.
B. John *realized* that their major product is dairy goods.
C. John *understood* that their major product is dairy goods.
D. John *observed* that their major product is dairy goods.

Memory: "Recall"

8. Tammy recently made friends with another girl from school, Rebecca. Tammy has called Rebecca on the phone a few times. Tammy is at another friend's house. She wants to call Rebecca so they can all play. She has never called her before without looking up the number in her address book. Tammy *knows* the number and calls Rebecca.

A. Tammy *apprehended* the number.
B. Tammy *perceived* the number.
C. Tammy *comprehended* the number.
D. Tammy *recalled* the number.

Understand: "Realize"

9. Claudia is learning how to play a new game. She is trying to teach her friend James how to play the game. Claudia has already read the directions, but they are not playing the game right. Claudia rereads the directions. They are now playing the game correctly. Claudia *thinks* she can play the game right.

   A. Claudia *concludes* this is the way to play the game.
   B. Claudia *recognizes* this is the way to play the game.
   C. Claudia *assumes* this is the way to play the game.
   D. Claudia *realizes* this is the way to play the game.

Understand: "Apprehend"

10. Bill is putting together a model kit of a car. He reads the next step in the directions. He glues the body together. Next, he is trying to put the rear seat in the body, but it does not fit. He rereads the last line in the directions again. It says to glue the rear seat in before you glue the body together. At first, Bill *thought* the directions said to glue the seat in after you glue the body together.

    A. Bill did not *apprehend* the directions.
    B. Bill did not *evaluate* the directions.
    C. Bill did not *interpret* the directions.
    D. Bill did not *recognize* the directions.

Understand: "Understand"

11. Danielle has been working on her math homework for over an hour. She was having trouble with one problem. Finally, she tried to use a different formula and it worked. The teacher graded her homework. She got 100%. Now, Danielle *knows* how to do the problem.

    A. Now, Danielle *recognizes* this is the way to do the problem.
    B. Now, Danielle *understands* this is the way to do the problem.
    C. Now, Danielle *assumes* this is the way to do the problem.
    D. Now, Danielle *concludes* this is the way to do the problem.

Understand: "Comprehend"

12. Stanley is an expert on the ocean. Stanley explains to Geoff why there are tides in the ocean. Later, Geoff tells his teacher about the cause of the tides. Geoff says, "The water comes in and out from shore because the gravity between the earth and moon changes." His teacher is very impressed. Now, Geoff *knows* why there are tides in the ocean.

    A. Geoff *recalls* why there are tides in the ocean.
    B. Geoff *interprets* why there are tides in the ocean.
    C. Geoff *infers* why there are tides in the ocean.
    D. Geoff *comprehends* why there are tides in the ocean.

Evaluation: "Doubt"

13. Cathy and Erica are visiting the zoo. They are trying to identify the animals without looking at the labels on their cages. They come to the monkey cages. Erica has labeled every monkey correctly so far. They come to next cage. Cathy labels this monkey a chimpanzee, but Erica *thinks* the monkey is a great ape.

   A. Erica *doubts* the monkey is a chimpanzee.
   B. Erica *understands* the monkey is a chimpanzee.
   C. Erica *considers* the monkey is a chimpanzee.
   D. Erica *imagines* the monkey is a chimpanzee.

Evaluation: "Infer"

14. Chris leaves a candy bar on the kitchen counter by mistake. While Chris is outside, his mother finds the candy bar and puts it in a drawer. When Chris comes home, his candy bar is not on the counter. On his way to his room, he sees a wrapper of the same kind of candy on his brother's floor. Chris *thinks* that his brother ate his candy bar.

   A. Chris *infers* that his brother has eaten his candy bar.
   B. Chris *comprehends* that his brother has eaten his candy bar.
   C. Chris *conceives* that his brother has eaten his candy bar.
   D. Chris *contemplates* that his brother has eaten his candy bar.

Evaluation: "Conclude"

15. Patrick comes home early from school and finds that nobody is home. He looks in the garage and sees that his mother's car is gone. He also sees that his brother Sam's football equipment is not in the utility room where it always is. He *knows* that his mother is driving Sam to football practice.

   A. He *understands* that his mother is driving Sam to football practice.
   B. He *considers* that his mother is driving Sam to football practice.
   C. He *concludes* that his mother is driving Sam to football practice.
   D. He *imagines* that his mother is driving Sam to football practice.

Evaluation: "Hypothesize"

16. Kathleen walks outside for recess and meets up with two classmates in the playground. One is very big and the other is very skinny. They tell Kathleen that they have just balanced themselves on the seesaw on the other side of the playground. Kathleen did not see them do it, but she *knows* they balanced themselves by putting themselves at different distances from the center of the seesaw.

   A. Kathleen *comprehends* how they balanced themselves.
   B. Kathleen *ponders* how they balanced themselves.
   C. Kathleen *contemplates* how they balanced themselves.
   D. Kathleen *hypothesizes* how they balanced themselves.

Metacognition: "Consider"

17. Cheryl is studying for a science test tomorrow. Her teacher said that the test is going to cover the main ideas that she talked about in class. Cheryl is trying to decide whether to spend most of her time on the parts of the textbook the teacher covered in class or to study all of the details. Cheryl *thinks* about how to learn the material the best.

    A. Cheryl *concludes* how to learn the material the best.
    B. Cheryl *considers* how to learn the material the best.
    C. Cheryl *expects* to learn the material the best.
    D. Cheryl *intends* to learn the material the best.

Metacognition: "Contemplate"

18. Tom and Megan are married and often fight over small things. They just got in a yelling match over who has taken out the garbage more. In the past they have divided the work around the house evenly. Tom is upset. He is not sure why they are always yelling at each other. He *thinks* it may be because they have different ideas about what it is to be a husband and a wife.

    A. Tom *apprehends* why they fight so often.
    B. Tom *contemplates* why they fight so often.
    C. Tom *predicts* why they fight so often.
    D. Tom *anticipates* why they fight so often.

Metacognition: "Reflect"

19. Georgia sees an animal at the zoo that she has seen before. Her friend Cynthia asks her what it is called. Georgia calls it a Cheetah. Cynthia says, "No, it is a Hyena." Georgia *knows* why she called it a Cheetah and not a Hyena. Both animals have spots and their names sound the same.

    A. Georgia *assumed* this is the reason she called the animal a Cheetah.
    B. Georgia *bet* this is the reason she called the animal a Cheetah.
    C. Georgia *expected* this is the reason she called the animal a Cheetah.
    D. Georgia *reflected* on why she called the animal a Cheetah.

Metacognition: "Analyze"

20. Joe and Fred went off by themselves to explore a lake. They came to a group of boys jumping off a very high tree into the water. Joe and Fred decided to jump. When Fred was about to jump, he became afraid. The many times he jumped off the high dive at the school swimming pool popped up in his mind. He jumped. After the jump, Fred *knew* jumping off the diving board at school helped him to jump off the tree.

    A. Fred *inferred* how he jumped off the tree.
    B. Fred *predicted* how he jumped off the tree.
    C. Fred *anticipated* how he jumped off the tree.
    D. Fred *analyzed* how he jumped off the tree.

Planning: "Predict"

21. Dave and Bruce want to go camping in the mountains this weekend. They should not go if it is going to rain. It rained all week. There is not a cloud in the sky the Saturday morning they want to leave. Dave listens to the weather channel a lot. Dave *thinks* that it will not rain this weekend.

    A. Dave *imagines* that it will not rain this weekend.
    B. Dave *considers* whether it will rain this weekend.
    C. Dave *predicts* that it will not rain this weekend.
    D. Dave *infers* that it will not rain this weekend.

Planning: "Intend"

22. Patty has a very busy week next week. She has a math and science test at school. She has a doctor's and dentist's appointment. She is going to Heidi's and Linda's birthday parties. And she has other things to do too! She studied for her tests during the weekend. She *thinks* she will study more after the birthday parties.

    A. Patty *intends* to study after the birthday parties.
    B. Patty *conceives* of studying after the birthday parties.
    C. Patty *concludes* to study after the birthday parties.
    D. Patty *contemplates* studying after the birthday parties.

Planning: "Expect"

23. A local high school has a very good basketball team. They are rated number one in their division. They have only lost once during the season. They lost to the second best team in the league. The coach tells his team that they are playing a team tonight that is rated poorly in the league. The coach *knows* they are going to win the game tonight.

    A. The coach *imagines* his team will win tonight.
    B. The coach *expects* his team will win tonight.
    C. The coach *considers* his team will win tonight.
    D. The coach *assumes* his team will win tonight.

Planning: "Anticipate"

24. Mary and Alice always go to church together on Sunday morning. They always meet in front of the ice cream store at 10 o'clock and walk together to the church. One Sunday morning when Alice is getting ready to leave, her mother asks her, "Have you called Mary to make sure you are meeting in front of the ice cream store?" Alice says, "No, but I *know* that Mary will be there."

    A. Alice *conceives* Mary will be there.
    B. Alice *contemplates* Mary will be there.
    C. Alice *anticipates* Mary will be there.
    D. Alice *infers* Mary will be there.

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