VARIABILITY AND LANGUAGE LEARNING DISABILITIES

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Information processing has often been used as a theoretical orientation for attempting to understand language learning disabilities. For the most part, the use of this orientation has focused on a search for one aspect of information processing (e.g., memory span, discrimination) that might be defective and the cause of problems with language learning. Such approaches have been criticized by many (e.g., Johnston, 1982; Lahey, 1988; Leonard, 1987; Vellutino, Pruzek, Steger, & Meshoulam, 1973; see also Wallach & Butler, chap. 1). The critiques stress the fact that it is difficult to measure one aspect of processing in isolation from what is being processed. For example, the memory span of language learning disabled (LLD) children in comparison with peers, and of adults in comparison with children, is similar when the material to be recalled is equally familiar (e.g., Case, Kurland, & Goldberg, 1982; Vellutino et al., 1973). Furthermore, the variability among LLD children makes it clear that deficits in one process are unlikely to explain the different manifestations of language problems found among LLD children (Friel-Patti, chap. 14).

Information processing approaches that focus on one deficit as the cause of a student’s academic or learning problem are of questionable value (see, e.g., Bloom & Lahey, 1978; Lahey, 1988, for explication of such a specific abilities orientation). The approach presented in this chapter is an alternative information processing approach to language development and disorders and can be applied to identification of LLD children as well as to planning language learning intervention. This approach provides clinicians and teachers with a way of taking into account some of the variability found within a single child’s performance as well as some of the variability found among LLD children of similar cultural and linguistic backgrounds. (For a discussion of variability related to cultural and linguistic diversity see Westby, chap. 7; Lahey, 1992; Seymour, 1992.) So often, LLD children perform well at one time but fall apart on a similar task at another time. For example, a child may produce a coherent and cohesive well-developed narrative one day but be dysfluent and incoherent in attempting to produce an apparently comparable narrative the very next day. One is left with the perplexing problem of where to begin language intervention. It is not clear what level of narrative production should be the goal or even that the child needs help with knowledge of narrative structure. In fact, observation of the same child’s performance at certain times may lead one to question whether that child has a language learning problem.

Teachers and parents also often report that an LLD child appears to know something one day only to have completely forgotten it the next. This variability has been an enigma to those who try to understand LLD or work with LLD children; it is a problem one would prefer to ignore. One would like to assume that descriptions of a child’s performance are a fair indication of the child’s knowledge (or competence); professionals hope that they can more readily identify a child who is different from peers and determine what the child needs to learn. However, describing a child’s performance in a way that makes possible inferences about knowledge is a difficult task.

The concept of a limited capacity processor as a paradigm for understanding some of the variation observed within and among children is described in this chapter. It is suggested that task analysis of factors that could be competing for limited processing capacity may help to clarify goals and determine intervention procedures in the face of variable perfor-
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In recent years, the field of language and cognitive development has shifted its focus from a narrow emphasis on specific language skills to a broader perspective that considers the role of general cognitive abilities, such as working memory and executive function. This information processing approach focuses on the synergistic interaction of several processes with each other, with context, and with the material to be processed rather than emphasizing a specific ability (see also Silliman & Wilkinson, chap. 2). The view of language processing as a limited capacity system comes from Baddeley (1986), Case (1985), Kahneman (1973), and others.

Integral to the limited capacity processing perspective presented is an important component of language processing that has received little attention in our literature. This component involves constructing and holding in mind the momentary mental representations that underlie the expression and interpretation of language. As discussed later, people can only talk about what they are currently thinking about—the ideas they talk about must be constructed in consciousness based on information from long-term memory and from context (as also discussed by Blachowicz, chap. 11; Milosky, chap. 10, relative to interpreting written language). The concepts presented in this chapter concerning the importance of such mental representations to language processing are based on the works of Bloom (1991, 1993), Bloom and Beckwith (1986), Fauconnier (1985), Johnson-Laird (1983), and others.

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The term *consciousness* is used here to refer to the portion of the mind that intervenes between events occurring in the immediate context and the knowledge base stored in memory (Bloom, 1991). All knowledge is represented mentally, although the way it is represented is highly controversial (e.g.,

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1*Consciousness* as used here does not imply a metalevel. That is, it does not imply that we are necessarily always aware of having an idea in consciousness.
The representations that are based on past experience and constitute a base of knowledge are not in consciousness but are in what is usually referred to as long-term memory (LTM). One cannot act on this stored information until it is brought to some level of consciousness—that is, until one is attending to or thinking about it in some way. Knowledge in LTM can be accessed and brought to consciousness in a number of ways. For example, thoughts of snow skiing can be cued from perceptions in the context (e.g., one sees a pair of skis and thinks of snow and skiing), or it can be cued from language (e.g., in the middle of the summer, one is asked if one has skied at Aspen). To reiterate, this notion is important for understanding LLD students because, as clinicians and educators, professionals try to ascertain whether poor performance is related to insufficient knowledge in LTM, difficulties in accessing that knowledge, or difficulty in constructing and holding ideas in consciousness (perhaps because of competition for cognitive resources).

Terminology used to refer to the mental representations constructed and held in consciousness (in contrast to those in LTM) varies and includes terms such as mental spaces (Dinsmore, 1987; Fauconnier, 1985), intentional states (e.g., Bloom & Beckwith, 1986; Searle, 1983), mental plans (e.g., Miller, Galanter, & Pribram, 1960), and mental models (e.g., Johnson-Laird, 1983). The term mental models is used in this chapter to refer to the representations or momentary contents of consciousness that underlie intentional actions and interpretations of the actions of others. A mental model is, then, a private representation of an idea constructed out of both knowledge accessed from LTM and the data in perceptions based on the present context. It is fleeting, and its content changes from moment to moment with changes in the context and what is recalled from memory. The content of a mental model occurs with an attitude toward it; these attitudes are the feelings, beliefs, and desires we have about the objects and events represented (Bloom, 1991, 1993; Bloom & Beckwith, 1986). While this constructing process goes on in consciousness and results in the objects of awareness and attention, one is not aware of the process or conscious of it in the metacognitive sense of knowing that one knows (or being conscious of what is in consciousness).

Developmental Changes in Complexity and Source of Mental Models

Mental models are constructed from present perceptions and from a store of knowledge based on past experiences. Developmental differences can be inferred in both the complexity of the models that underlie actions and in the relative influence of present perceptions on the construction of models.

Most clinicians and educators are familiar with the works of Jean Piaget and the concept of representational thinking that develops during the sensorimotor period. Piaget was concerned with the development of the structures of thought that children represent in LTM (e.g., object permanence, means–end relations) and that provide the organization of the knowledge base. He was also concerned with the symbolic process that enables children to form representations in consciousness. The methodology for descriptions of mental models is similar to the methods proposed by Piaget. Both rely on inferences made about what underlies intentional actions.

Mental Models and Play. The actions of the young infant allow one to infer simple mental models. The young infant models are formed primarily from perceptual data. For example, the infant’s play with objects can be described in terms of the mental models underlying their actions (Lifter & Bloom, 1989). As described by Lifter and Bloom, the infant, early on, dismantles objects presented in a configuration (e.g., rings on a tower, little people in a bus); the model underlying such intentional behavior can be cues primarily from what the infant sees (i.e., that the objects are separable). Eventually, the infant begins to reconstruct what has been taken apart. Now the mental model includes memory of recent prior experiences with these objects or similar objects. However, immediate perceptions still provide some cues for the reconstruction; the shapes of the objects suggest the intended relations (e.g., the hole in the ring and in the bus). Later, the infant relates two objects together in ways that are not so readily cued by their perceptual shapes, as when the child sits a doll in a truck or puts it in a bed. The mental model underlying such intentional behaviors appears to come primarily from knowledge based on past experiences and includes social and conven-

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2This use of the term mental models differs a bit from the use by Johnson-Laird (1983), who distinguishes three types of conscious representations (i.e., images, propositions, and models). The term is used in this chapter to refer to representations that may be eclectic in notation and include images and/or propositions of some sort.
ditional knowledge. Thus, the infant’s actions reflect the developing ability to form models with decreasing dependence on context and increasing dependence on memory of past experiences (Bloom, 1991; Lifter & Bloom, 1989). This developmental trend continues and is reflected in language performance into the school years; decreasing dependence on context and increasing dependence on information in LTM is often a goal for the LLD student (Milosky, chap. 10).

**Mental Models and Language.** Other examples of developmental changes, in both the source of input for the construction of mental models and in the complexity of the models underlying actions, come from descriptions of language development. As noted by Brown (1973), young children talk in the “here and now” and only gradually come to be able to talk about the “there and then.” Thus, it seems that the mental models underlying early utterances rely heavily on the data of perception in the here and now for their construction. With development, children increasingly come to use information from past experiences that are stored in memory for constructing mental models that underlie language.

As children move from talking about the relations between objects with single words and simple sentences to talking about relations between events that are expressed in complex sentences, an increase in the complexity of the mental models that they construct can be inferred (Bloom, Lahey, Hood, Lifter, & Feiss, 1980). In the early productions of complex sentences, the relations between the events do not need to be held in consciousness before or while the child speaks. For example, when the child looks at a picture and (as she points to the dog) says “The dog eats” (then pointing to a cat) “and the cat eats,” no relation between the events needs to have been constructed in consciousness. The model underlying each utterance could have been independent of the other. Such utterances express additive relations. Likewise, a prior mental model of two events and the relations between them is not necessary to produce utterances chained to actions such as “put it away” (as the child places the book on the shelf) “then get another one” (as the child picks up another book). The child needs only have the model of putting the book away for the first utterance. The model with the desire to get another book could have been cued by seeing the desired book on the shelf as the first book was returned. In contrast, other utterances clearly suggest that complex relations between events are represented in consciousness and being expressed.

Consider the utterance “bend him so he can sit” as a child handed her mother a rubber doll. In this instance, the child had represented in consciousness a complex relation between the current state of the doll and an action that would result in a desired change of state. Furthermore, the utterance suggests that the child’s mental model included not only a representation of the action necessary for the change of state but also her desires regarding that change and a belief that her mother could accomplish the change.

Eventually, as children produce narratives, expression through language relies on models of the relations among multiple events. Narrative development appears to follow a course of development similar to that for complex sentences in terms of expressing first additive relations followed by temporal and causal relations (for a review, see, e.g., Lahey, 1988). However, the early series of utterances that children produce do not necessarily represent complex models of relations among events, even though they appear to be cohesively tied to one another. For example, early “stories” include strings such as “The dog went on the puppet, the puppet went on the house, the house went on the pigeon” as well as “The monster. The monster ate the house, the monster ate the cat and also the dog.” (both from Sutton-Smith, 1981). In these stories, each event could have been represented one at a time; no predetermined temporal or causal relations among the events appear to have been represented in an underlying model. In the second story, the child shows evidence of holding in mind a theme of a monster eating but any relations among the eating events are not obvious. Thus, such narratives are like additive chains of utterances that do not appear to require any more complex mental models than early complex sentences with additive relations. These early narratives also tend to repeat the same verb (as in the preceding went or ate) over and over (e.g., Botvin & Sutton-Smith, 1977). This reduces the load on lexical and syntactic search and reduces the complexity of the mental model.3

Changes in narrative productions that come with increased age include the addition of a main character as agent of the events (e.g., the monster in the

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3Frequent repetition of the same verb is also found among earliest complex sentences, as in “I sit here and you sit there” (Bloom et al., 1980) and is an important feature in the development of contingent discourse (Bloom, Roscissano, & Hood, 1976).
preceding example) and constraints on the objects acted on (e.g., eating only foods) (see, e.g., Applebee, 1978; Botvin & Sutton-Smith, 1977; Sutton-Smith, 1981). These changes suggest a gradual growth in the complexity of the model that can be constructed and held in mind while the child speaks. With more highly developed narratives, the underlying model is quite complex and the relations among events include cause and effect relations (i.e., narratives with plots). With the production of plots, the child appears to be able to hold in mind some model of the sequence of events including a state of disequilibrium (i.e., a problem), attempts to resolve the problem, and a resolution. By the age of nine or ten, children embed one plot within another, suggesting that an even more complex mental model of relations among events has been constructed in consciousness. Thus, narrative development involves more than knowledge of narrative structure; it involves being able to hold in mind a complex model of relations among events while using language to express these relations. With the assistance of pictorial cues or prompts in constructing and holding in mind mental models, children show evidence of earlier knowledge of plots (e.g., goal, plan, purpose, cause–effect relations) than they do with open-ended elicitation techniques (Trabasso, Stein, Rodkin, Munger, & Baughn, 1992). This finding supports the conclusion discussed later in this chapter concerning the importance of varying elicitation techniques in assessing LLD student’s language performance. When assessing or facilitating a child’s narrative performance, one needs to consider the complexity of the model that underlies the narrative including factors such as use of evaluations and cohesive devices.

The developmental increase in the use of evaluations in narratives is further evidence of children’s increasing ability to construct and hold complex models in mind for narrating events. Evaluations require that the narrator hold in mind both the events and the evaluation of the events. For example, in describing the experience of being in a boat during a storm at sea, one might inject evaluative comments such as “I was so scared! I thought I would die!” The frequency and complexity of such comments increase with age (e.g., Labov, 1972; Peterson & McCabe, 1983). Likewise, the use of certain cohesive devices involves constructing and holding in mind models of more than one event. For example, with the utterances “The boys played ball. When they finished _____, they went home,” the production and interpretation of the anaphoric pronouns “they” and the anaphoric ellipses (i.e., the omission of “playing ball”) require reference to the model created by an earlier utterance. The use of such cohesive devices increases with age (e.g., Bartlett, 1982; Bloom, Merkin, & Wooten, 1982). These developmental progressions in the use of cohesive devices provide evidence of the child’s increased ability to construct and retain more complex mental models (as well as evidence of other knowledge) (see van Kleeck, chap. 3).

Some of the individual differences in comprehension, inferencing, and reasoning also appear to be related to the ability to construct and hold in mind mental models. Inferences and syllogistic reasoning depend on the creation of mental models that exceed what is coded by language (see Milosky, chap. 10; Blachowicz, chap. 11). After hearing the sentence “Three turtles rested on a floating log, and a fish swam beneath them,” subjects will infer that the fish swam beneath the log, although that was not explicitly stated. This inference was based on the mental model they had constructed from world knowledge in LTM—knowledge that was cued by the words in the passage (Bransford, Barclay, & Franks, 1972; and see Milosky, chap. 10, for additional examples).

Reasoning syllogistically also depends on constructing and manipulating mental models (Johnson-Laird, 1983). A model of a first premise (e.g., “some of the boats are sailboats”) is constructed, then information from a second premise (e.g., “all of the sailboats have keels”) is integrated or related to the original model. Finally, a conclusion that is consistent with both premises is drawn (e.g., “therefore, some of the boats have keels”). The ease with which such reasoning takes place depends on the number of models involved and the ease with which they can be constructed. Even most adults have difficulty drawing the correct conclusion in syllogisms where models are difficult to integrate, such as when each premise involves a distinct model (e.g., “none of B are A, all of B are C, therefore, some of C are not A”) (Johnson-Laird, 1983). Furthermore, the order in which the premises are presented and the content of the premises can influence the ease with which an integrated mental model is created and, therefore, the accuracy and speed with which conclusions can be drawn. For example, syllogisms with premises about familiar concepts, such as boats, are easier to resolve than those that refer to abstractions such as group A, B, and C. The relative ease with which men-
tal models are constructed, held in mind, and acted on is related to limited capacity processing, discussed later. The point here is that the construction of mental models is part of the process involved in the comprehension of discourse (Bloom, 1974) and in reasoning (Johnson-Laird, 1983), both of which involve inferencing. Any cues that help us build a mental model (e.g., order and type of information presented, use of cohesive devices, inclusion of a title) aid comprehension and recall (e.g., Bransford et al., 1972; Johnson-Laird, 1983). For some specific examples for intervention, see Blachowicz (chap. 11).

Implications. By examining language performance in terms of the complexity of the mental model (i.e., the mental representation constructed in consciousness) that underlies language performance and in terms of the sources of data used to construct the model, one can observe developmental differences that may have important implications for LLD students. Some of the variability in a child’s language performance (including production and comprehension of single sentences or of text, inferencing, and reasoning) may be related to the ease of constructing, or to the complexity of, the mental models that underlie correct performance in each instance.

As an example, consider a child’s written or oral narrative productions and the mental models that might be attributed to what is underlying that production. Both the degree of complexity of the model and the ease with which such a model might be formed are schematized in Figure 13–1. Degree of complexity is arranged on the x-axis from least complex on the left to more complex on the right. Least
complex narratives include chains of utterances that could be produced in any sequence; that is, they are only additive with no logical or temporal connection among them (e.g., the additive chains discussed by Lahey, 1988). These could be descriptive sequences or repeated actions, as in the “monster” example described previously. In these types of productions, mental models might change from sentence to sentence, with perhaps only the topic or main character held in consciousness across the sentences. Increasing complexity, on the right of the grid in Figure 13–1, moves from sentences describing events with sequential relationships between them to the expression of events with causal relationships among them (or simple plots). In addition, the use of elaborated settings, plans, and attempts places a narrative to the right of the grid. At the far right are represented embedded, elaborated causal chains (or plots) with inclusion of information that enables the listener to get the point (as information about the significance of participants) and to understand the narrator’s point of view (e.g., evaluations, as discussed earlier). This horizontal axis, therefore, plots a continuum in the varying complexity of the different mental models that narrators construct and hold in mind to successfully produce coherent narratives of increasing complexity. Thus, different narrative productions by the same child are assessed according to the complexity of the mental model that underlies each. An important second step in understanding why variability in performance may exist is to examine the ease with which these models can be constructed.

The ease with which such a model could be constructed, given the individual’s context, is arranged on the y-axis in Figure 13–1. The lower levels in Figure 13–1 represent models constructed relatively easily because the production of the narrative entails accessing familiar content that has been well practiced in prior experiences and is supported by contextual cues. Contextual support might include visual cues such as the presence of the persons or objects involved as well as linguistic cues including probing comments by the listener or an outline format by the teacher. The upper levels of Figure 13–1 include models that depend more on LTM with little cues from context. Furthermore, these upper levels include the expression or interpretation of less familiar ideas that have not been expressed before. If all other factors are equal, one would expect elicited narratives (i.e., when we ask someone to make up a story or retell a previously heard story) to be higher in difficulty on the chart than spontaneous narratives, because spontaneous narratives express a model the speaker has already constructed in consciousness. For practical necessity, however, most assessment procedures with LLD children involve elicited narratives. To sample varying degrees of complexity in constructing mental models, we must vary the types of elicitation (e.g., retelling, creating, telling from pictures, recalling past experiences) and the use of prompts (e.g., Trabasso et al., 1992), thereby varying the degree of contextual support and familiarity of content.

The important point is that both familiarity of content and the strength of contextual cues influence ease of constructing a mental model. Strength, or usefulness, of contextual cues could also vary with the child (e.g., pictures may help one child but constrain or hinder another, pictures of some content may be easier than those of another). Intuition might suggest that retelling a story would be easier for a child than making up a new story. However, in retelling a story a child must still construct a mental model from the original story to produce a coherent and cohesive retelling (unless the story is short enough to be memorized). The difficulty of retelling will depend on how easy it is for a child to develop a mental model from the original presentation of the story as well as the ease of accessing what is recalled of the original model. For a familiar story, this may be easy, but for an unfamiliar story, it may be a very difficult task.

Degree of complexity of a model (i.e., represented horizontally on Figure 13–1) could fall anywhere on the continuum of ease of access (represented vertically) and vice versa. Some of the variability in a child’s performance could be related to the ease with which mental models can be constructed and held in mind. Given familiar material, a child might express complex narratives; given unfamiliar material, the child may well be dysfluent and have difficulty expressing even a simple sequence of relations. Recall your own efforts trying to explain a new concept presented from a lecture to a colleague or friend. At the time you first heard the ideas, you might have understood them well and could relate them to your past experiences. In other words, you found it easy to construct a mental model of the ideas presented as the lecture was presented. But when, in turn, you try to explain them to a friend, you
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may find it difficult, at first, to do so coherently and cohesively. This difficulty has little to do with your knowledge of language or narrative structure. Rather, you may be having difficulty representing what you remember of the new concept in a mental model for expressing it. Reference to notes might help you reconstruct the lecture by cuing some of the ideas in LTM. Often, after you have attempted this explanation to a few people, it is much easier to construct the model and to express the ideas coherently and cohesively.

Other types of performance (e.g., play behavior, reading comprehension, inferencing) could also be evaluated with a similar grid to evaluate complexity and ease of constructing the underlying mental models. To reiterate: mental models underlie all intentional behavior, and mental models vary in complexity and in the ease with which they can be constructed and held in mind. Consideration of these points may help professionals sort out why some children appear to perform well in one context but not in another. It may explain why some children appear to perform well with their friends (even relating rather complex narratives) but have considerable difficulty in the classroom. The ability to construct, retain, and act on mental models is heavily influenced by the limited capacity of working memory (Johnson-Laird, 1983).

A LIMITED CAPACITY SYSTEM

Constructing and holding mental models in mind uses a portion of a limited supply of cognitive resources. This limited supply of resources is shared with other operations. When the system is strained, the operations compete with one another, and trade-offs can result. Such competition for resources is evident in many aspects of everyday living. For example, in learning to drive a manual shift car, many people have trouble operating the clutch and the accelerator pedals while shifting and steering at the same time. Few novices can do this while carrying on an intense conversation. In time, shifting and steering become automatic; that is, they cease to use as many cognitive resources. After this automatization occurs, people are able to drive while arguing, planning complex affairs, and problem solving. However, some still need to turn down the radio or ask others to be quiet when traffic is heavy, the roads are slippery, or other factors need more of their cognitive resources to manage the car safely. Language processing is also influenced by the competition for the resources that are tied to operations that involve other intentional actions, although the sources of such competition are often more subtle than in learning to drive.

The concept of a limited capacity mechanism being involved in language processing has been postulated by many (e.g., Baddeley, 1986; Bloom, 1993; Bloom, Miller, & Hood, 1975; Case, 1985; Kahneman, 1973; Pascual-Leone, 1970). Baddeley’s construct of “working memory” differs from the usual concept of short-term memory in that “working memory” includes processing as well as storage.

Working Memory

According to Baddeley and Hitch, working memory “consists of a limited capacity work space that can be divided between storage and control processing demands” (1974, p. 76). A part of the system is allocated to storage and a part to processing. Working memory, therefore, contrasts with the typical view of short-term memory as a limited capacity storage-only mechanism; working memory is an information processing system with limits on both storage and processing capacity.

The storage components are modality specific; there is an auditory store, referred to as the articulatory loop, and a visual store, referred to as the visual-spatial scratch pad (Baddeley, 1986). The articulatory loop is the storage component for phonological information and is the component of working memory that has been most often studied (usually by measuring the number of items that can be repeated after presentation). A number of studies have demonstrated that memory span for linguistic information is related to phonological and articulatory coding. For example, people can repeat back a longer sequence of short words than long words (e.g., Baddeley, 1986; Hulme, Thomson, Muir, & Lawrence, 1984). Memory span has also been highly correlated with rate of articulation (Case et al., 1982; Hulme et al., 1984). Phonological similarity of stimulus items decreases memory span for these items, at least if the number to be recalled is not near span capacity (Baddeley, 1986; Shankweiler & Liberman, 1976).
Although the storage component in working memory is considered to be dedicated to storage, the processing component, referred to by Baddeley and associates as the central executor, is more flexible and can be used for both processing and storage. If the storage component is at capacity, the processing component is also used to store information, and this can result in a decrement in the rate and accuracy of other processes. Even when storage is not at capacity, the processing component is involved in some aspects of storage in that it recodes input, sets rehearsal routines, and retrieves information from storage. In experiments that require subjects to hold in memory a long series of digits while performing other tasks (e.g., semantic categorization, reasoning, or comprehending narratives), accuracy and/or speed in performance are impaired (see, e.g., Baddeley, 1986; Baddeley & Hitch, 1974).

The central executor described by Baddeley (1986) has been likened by him to the supervisory attentional system of Shallice (1982, cited in Baddeley, 1986). This system is used for a wide range of tasks that involve conscious attentional control including planning or decision making, trouble-shooting normally automatic operations, performance of new or poorly learned acts, and blocking strong habitual responses that are not appropriate to the situation. When first learning tasks (e.g., speaking, writing, reading, throwing a ball, typing, driving), efforts to carry them out require conscious attentional control and use the limited resources of the central executor. These resources are, then, not available for other operations such as constructing the complex mental models necessary for problem solving or creative thinking. When, for some reason, people have difficulty carrying out operations that are usually automatic, they also need conscious attentional control. For example, when listeners try to understand someone with an unfamiliar accent or dialect or to understand someone in a noisy environment, they use more processing resources than when listening to familiar speech patterns in a quiet room. Likewise, when trying to construct mental models of unfamiliar content to problem solve in a new situation, one uses considerable processing resources. If speakers try to express ideas with words that they rarely use, perhaps to impress someone or because only those words capture the concept, they may have to consciously search for the words and use extra processing resources. In each of these cases, by using the resources of the central executor, one limits the resources available for other operations. LLD children for whom certain operations (e.g., word retrieval, decoding, writing) may not be as automatic as they are for their peers will use resources that their peers have available for other tasks (e.g., constructing complex mental models).

Many developmental changes in language performance that occur with age (for both young and old) have been related to limitations in “working memory.” Reports of decrements in language performance in some elderly suggest that the effective capacity of working memory decreases with advancing age in adulthood. For example, analyses of written diaries indicated a decrease over time in the use of such cohesive devices as anaphoric reference and ellipsis, and in the use of complex sentences (e.g., Kemper, 1990; Lahey, 1984). The appropriate use of cohesive devices in text as well as the use of complex sentences require holding more than one event in mind while processing language. Furthermore, a trade-off in performance found between the complexity of narrative structure and the use of cohesive devices supported the notion that limitations in working memory are involved (Kemper, 1990).

In contrast to what happens during the course of aging in adults, the “effective capacity” of working memory increases as children grow older. For example, older children use more cohesive devices than younger children. Further support for a developmental expansion in the limits of working memory comes from evidence of increased memory span for words (e.g., Case, 1985; Huttenlocher & Burke, 1976), speed of naming objects (Cirrin, 1983; German, chap. 12; Lahey & Edwards, 1991), and speed in making lexical decisions (Edwards & Lahey, in press). Thus, many developmental changes in language performance appear to be related to changes in the effective limits of working memory. As noted early, however, these developmental increases in “effective capacity” are influenced by other factors such as familiarity with the stimuli.

How can one account for the developmental expansion of the limits of a working memory system that includes both storage and processing components? The changes are, no doubt, partially explained by neurological factors. Physical maturation may result in speeded processing and, perhaps, such maturation also increases the absolute capacity limitations of working memory (e.g., Case, 1985).
addition, efficiency in processing appears to have a major influence on the limits of working memory (e.g., Case, 1985). Although increased efficiency and automatization of processes do not increase absolute capacity, they can free resources (or "space") in working memory with a resulting effective increase in capacity. This is an important concept to clinicians and educators, who can do little to directly manipulate neurological development and increase the absolute capacity of working memory. However, professionals can facilitate increased efficiency and automatization of many aspects of processing and, therefore, effectively increase working memory capacity. Certainly, one way to help automatize processes involves repeated use or practice. Often, attempts to bring a child's performance up to peers lead professionals to move quickly on to new skills without allowing the child the opportunities to establish some level of automaticity with the old. At times the child is still using so many resources to accomplish what has just been learned that movement forward is thwarted or is limited to very few contexts. Practice does not necessarily mean repetitive production—or what one derisively thinks of as drill—of words or syntactic structures out of context. Practice can be repeated production of language in communicative contexts (i.e., repetition of content-form-use interactions). Providing opportunities for repetitive meaningful contexts is the task for the clinician and educator.

Limitations in working memory could be the result of a number of different problems. In addition to the developmental changes in working memory discussed previously, researchers find differential performance among the components within working memory. As discussed in detail by Blachman (chap. 9), poor readers have difficulty with phonological processing but not visual-spatial processing. Furthermore, some believe that difficulty with phonological processing may be related to speech-motor encoding (Catts, 1989; Kamhi, Catts, Mauer, Apel, & Gentry, 1988; Spring, 1976). Evidence suggests that some reading problems can be a result of a deficit in the articulatory loop or the auditory storage component of working memory (e.g., Baddeley, 1986). In contrast to developmental reading problems, Baddeley suggests that dementia is a deficit in the functioning of the executive processor although the articulatory loop and rehearsal strategies for repetition of presented material apparently function normally. That is, immediate short-term recall (as measured by immediate repetition) is less of a problem than constructing complex mental models from language input and accessing information in LTM. Thus, differential deficits can exist in storage mode and between storage and the central executor. To say the least, statements such as "the student has a memory problem" need further explication to be useful for educational purposes.

Mental Models and Working Memory. One relevant function of working memory is to maintain earlier presented information and to integrate it with new information. This function is an important one for constructing and holding in mind mental models. Mental models use some of the limited capacities of the central executor and storage components of working memory. Some models require more resources than others. If the assumption is made that developmental sequences suggest a continuum of complexity for children (i.e., that what they do first is easier than what they do later), then constructing models based on perceptual evidence is easier than constructing a model from information in LTM. Factors that influence the ease with which models can be constructed from LTM no doubt include how information is organized in LTM (e.g., the type and strength of associative links) as well as the number of times that information has been previously accessed. Complex mental models that involve unfamiliar content and that have little perceptual support (those with difficult access and complex structure, represented in the upper right quadrant of Figure 13–1) would use the most resources. By contrast, simple models based on familiar events with perceptual support to cue necessary information from memory would use the least resources (i.e., those with easy access and simple structure, represented in the lower left quadrant of Figure 13–1). A child might, therefore, produce a fluent complex narrative using complex syntactic structure if the narrative falls in the easy-access/simple-structure quadrant. However, the child may have obvious word finding problems and errors in syntax and may appear to be unaware of the listener's needs when the narrative falls in the difficult-access/complex-structure quadrant or even the difficult-access/simple-structure represented in the upper left quadrant of Figure 13–1. The resources needed to construct and hold the model in mind may be competing with the resources...
needed to search for lexical or syntactic structures or to adapt presentations to listener needs. The effect of resource competition may be seen in an assessment session. For example, in conversation about a particular baseball game or in retelling a familiar story (e.g., “The Three Bears”) from a picture book, the child may be fluent and coherent, expressing cause-effect relations with complex linguistic structures. Yet, the same child may perform more poorly when asked to retell an unfamiliar, and perhaps more complex, story without visual context, or when asked to explain the game of baseball to an unknowledgeable listener.

Language Performance and Working Memory. In addition to the mental representation of ideas and attitudes in consciousness, both the expression and interpretation of language involve accessing knowledge of language form. Knowledge of form includes phonological, morphological, and syntactic information and its relation to content and use. The better developed one’s linguistic procedures, and the more experience one has had accessing them, the more automatic the operations become and the less resources one needs to carry them out. Accessing linguistic procedures may use considerable resources if they are not well established and their use has not been fully automatized.

Many of us have studied and gained some degree of proficiency in a foreign language. Yet, when we travel to the country where only that language is spoken, we often find ourselves resorting to single word utterances or stereotyped expressions when communication is urgent; processing the speech of the natives is slow, and they appear to talk very fast. Increased resources are needed to construct mental models, particularly under stress (as with disagreements about the bill or explaining an apparent traffic violation). Similarly, accessing linguistic information uses more of the young child’s, or the LLD child’s, resources when first learning language; accessing linguistic information uses more of the LLD child’s resources continually if the child has word finding problems or problems with other aspects of spoken or written language learning or use. Even small differences in the resources needed to access particular words or structures can have incremental impacts on the production or comprehension of connected discourse. When accessing language is not automatic, resources that could be devoted to constructing complex mental models, taking account of listener needs, or other processes are diverted to the effort of interpreting or producing lexical and syntactic structures. Some monolingual LLD students function in their native language like foreign language students function in their newly acquired language (see Wallach & Butler, chap. 1).

In normal development, the use of “old forms for new functions” (e.g., Bloom, 1970; Slobin, 1973) has been noted and seems related to sharing resources of a limited capacity processor. When talking about new semantic relations, children tend to use familiar forms. For example, “and” is one of the first conjunctions learned. It is used by two-year-olds to code many new semantic relations in complex sentences (e.g., adversative, temporal, causal) (Bloom, Lahey, et al., 1980). LLD children often persist in using “and” in writing for many semantic relations (e.g., Wallach & Butler, chap. 1; Scott, chap. 8; Westby, chap. 7). The use of familiar forms frees resources needed for constructing and holding in mind mental models of new or more complex relations. Likewise, when learning new syntactic forms, children tend to talk about familiar ideas (e.g., the early use of some verb inflections, e.g., -ing, redundantly codes the aspect [durative, noncompletive] of the verbs to which it is attached, as with “playing”: Bloom, Lifter, & Hafitz, 1980). When added resources are needed to access and produce new linguistic forms, it helps ease the total load if the new forms are used to express models of familiar content. Application of such concepts to learning a new modality of expression such as written language appears promising, as discussed in the next section and by Scott in Chapter 8.

Perceptual-Motor Factors and Working Memory. The motor action involved in expressing ourselves with language (spoken or written) also draws on the limited resources of working memory. Children’s rate of articulation and motor responses become more rapid with age (e.g., Abbeduto, 1987; Edwards & Lahey, in press; Lahey & Edwards, 1991). Thus, practitioners assume that older children need fewer cognitive resources than younger children for expressing themselves through speech. Children first learning to talk use a small number of preferred phonemes or phonological shapes for producing many of their new “words” (Ferguson & Farwell, 1975; Ferguson, Peizer, & Weeks, 1973; Ingram, 1976; Lahey, Flax, & Schlisselberg, 1985; Menyuk & Menn, 1979; Schwartz & Leonard, 1982; Schwartz, Leonard, Folger, & Wilcox, 1980; Waterson, 1978); the effect of
this is to maximize a child’s resources. Moreover, they tend to learn new words faster if the new words conform to those preferences (e.g., Leonard et al., 1982). In children who are just learning to express themselves through written language, the level of language produced is less complex than that used for oral expression (e.g., Lahey & Launer, 1986). As mentioned earlier, the process of writing uses resources that cannot then be devoted to the processes of constructing mental models and accessing linguistic structures (Scott provides many examples in chap. 8).

Even adults devote considerable conscious effort to producing or reading long phonologically complex words that are new in their vocabulary. They may pause and stumble when introducing someone with a foreign name. When typing, adults may quickly gloss over familiar words as if they were one stroke but struggle letter by letter in typing new medical terms, unusual names, or other phonologically unfamiliar words. Individuals with problems in motor planning or execution may require a considerable amount of attentional resources to express themselves through either speech or writing. For such individuals, the act of expressing may use so many resources that it interferes with setting up mental models underlying the expression and with accessing the language to express the ideas.

As noted earlier, some evidence suggests that LLD children have deficiencies in speech-motor planning (e.g., Catts, 1989; Kamhi et al., 1988; P H. Wolf, Michel, & Ovrut, 1990). For such children, processing at this level may be using resources that could be allocated to constructing mental models and accessing and producing language to express them. It could be, therefore, that problems with oral language expression observed in some LLD children are related to the load placed on working memory by difficulties with aspects of processing required for speaking.

In comprehending either written or spoken language, perceptual processing of the input may also be problematic (particularly if the input is distorted) and may require the use of additional resources. Listeners who are anxious to hear about the stock market or the results of a game played by their favorite football team may find themselves devoting extra resources to processing the signal when the radio is filled with static. This allocation of attention may cause them to have trouble doing other tasks simultaneously. Similarly, when trying to interpret the penmanship of a friend or teacher whose writing is illegible, readers often work so hard to decipher the words that they have few resources left for constructing a mental model to make sense of the entire message. Many people find that they cannot carefully proof work for errors of form (e.g., spelling, verb agreement) at the same time that they read for content of any complexity.

Again, one’s attentional resources are taxed so they cannot process the form and construct a mental model of the content at the same time. Similarly, an LLD student who must work extra hard on form may have considerable difficulty constructing and holding in mind complex mental models.

Social-Emotional Factors and Working Memory. Emotional and interpersonal factors can also compete for use of resources that could be used for other operations. Most people have experienced a temporary inability to coherently relate events when talking with particular people (e.g., someone who is extremely critical of them, or someone who has the power to make an important decision based on their performance) or in front of groups (particularly if one has a history of failure in such a context). Indeed, it seems as though one’s intentional efforts to do well often have the opposite effect and interfere with successful performance. A person’s efforts may be using the resources needed for operations related to the construction of ideas (i.e., mental models) or to accessing and producing the language to express the ideas. At other times emotional concerns may interfere with performance; it is hard to concentrate, that is, to use one’s limited resources to construct and express models not related to one’s personal concerns.

Some seminal research in the interaction between affective expression and language development supports the view that affective expression can compete with expression through language (Bloom, 1993; Bloom & Beckwith, 1989; Bloom, Beckwith, Capatides, & Hafitz, 1988). Children with high frequency of affective expression spoke their first words later than children with lower levels of affective expression. The infants tended to say their early words while they were expressing neutral affect, and new words continued to be said in neutral affect. Familiar words (i.e., words the infant had used a number of times before) were more likely than unfamiliar words to be spoken in conjunction with positive or negative affect. Furthermore, as children were first learning to
say words, there was a drop in affective expression about three to eight seconds before a word was uttered with a rise in affective expression after the word was completed. These findings support the suggestion that children learning language need to allocate considerable cognitive resources for speaking (i.e., constructing and holding a mental model in mind, finding the appropriate lexical item, planning motor response, and executing the motor plan) and that affective expression competes for the same resources. Once a word has become more practiced and automatic, fewer resources are needed for speaking. As a result, resources are then available and can be allocated to affective expression.

The variable language performance often observed in LLD children may be the result of several different factors competing for the limited resources of working memory. A number of processing operations that compete for resources include constructing the mental models underlying expression (including accessing world knowledge); accessing words and linguistic procedures; perceptual-motor processing related to interpreting and expressing messages; and expressing affect. Competition among these operations can explain both the variability seen among children and variability in a particular child’s performance at different times (i.e., differential use of resources varies with context).

**Implications for Assessment and Intervention**

One might ask “so what?” How does this information processing perspective change how language specialists and educators view the LLD child or what they do in assessment or intervention? One possible consequence of using any information processing approach is to consider a task analysis for each child’s performance. Task analysis is not new to the field. Task analyses, however, have often focused on looking for weakness in a particular process so that the weak process could be remediated; they have rarely focused on how aspects of the task itself influence performance. For example, a finding that the number of words or numbers that a child can repeat is less than age expectations was often interpreted as evidence of a deficit in short-term memory that needed direct remediation. Rarely was variability in such performance considered. If observed, variable performance was attributed to the child’s being tired or “inattentive” rather than being analyzed to see what information it could give about the child’s processing.

In the information processing approach to task analysis discussed in this chapter, one might try to understand poor and variable performance by varying elements of the task. For example, one could vary the stimuli and observe the effect. Variations in stimuli used for recall could include length, familiarity, concreteness, phonological structure, and semantic grouping. The child’s performance could be compared with achieving students when nonsense words are used as stimuli. It may well be that no differences are found in the number of items recalled and, thus, that the deficit is not in absolute memory capacity. Further variations in the task could include giving the child the opportunity to practice production of the stimuli before recall, or the task could be administered by a different examiner. Finally, the stimuli could be presented more slowly, or a delay could be introduced between input and recall. Thus, a task analysis could look for information on how aspects of the task itself influence performance. Such assessment might lead to a conclusion other than a deficit in memory. The apparent memory deficit may, instead, be related to factors such as retrieval of stimuli, speech-motor planning, interpersonal factors with a given examiner, speed of processing, or phonological processing.

The concept of a limited capacity working memory, as described earlier, suggests a synergistic view of processing components that directly relates to variable performance. A load on one processing operation interferes with the functioning of another. Furthermore, the drain on resources from the process of constructing and holding mental models in mind for expression and interpretation has not generally been recognized in task analyses. A modification of previous task analyses is in order. The modification suggested here attempts to account for variable performance and contributes to understanding how processing can be influenced by a number of factors. Such analysis could lead to conclusions that are quite different from those previously reached about the techniques that may improve language performance. Alternatively, for experienced clinicians, it may simply provide a way to talk about, think about, and perhaps slightly alter, the techniques that they already have found successful.

**Assessment.** One part of assessment is the identification of children who are having difficulty with oral or written language performance. Some of these children may have the knowledge of language they
need but be unable to access that knowledge, whereas others may have limited linguistic knowledge. (See German, chap. 12, for a discussion of this distinction in relation to word finding.) For purposes of identifying students with LLD, diagnosticians are not looking for best performance (or what the child can do) but are looking, instead, for what the child does in comparison with what peers usually do when the system is stressed. One assessment implication of the earlier discussion about limited capacity processing and mental models is that assessment procedures be evaluated in terms of the demands that procedures place on working memory. For example, contexts of connected speech (e.g., narrative production or comprehension about unfamiliar past events) will no doubt reveal more problems than tasks requiring single word or single sentence processing (e.g., McLachlin & Chapman, 1988), particularly if the content of the single words or sentences is supported by context. Materials that involve complex mental models and in other ways use considerable cognitive resources should perhaps become a regular part of assessment batteries; reports should describe the influence of different levels of cognitive load on performance.

Moreover, reaction times and timed performance may reveal problems that are not otherwise obvious when time is not an issue. LLD students are often given untimed tests when the purpose of testing is to evaluate what they know. Timed performance reveals accessing problems not always evident in untimed tasks. For example, research suggests that LLD children perform more slowly on rapid automatized naming tasks (Denckla, 1974; Menyuk et al., 1991) and confrontation naming tasks (German, chap. 12; Leonard, Nippold, Kail, & Hale, 1983; M. Wolf, 1982) even though the stimuli are a part of the child’s productive vocabulary. In young children, performance on such timed tasks appears to be predictive of future success in learning to read (Menyuk et al., 1991; M. Wolf, 1982). Thus, timed tasks might also be considered an important part of a protocol designed to identify children who are having, or who are at risk for having, language learning problems. Stressing the system does not have to stress the child. To try to do something “as fast as you can” does not need to be a context for potential failure. Feedback about effort and attention can be given without mention of obtained or desired response time. Timed tasks appear to be most useful when the purpose of assessment is identification of a child as LLD, or as being at risk for having future problems with language, and when other more standard types of assessment have not so identified the child. Slow performance, however, does not explain the totality of an LLD child’s problems or lead directly to intervention. That is the next step in assessment.

After a child has been identified as LLD or as being at risk for having language learning problems, assessment is geared toward determining goals and procedures of intervention. At this level of assessment, it is helpful to determine how much of the child’s performance is related to deficits in general knowledge versus problems in accessing that knowledge (see also, Milosky, chap. 10; German, chap. 12). Similarly, language performance on any task could be the result of deficits in linguistic knowledge or problems in accessing that knowledge. Problems that appear to be related to access might be related to limitations on working memory caused by the resources needed for other processes. Available resources change from child to child and from time to time. For some children, poor performance may be related to organization or depth of world or linguistic knowledge (as discussed in Milosky, chap. 10). For others, speech-motor encoding and planning may take extra resources. Whereas for still others, social-emotional factors (including cultural factors, as discussed by Westby, chap. 7) may usurp the resources of working memory. The variability among and within children suggests that professionals try to determine how these factors interact in any one child and that professionals plan different goals and procedures of intervention depending on this interaction.

For example, slow performance on confrontation naming tasks may be related to semantic access or word familiarity for some children, as pointed out by German in Chapter 12. For others, slow performance may be related to perceptual encoding of the input or to response encoding (e.g., phonological processing, motor planning, motor execution), as noted by Lahey and Edwards (1991). Assessments that attempt to sort out some of these factors may lead to more efficient treatment strategies. Two treatment strategies for word finding have been tested by Wing (1990). In one, the focus was on perceptual-motor training; in the other, it was on semantic organization. Although the group effect indicated more improvement based on perceptual-motor strategies, individual children no doubt vary in the impact of each. Strategies focused on phonological processing or perceptual processing may not be helpful to the
child whose problem is related to semantic organization or limited vocabulary. Likewise, treatment strategies designed to improve semantic organization may not be beneficial to a child whose problem is in response encoding. One might try to assess which is most important to a particular child by comparing a child’s performance relative to peers for immediate naming in contrast to naming when the child has looked at the picture for one or more seconds (e.g., Lahey & Edwards, 1991). If differences between the LLD child and peers in the delayed naming task (where plenty of time is available for access) are equal to those in the immediate naming task, one could conclude that response factors rather than semantic organization or access is what differentiates these children. Therefore, intervention would not focus on semantic organization. If intervention was deemed necessary, it might better focus on phonological processing or motor responses. By contrast, if differences between an LLD child and peers on an immediate naming task were eliminated by the delay condition, then intervention might focus on semantic organization and access (see German, chap. 12, for additional information on word finding intervention).

Another example of how tasks can be varied was presented earlier under the discussion of mental models and working memory. The grid in Figure 13–1 schematizes the ease with which mental models underlying performance on a task can be constructed and held in mind. It considers the interaction between the complexity of the model and the ease with which the information necessary to construct the model can be brought to awareness. Assessment tasks could be designed that fall in various quadrants of this grid. For example, tasks involving the retelling of a familiar story or narrating a scripted event may have been so well practiced that the underlying models are easy to construct, even though they may have a rather complex structure. In contrast, retelling a new story or relating a novel event could involve a model of similar complexity but be more difficult to construct because the information cannot be easily accessed from LTM. The tasks where mental models would appear to use the least resources (those in the lower left quadrant) are those for which the child must name an object or express a simple relation with contextual support. If all other factors are equal (e.g., familiarity, affect, social pressures, linguistic complexity), one would expect better performance on tasks that fall to the left of the figure than on the right, and for those closer to the bottom than the top. By varying tasks, diagnosticians and teachers may be able to better understand the degree to which a child’s problems are related to language knowledge or model construction and what factors influence expression of those mental models. Holding constant the ease with which mental models can be constructed and varying the load for other processing operations will help us understand the interactions among factors that compete for the limited processing capacity in a particular child.

Assessment of a child’s best and worst performance might also reveal information about a child’s language knowledge. Concepts such as productivity and achievement are useful in distinguishing various levels of knowledge (see Bloom & Lahey, 1978; Lahey, 1988, for further discussion). Productivity implies the child has some limited knowledge, such as of the interactions of content–form–use in language. Productivity in language has often been inferred when a behavior is observed in 80% to 90% of obligatory contexts (e.g., Brown, 1973; Bloom & Lahey, 1978; Lahey, 1988). By contrast, achievement of a content–form–use interaction implies a more established knowledge and is often inferred when a behavior is observed in 80% to 90% of obligatory contexts (e.g., Brown, 1973; Bloom & Lahey, 1978; Lahey, 1988). Only stressed conditions will give evidence of how automatic that knowledge is. Perceptual processing and motor planning and execution also need to be evaluated. Many measures are in place for evaluating a child’s ability to process stimuli, usually under distorted conditions (see, e.g., Keith, 1984). If a child is slower or less accurate than peers on such tasks, one does not have to assume that the child has a perceptual deficit, because familiarity with the stimuli as well as other factors will influence such performance (e.g., Lahey, 1988; Vellutino et al., 1973). However, one may infer from poor performance that the child is more likely straining available resources for processing such input than peers and that stressed conditions could influence that child’s language performance. Likewise, measures of rate of articulation or of initiation of motor responses suggest greater use of resources for motor production (with the same caveat as previously).

Emotional factors may be a bit more difficult to manipulate. Social contexts, however, can be varied
after discussion with the child and those who know the child. For most children, some interpersonal interactions are more threatening than others. Communication with peers they are trying to impress or who have made fun of them may demand more resources than communication with siblings, younger children, or friends. Furthermore, some contexts are more demanding than others. In contexts where children presume they are being evaluated (e.g., diagnostic sessions or presentations in front of peers), they may pay more attention to the content and form of communication than they do in casual conversations with one or two friends. Information from other professionals and reports as well as direct observations of the child in a number of social contexts could be informative in planning contexts that would exemplify varying pressures for a particular child. When observing the larger social contexts, one might apply Silliman and Wilkinson's “wide-angle” lens (as described in chap. 6).

The important point relative to the information processing perspective presented here is that each child may have some unique complex of factors that interfere with language performance. Whereas researchers tend to look for commonalities among LLD children, clinicians and educators must realize that most group findings are only hypotheses for what to expect in a particular child. Statistically significant findings for a group are not necessarily relevant to any one child. Rather, it is important to examine which factors might be competing for resources in working memory and, therefore, be influencing the level of language performance that is observed in each child.

**Intervention.** The notion of language being processed by a limited capacity processor suggests that one should be constantly aware of the load being placed on working memory during teaching and intervention sessions. When attempting to facilitate new behaviors, one wants to lighten the use of resources for other behaviors. For example, in teaching a child to write stories, clinicians might consider conditions of low social stress, familiar lexicon, mental models that are easy to construct and not too complex, and use of simple syntactic constructions. Over time, each of these could be independently varied, so eventually the child has practice in more difficult conditions. One might work with descriptions or scripted events and practice these before asking the child to produce plots (i.e., causal chains). When the child is ready to relate less familiar events from LTM, one could at first provide appropriate contextual and linguistic cues to ease access. If accessing knowledge from LTM is often a major problem for a child, the clinician can work on ways to ease that burden, including semantic mapping and the traditional techniques involved in improving semantic organization. Learning new syntactic structures should involve familiar lexical items and those with simple phonological form. When beginning work on inferences or developing reasoning skills, one would use familiar content. Several sequences for written language are described in greater detail by Scott (chap. 8).

Furthermore, language specialists may want to watch how they set the climate for classroom and individual learning. Often, clinicians and educators tend to present and encourage a high level of affect during our sessions to keep the child engaged. Given the suggestion that affective expression uses resources that could be allocated to expression with language, one may need to rethink this style for some children. This is not to say that teachers need to bore them but that they need to allow children more time in a neutral reflective affect when presenting new material. In particular, facilitation of new types of expression or interpretation of language may be more successful with expression of neutral affect.

When the search for lexical and syntactic structures is more automatic, fewer resources are needed for expression and interpretation. Automatization comes from the repetitive use of content–form–use interactions. When clinicians are tempted to move too quickly with the goals of intervention (perhaps because the child seems able to perform in some contexts), they may want to reconsider the resources the child needs in order to use this new knowledge. One argument for following a developmental sequence in setting goals of intervention (e.g., Lahey, 1988) (rather than teaching the skills that are age appropriate) is the need for a degree of practice at earlier levels before some aspects of later levels can be expected. For example, the child who can produce only narratives with additive chains (i.e., sequences of clauses without any sequential or causal relations) may need some practice at this level and with sequential relations before producing the traditional plot narrative, even though the child might be eight or ten years of age.
**SUMMARY**

Variation in performance among LLD children and within the performance of individual LLD children from time to time is common. Differences in performance observed in LLD children have important implications for both identification and planning goals of intervention. An information-processing perspective involving a limited-capacity system provides a means of looking at some of the possible sources of variation in a child’s performance. One of the processing factors considered was the need to construct and hold in mind the mental models that underlie intentional performance. These models are mental representations in consciousness and were differentiated from representations in LTM. Factors influencing the ease with which they are constructed and held in mind were discussed. Such activity uses some of the limited resources of working memory. In addition, some of the other processes that use the limited resources of working memory were considered, including accessing linguistic knowledge, processing perceptual input, motor programming and execution, and social-emotional factors. Task analysis of the factors that may be competing for working memory may be helpful in planning intervention with LLD children. Some examples of how contexts could be varied to examine the influence of different factors (as a type of task analysis) were presented. Furthermore, some suggestions for taking account of the limited resources in working memory during teaching were discussed.

**REFERENCES**


