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**Language Acquisition after the Critical Period:
A Case Study of an Adolescent with an Intellectual Disorder**

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A Thesis

in

The Department

of

Education

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ABSTRACT

Language Acquisition after the Critical Period: A Case Study of an Adolescent with an Intellectual Disorder

Marisa Goffredo

A 15-year-old adolescent with an intellectual disorder received intensive parent-implemented cognitive-behavioral treatment (Zelazo et al., 1984) designed to elicit expressive language skills. The results indicate the acquisition of imitative and spontaneous words and word approximations, and the acquisition of spontaneously generated two- and three-word approximation phrases with correct word order. Finally, increased attention, impulse control, language comprehension, and attention to and compliance with verbal instructions were evident during the post-treatment conventional assessment. The findings suggest the beginning of the use of verbal communication in an adolescent beyond the critical period for language acquisition and the acquisition of the prerequisites necessary for success on conventional tests of mental development. The usefulness of the notion of a critical period for language acquisition is discussed.

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Language Acquisition after the Critical Period:

A Case Study of an Adolescent with an Intellectual Disorder

The theoretical issue of a critical period for language acquisition has been debated in the literature for many years. The main goal of this case study is to stimulate expressive language in a non-verbal adolescent boy, with an intellectual disorder, who is well beyond the proposed critical period for language acquisition, namely, puberty (Lenneberg, 1967). This will be attempted with the use of a parent-implemented cognitive-behavioral treatment program (Zelazo, Kearsley, & Ungerer, 1984) that has been shown to be effective in stimulating language development in toddlers with pervasive developmental delays and autism (Zelazo, 1997b), and recently in a boy with an intellectual disorder who was approaching the critical period for language acquisition (Reid, Rotsztein, & Zelazo, 1997). This case study will shed light upon the issue of a critical period for language acquisition and the quality of language development beyond the critical period for individuals with intellectual disorders. In addition, the possible increased scores on conventional tests of mental ability as a result of developing expressive ability and the potential clinical utility of the parent-implemented cognitive-behavioral treatment program with adolescents will be assessed.

LITERATURE

What Is Language?

Language can be described as a collection of symbols and rules that allow us to express ideas and communicate with others (James, 1990). Furthermore, language is arbitrary, creative and learned. Language is arbitrary in the sense that no logical or necessary relationship exists between verbal symbols or words and the objects they

describe. Language is also creative in that persons can generate and understand sentences that they have never spoken or heard before. Finally, language is a learned behavior (James, 1990). Although children seem innately equipped to learn language, they must still learn the symbols and rules pertaining to the language in their particular environment.

Two abilities that are related to language development are speech and communication (James, 1990). Often, the terms language, speech, and communication are used interchangeably, however, important differences exist between these terms. Speech, the oral expression of language, involves motor activities that result in the production of sound units. These sound units are then combined to form language units such as words and sentences. Thus, children will not only learn the symbols and rules of their language system, but also the sounds and the combination of sounds possible, and the corresponding motor behaviors involved in producing the sounds. Communication, on the other hand, is the process of expressing thoughts, feelings, and intentions. Language and speech can be used as a means of expression, however, one can communicate with others using different modalities such as gestures or facial expressions. Therefore, language acquisition involves learning the symbols and rules of a language, learning the motor activities involved in speaking and using this knowledge to communicate with others.

The Course of Language Acquisition

Language development shows a fairly consistent pattern among children, however the time at which certain events occur shows great variability (Medin & Ross, 1992). Young infants begin cooing, producing one-syllable vowel sounds such as *aa* and *oo*, at

about 2 months of age (Vasta, Haith, & Miller, 1995). At about six months of age, infants begin to string together several identical sounds, such as *papapapa*. This is referred to as reduplicated babbling. By the end of their first year, the infant's babbling loses its duplicated nature, and they begin to combine different sounds, such as *da-doo*.

At about one year, infants begin to produce single words (Medin & Ross, 1992). Early vocabulary consists of mostly actions such as *bye-bye* and nouns or names such as *doggy* or *mama*. The one-word stage is often referred to as the holophrastic speech stage because the child seems to use a single word to stand for an entire sentence. For example, a child might say "Cat" to express the idea "I want the cat".

At about 18 months of age, the child begins to combine words into two-word sentences (Medin & Ross, 1992), and by two years of age most children produce three-word sentences (Vasta, et al., 1995). This stage of language development is often referred to as the telegraphic speech stage because children often leave out unnecessary function words, such as *a*, *the*, and *of*, as in telegram messages. By two and a half years of age, the child's average length of utterance increases systematically and their speech becomes increasingly complex (Medin & Ross, 1992).

By the age of three, children usually demonstrate ample grammatical knowledge (Berger, 1998). Their sentences include the correct subject-verb-object ("I want cookie") pattern, they can form the plural of nouns, the past, present, and future tenses of verbs, and the subjective, objective, and possessive forms of pronouns. They can also rearrange word order to create questions and can use auxiliary verbs ("I *can* do that"). Finally, three-year-old children can use more complex forms of negative sentences, such as "I want nothing" and "I am not hungry".

This synopsis of the course of language acquisition shows that children acquire the verbal means to express themselves over a period of three years. In order to appreciate exactly what children learn over the three-year period, let us examine the components of a language system.

The Four Components of Language

All languages are composed of four main components. These include the phonological, semantic, syntactic, and pragmatic components.

Phonology.

The phonological component of language deals with the speech sounds or phonemes of a language (James, 1990). A phoneme can be defined as the smallest significant sound unit in a language. When one phoneme is replaced with another, the meaning of the word changes. For example, the only difference between the words “fat”, “mat”, and “hat” is in the first phoneme, yet these words all mean something different (James, 1990). In addition to phonemes, languages also have phonological rules that dictate which phonemes can be combined and in what order they can be combined. For example, in English, the phonetic combination /st/ is acceptable at both the beginning of a word and at the end of a word (e.g. stop and cast). However, the combination /ts/ is only acceptable at the end of English words (e.g. cats) (James, 1990). Therefore, children must learn those combinations that are appropriate and those that are not.

Research in early speech perception has shown that babies are born with the ability to discriminate sounds belonging to different phonemic categories, and that the more they are exposed to a language, the sharper their phonemic discrimination becomes (Vasta et al., 1995). Conversely, a decrease in exposure may depress these abilities. By

the end of the first year, babies seem to lose the ability to discriminate the sound contrasts to which they have not been exposed.

Miller (1997) reports on the development of phonemic awareness in prelingually deaf students learning Hebrew. The experiment was designed to clarify several hypotheses concerning the contribution of communication mode for the development of phonemic awareness. Long-term auditory deprivation, characteristics of individuals with profound hearing losses, should make the formation of auditory memory more difficult, thereby interfering with the emergence of phonemic awareness.

Hebrew was chosen to study phonemic awareness in deaf individuals due to the fact that some of the phonemes in Hebrew are depicted by two different graphemes (letters or vowel signs). This allows one to determine the nature of an individual's processing strategy. Individuals may use a phonological strategy whereby they identify phonemes through their sounds or they may use a graphemic strategy and identify phonemes visually.

Therefore, two categories of items were generated. In the first category (GPI = grapheme and phoneme identity), the phonological criterion of the items was represented at the graphemic level by two identical letters, therefore both a phonological and a graphemic strategy was adequate to identify phonemes. In the second category (PIO = phoneme identity only), two different graphemes were used to denote the phonological criteria. In this case, a phonological strategy was necessary in order to identify the phonemes.

Miller studied three groups of individuals including: a *deaf oral* group: using oral language exclusively to communicate with their parents and teachers; a *deaf signing*

group: using Israeli Sign Language (ISL) as their primary means of communication; and a *hearing control* group. Participants were shown labels for four items at a time and were asked to point to the two items that had similar phonemes. Both the groups' response accuracy and response latency was measured.

The results indicated that for both the deaf oral and the deaf signer groups, the judgement of the PIO series proved to be less accurate and slower than the judgement of the GPI series. Both deaf groups then, had more difficulty when only a phonological strategy would work. For the hearing group, however, the judgement of the PIO series was slower than the judgement of the GPI series, but was not less accurate. The hearing participants judged the PIO series and the GPI series with equal accuracy.

Therefore, the hypothesis that the deprivation of auditory stimulation would lead to reduced phonemic awareness within spoken language was supported in that the ability of deaf individuals to judge item labels with a phonological strategy only (PIO series) was significantly poorer than that of their hearing peers. Prelingual deafness does exert an inhibiting influence on the development of phonemic awareness, however it does not totally prevent its formation. Although the deaf participants' performance was significantly inferior to that of their hearing counterparts, it was still well above chance level (i.e., over 50% accuracy rate on GPI and PIO series).

These findings emphasise the importance of auditory input for the development of a robust phonological code (Miller, 1997). In order to understand spoken language then, one must divide the sounds they *hear* into meaningful segments such as syllables, words, and sentences (Vasta et al., 1995). In addition, Vasta et al. point out that the listener must

also attend to the characteristics of speech, such as rising and falling intonations, pauses between words and phrases, and stress placed at different points in a sentence.

Semantics.

Semantic development assesses how children acquire words and their meanings (Vasta et al., 1995). At first, children acquire words quite slowly, however, when they reach about 50 spoken words (about 18 months of age), their lexicon or vocabulary goes through an explosion and increases dramatically. In addition, children understand many more words than they can produce. It is suggested that this is due to the nature of what is recognized and what is recalled (Huttenlocher, 1974; as cited in James, 1990). While comprehension involves recognizing a word and recalling its referent, production involves recognizing an object and recalling the word that represents it. The process involved during production appears to be less direct than the process involved in comprehension because many different words may be used to refer to an object (James, 1990).

Markman (1990) proposes that children's lexical acquisition is guided by three constraints that limit the kinds of hypotheses children consider, making the process of acquiring word meanings more efficient. The first constraint on word meaning, the *whole object assumption*, assumes that a novel label is likely to refer to the whole object and not to its parts, or other properties. The *taxonomic assumption*, the second constraint, states that labels refer to objects of the same kind rather than to objects that are thematically related. Although research (Markman, 1981; as cited in Markman 1990) has shown that children are more interested in the thematic relations among objects (e.g., placing a boy and a dog together because the boy is taking his dog for a walk) than among taxonomic

relations, the English language does not have a single word for thematically related objects such as “boy and his dog” (Markman, 1990). Therefore, Markman and Hutchinson (1984; as cited in Markman, 1990) proposed that children *expect* labels to refer to objects of the same kind or same taxonomic category.

In order to test the taxonomic assumption, Markman and Hutchinson (1984; as cited in Markman, 1990) conducted a study which compared how children would organize objects when they were not provided with an object label versus when the objects were given a novel label. Four- and five-year old children were taught the taxonomic and thematic relations between pictures of artificial objects rather than familiar objects to provide evidence that children interpret novel labels as labels for objects of the same type rather than objects that are thematically related even with abstract knowledge about words. Children were then shown a target picture and asked to find another one like it from a choice of two additional pictures. Children were divided in the No Word Condition where they did not receive a label for the target picture while the target picture for the children in the Novel Word Condition was labelled with a nonsense word. The results revealed that when the target picture was labelled, children were more likely to select categorically, whereas when the target picture was not labelled, children selected the thematically related object. These results were also obtained with 18- to 24-month-old children. Therefore, children from 18 months on place a constraint on what single nouns might mean. They expect novel labels to refer to objects of the same kind and not objects that are thematically related.

The third and final constraint, the *mutual exclusivity assumption*, leads children to expect each object to have only one label (Markman, 1990). Markman maintains that the

mutual exclusivity bias guides children's initial hypotheses about a word's meaning and without evidence to the contrary children will assume that each object will have one and only one label. Mutual exclusivity helps overcome the major limitation of the whole object assumption in that it allows children to learn terms other than object labels. The taxonomic and the whole object assumption, as first hypotheses, come into play then when the child does not have a label for an object, whereas the mutual exclusivity assumption will motivate children to acquire terms other than object labels (e.g., labels for parts, or physical properties of the objects) when faced with objects with already known labels.

In order to assess whether children follow the mutual exclusivity assumption, Markman and Wachtel (1988; as cited in Markman, 1990) conducted a number of studies. First, they assessed whether children would map an unfamiliar term to an unfamiliar object when presented with two items, one of which already had a known label. They found that three-year-old children in fact labeled the unfamiliar object with the unfamiliar term and therefore used the principle of mutual exclusivity in figuring out the meaning of the new term. They did not think the new label was another word for the already labeled object.

Markman and Wachtel (1988; as cited in Markman, 1990) also studied what children did when presented with either a familiar or unfamiliar object labeled with a novel term. They tested whether the children thought the term referred to the object as a whole or to the salient part of the object. According to the mutual exclusivity assumption then, it was predicted that children would interpret the label as referring to the object itself for unfamiliar objects, but to a part for familiar objects. As predicted, children who

heard the term in the presence of an unfamiliar object more often interpreted the term as referring to the object (60%) and not its part (20 %). The children who were familiar with the object, on the other hand, interpreted the novel labels as referring to parts of the object (57%) more often than referring to the whole object (43%). The mutual exclusivity hypothesis then, according to Markman and Wachtel, is supported in that children rejected the novel term for the already labeled object and assumed that the word referred to a part of the object.

However, Clark (1997) claims that this is evidence against the mutual exclusivity assumption because children were willing to assign a second term to pick out the same referent nearly half the time. Markman (1990) does acknowledge that mutual exclusivity can be overridden and that children will relinquish the assumption when presented with clear evidence.

Syntax

Syntax is an aspect of grammar that assesses the rules which guide the formation of statements, questions and commands from words (James, 1990). Children must learn these rules in order to understand a language and speak it (Vasta et al., 1995). Children's acquisition of syntax involves a number of phases. The first phase begins late in the one-word period, when children begin to produce several single-word utterances in a row. For example, a child might say "Mommy-ball" to notify his/her mother that a ball is desired. These multiple one-word utterances are different from the two-word utterances that will emerge in that a longer pause exists between the two single words. The second phase begins with the emergence of two-word utterances. An analysis of children's two-word utterances reveals that children's first syntactic rules seem to be built around

individual words. For example, a child might say “all-gone doggie” or “all-gone milk”, using “all-gone + _____” as a basic rule. Finally, the third stage begins with the already-described telegraphic speech stage, during which unnecessary function words are omitted from the child’s speech (Vasta et al., 1995).

The importance of syntax can be seen from the two phrases “John hit Bill” and “Bill hit John” (Medin & Ross, 1992). These two phrases have very similar surface structure, however, they have quite different meanings. Therefore, children need to acquire a deep analysis of sentence structure that goes beyond word order so as to be able to comprehend language and use it to communicate.

De Villiers and de Villiers (1992) discuss whether children’s grammars are semantics-based or based on abstract grammatical categories. A semantics-based grammar that maps propositions onto elementary word combinations seems like a reasonable place considering children’s communicative needs. However, for true linguistic competence, the child needs to build a theory around component such as subjects, objects, noun phrases, and verb phrases. And these abstract categories do not translate easily into semantic relations. Therefore, the debate revolves around whether children’s grammars are based on the same principles and abstract categories as adult’s grammars are, but are less complete, or whether they begin as semantically based grammars and then undergo restructuring during development so they end up like adult grammars (de Villiers & de Villiers, 1992).

Pinker (1987; as cited in de Villiers & de Villiers, 1992) argues that children gain a base for abstract analysis by knowing first, the meaning of individual words and second, the conceptual structure of an event (e.g., “dog” is the agent and “bit” is the

action). However, he claims that children further hypothesize that agents are usually subjects, actions are usually verbs, and things are usually nouns. According to Pinker, these latter assumptions come from built-in notions about grammar and not from the child's experience with language. Therefore, children might initially use semantic notions that become bootstraps for the learning of a grammar (Pinker, 1987; as cited in de Villiers & de Villiers, 1992).

Studies generally support the semantics approach to the acquisition of children's initial word combinations (Vasta et al., 1995). For example, children often produce the utterance "Mommy play" or "Baby wash", which takes the form of "agent + action". However, children rarely use verbs that do not convey action, such as in "Mommy feels" or "Baby likes", which have the form of "subject + verb". As language development progresses, children's attention to the structure of speech does appear to increase (Matthei, 1987; as cited in Vasta et al., 1995). Therefore as Pinker (1987; as cited in de Villiers & de Villiers, 1992) suggested, semantic information might provide children with a base for syntactic learning.

Pragmatics.

Finally, pragmatics deals with the rules that tell people how to use language in order to communicate intentions and interact during conversations (James, 1990). In addition, the use of different speech styles in different situations is also governed by the pragmatic component of language.

During conversations, certain social rules of discourse should be followed (Vasta et al., 1995). One of the first rules children learn, by 18 months of age, is the "turn-taking" rule. This rule explains that each participant must take turns being the speaker

and being the listener. Some other rules of discourse are more difficult to learn and are therefore learned at a later age. The “answer obviousness” rule, for example, does not appear before about age five. This rule helps listeners assess whether certain statements that are phrased as questions can actually be intended as directives. The question, “Could you pass me the spoon?” would not be interpreted as a request for information as to whether we *could* pass the spoon, but as a request to be handed a spoon (Vasta et al., 1995). By taking context into account when being spoken to, a listener can assess a speaker’s intentions.

Pragmatics also seems to be involved in the process of lexical acquisition (semantics). Clark (1997) proposes the many-perspective account of lexical acquisition, which states that children learn to take different perspectives on the same object or event, and so accept and produce multiple terms for the same referent. The one-perspective view however, states that children first take one-perspective on each object or event because this simplifies their word learning in the early stages. As discussed, the one-perspective-view was proposed by Markman (1990). Clark, in fact, believes that children readily apply multiple terms to the same objects or events *when* adults provide them with adequate pragmatic directions.

Some pragmatic directions for relating unfamiliar terms to familiar ones include:

1) *Inclusion* - X is a kind of Y (e.g., A poodle is a kind of dog); 2) *Sets* - X is a Y (e.g., A cat is an animal); 3) *Definition* - X is a Y (e.g., A stag is a male deer); 4) *Comparison* - X looks like Y (e.g., A zebra looks like a horse); 5) *Property identification* - X is made of Y (e.g., The ball is made of rubber); 6) *Part identification* - X is part of Y (e.g., Your thumb is part of your hand); 7) *Alignment* (with X and Y known) - This is an X, this is a Y, and

this is a Z (e.g., This is the paw, this is the toe, and this is the claw); and 8) *Function - X* is used for Y (e.g., A wrench is used to tighten pipes).

Evidence that children accept and use more than one word for a particular referent comes from their ability to shift from one conceptual perspective to another (Clark & Svaib, 1997; Waxman & Hatch, 1992; as cited in Clark, 1997). In one study, two-, three- and four-year-old children were asked to accept and produce multiple labels for the same referent as they looked at a picture-book with animals dressed to represent various human professions. The questions required that the children either shift from one domain to another (e.g., dog to pet) or from one level to another (e.g., dog to animal). It was found that even two-year-old children understand that an object could be both a dog and an animal (level shift) or a cat and a pilot (domain shift), although they had more difficulty with level shifts than with domain shifts (Clark & Svaib, 1997; as cited in Clark, 1997).

In another study (Waxman & Hatch, 1992; as cited in Clark, 1997), three- and four-year-old children were asked to respond to questions that targeted one of three levels (superordinate, basic, subordinate). For example, the children were shown a picture of a rose and asked, "Is this a dandelion?" to elicit the subordinate term rose, "Is this a tree?" to elicit the basic term flower, and "Is this an animal?" to elicit the superordinate term plant. The results indicated that three-quarters of the three-year-olds and all but one of the four-year-old children produced more than one term for the same referent on at least half the trials, usually at the basic level and the subordinate level (Waxman & Hatch, 1992).

Overall, then, children as young as two-years-old can use more than one label to refer to a particular object when provided with pragmatic directions (Clark, 1997).

Therefore, word-learning research supports both Clark's many-perspectives account of lexical acquisition and Markman's (1990) notion of mutual exclusivity. Children make use of pragmatic information when they receive it, and they make inferences when no such information is available (Clark, 1997). However, if simple, commonly used pragmatic cues help children acquire multiple terms for one referent, it would follow that the need for the mutual exclusivity assumption is undermined (Tomasello & Akhtar, 1995).

Tomasello and Akhtar (1995) manipulated pragmatic cues in order to influence whether two-year-old children believed the adult was referring to an object or an action. The pragmatic cues they assessed included discourse newness, in the first study, and a complex of adult non-verbal behaviors specifying intentions toward the experimental materials (e.g., the preparation or lack of preparation of the materials, the timing of the language relative to the adult's behavior, and the adult's eye gaze pattern), in the second study.

In the first study, it was hypothesized that children would know that adults are more likely to be using novel language to indicate the element that is new to the current discourse. The children either heard a nonsense word modeled in the presence of a discrepant action (Action-Novel condition) or a discrepant object (Object-Novel condition). For example in the former condition, the experimenter first performed multiple actions with an apparatus on a target object, and then performed the target action on the same object while saying the nonsense word *modi*. In the latter condition, the experimenter first performed a target action on multiple objects, the experimenter then brought out the target object while saying the nonsense word *modi* and performed the

same action on it. During the testing procedure the experimenter asked the child to show *modi* from the array of objects and the apparatus that was used.

The hypothesis for the second study was that children would interpret the new word for the object or action that was most relevant to the adult's non-verbal behavior. The children in the Action-Highlighted condition first watched the experimenter demonstrate the target action with the target object and then prepare the apparatus for the child to use. The experimenter then secured the child's attention and looked back and forth between the child and the apparatus and said: "It's your turn now. Widget, Jason, Widget" (Tomasello & Akhtar, 1995, p. 216). In the Object-Highlighted condition, however, the experimenter first demonstrated the target action with the target object, then held up the target object, alternated her gaze between the object and the child, and said: "Widget, Jason, Widget" (Tomasello & Akhtar, 1995, p. 216). She then placed the object on the apparatus and said to the child: "Now it's your turn" (Tomasello & Akhtar, 1995, p. 216). The testing procedure was similar to that of the first study, where the experimenter asked the children to show *widget* from an array of objects and the apparatus that was used.

The results showed that more than half of the children in the Action conditions and in the Object conditions of both studies, displayed the target action and chose the target object respectively, in association with the nonsense word. These results show then, that although some children experience difficulty in using pragmatic cues to interpret new terms, most two-year-old children are able to use them. Therefore, when adults use words children have never heard before, the children use pragmatic cues to determine whether an adult tends to indicate an object or an action.

In summary then, in order for children to acquire language they must develop the four components pertinent to a language. They must first learn to acquire the sounds appropriate to the language used in their environment (phonetic component) and eventually combine these sounds into words and sentences (syntactic component). In addition, children must also learn the meanings behind their words and statements (semantic component) and be able to use language in an appropriate way (pragmatic component) to convey their intentions to others and to aid them in understanding what others are referring to.

Views of Language Acquisition

Behaviorist Hypothesis

A major attempt to explain language acquisition from the behaviorist point of view was that of Skinner. Skinner argued that language was learned through operant conditioning, a process that involves changes in behaviors resulting from experiencing events that are contingent upon those behaviors (James, 1990). Skinner's proposal included the idea of reinforcement, punishment and associations. A reinforcement is an event that increases the probability of a behavior's recurrence while a punishment is an event that decreases the probability of a behavior's recurrence. There are other types of consequences that alter the strength of a verbal response. Behavior may be reinforced by the reduction of aversive stimulation. When an aversive stimulus itself is reduced, we call the behavior escape. When some condition that characteristically precedes an aversive stimulus is reduced, we speak of avoidance. Thus, specific associations are formed between a child's behavior and the type of event that he/she experiences.

Operant conditioning is simply a way of controlling the probability of occurrence of a certain class of responses, including verbal responses. If we wish to make a response highly probable, we arrange for the effective reinforcement of many instances. If we wish to eliminate it from a verbal repertoire, we arrange that the effective reinforcement no longer follows. Reinforcing consequences continue to be important after verbal behavior has been acquired. Their principal function is to maintain the response in strength. How often a speaker will emit a response depends upon the overall frequency of reinforcement in a given community. If reinforcements cease altogether, a behavior grows weak and may undergo extinction.

Skinner (1957) claimed that verbal behavior was reinforced only through the mediation of another person. When verbal behavior is emitted in the absence of a listener, it generally goes unreinforced. After repeated reinforcement in the presence of the listener and extinction in the absence of the listener, the speaker would eventually speak only in the presence of a listener. For example, if a child said "Dada" in the presence of his/her father which prompted his/her father to begin attending and playing with the child (reinforcement), the probability of the child repeating "Dada" in the appropriate context of the presence of his/her father would increase. However, if the child said "Dada" when his/her father was not available, he/she would not receive any attention and therefore the probability of the child repeating that particular utterance in that context would decrease. Thus, the child formed the association between saying "Dada" in the presence of his/her father (behavior) and receiving attention for the utterance (reinforcement).

Imitation was also deemed important in the process of language acquisition according to Skinner. Imitation, like all verbal behaviors, is shaped and maintained by certain contingencies of reinforcement. Early imitation in young children is often very wide of the mark; the parent must reinforce very imperfect matches to keep the behavior in strength at all. In acquiring an imitative repertoire the skillful speaker increases the chances that he will correctly imitate new material by learning not to respond as he has already responded ineffectively. Partially imitative responses will be made to a novel stimulus as the result of earlier similar contingencies. The process of approximation will proceed more rapidly if the speaker can approach a given sound step by step, hitting upon a partially corresponding pattern. The first imitative language acquired by the child tends to be fairly large integral patterns. A unit repertoire at the level of separable "speech-sounds" such as *sp* or *th* develops later and often quite slowly. Such a basic imitative repertoire may be acquired at the same time as other forms of verbal behavior or even larger imitative units. The child may emit responses as large as syllables, words, or even sentences as unitary echoic operants. The development of a large imitative repertoire appropriate to a given language makes it harder to imitate verbal stimuli that do not belong in the language.

Therefore, in teaching the young child to speak, the formal specifications upon which reinforcement is contingent are at first greatly relaxed. Any response, which vaguely resembles the standard behavior of the community, is reinforced. When these begin to appear frequently, a closer approximation is insisted upon. In this manner very complex verbal forms may be reached.

Skinner also attempted to account for the learning of syntax (Ingram, 1989). He proposed that the structure of a sentence consists of a chain of associations between the words in a sentence. The development of grammar for the child, then, is the learning of a set of associations between words that can lead to “classes of words” (p. 20). A grammar will be a set of classes that occur in a predicted serial order.

Therefore, behaviorists wanted to explain language acquisition by assigning children very little innate behavior and determining the set of environmental conditions that lead the child to form associations. According to this view, children would be born with few general skills and language would develop with experience with the world.

Nativist Hypothesis

Unlike the behaviorist hypothesis, the belief that children have an innate mechanism that enables them to learn language is central to the nativist hypothesis (James, 1990). This mechanism is thought to contain linguistic information about general rules and structures relevant to all languages. However, in order for language to develop normally the child needs linguistic input from his/her environment in order to form hypotheses about the rules pertinent to that language.

According to Chomsky (1965), the linguist most closely associated with the nativist hypothesis, knowledge of language involves the ability to understand an indefinite number of sentences. A child who has learned a language has developed an internal representation of a system of rules that determines how sentences are to be formed, used, and understood. In other words, the child has developed and internally represented a generative grammar. Therefore, a generative grammar is a system of rules that can generate an infinite number of structures.

The child is thought to have acquired a generative grammar what Chomsky refers to as primary linguistic data. This includes examples of well-formed sentences, as well as non-sentences. To learn language then, the child must have a method for devising an appropriate grammar, given primary linguistic data. As a precondition for language learning, he must possess, first, a linguistic theory that specifies the form of the grammar of a possible human language, and second a strategy for selecting a grammar of the appropriate form that is compatible with the primary linguistic data.

Therefore, according to Chomsky a child who is capable of language learning must have: 1) a technique for representing input signals, 2) a way of representing structural information about these signals, 3) some initial delimitation of a class of possible hypotheses about language structure, 4) a method for determining what each hypothesis implies with respect to each sentence, and 5) a method for selecting one of the hypotheses that are allowed and are compatible with the given primary linguistic data.

A language acquisition device that meets conditions 1-5 uses primary linguistic data as the empirical basis for language learning. The device must search through the set of possible hypotheses, which are available to it by virtue of condition 3, and must select grammars that are compatible with the primary linguistic data represented in terms of condition 1 and 2. It is possible to test the compatibility between the data and the hypothesis through condition 4 of the device. Condition 5 of the device would then allow the child to select the appropriate grammar. The selected grammar now provides the child with a method for interpreting an arbitrary sentence. Therefore, the device is an innate component of the human mind that yields a particular language through interaction

with presented experience, a device that converts experience into a system of knowledge of one or another language.

The study of generative language shifted the focus of attention from the study of language regarded as an externalized object (behaviorism) to the study of the system of knowledge attained and internally represented in the mind/brain (Chomsky, 1986). Generative grammar shows what one knows when one knows a language that is what has been learned, as supplemented by innate principles. Universal grammar (UG) is a characterisation of these innate, biologically determined principles. Knowledge of language is knowledge of a certain rule system, and this knowledge arises from an initial state that converts experience to a steady state. Language acquisition is then, a matter of adding to one's store of rules, or modifying this system, as new data are processed.

In summary then, Chomsky (1986) claims that the language acquisition device is a distinct system of the mind/brain, with an initial state common to all. With appropriate experience, this device passes from the initial state to some relatively stable steady state, which then only goes through peripheral modifications (e.g., acquiring new vocabulary). The attained state then incorporates an internalized language. Therefore, UG is the theory of the initial state, while particular grammars are theories of various internalized languages. The internalized languages that can be attained with a fixed initial state and varied experience are the attainable human languages.

A shift from this earlier conception of UG in terms of rule systems to a principles-and-parameters model occurred in order to come to grips with the "poverty of stimulus" problem, that is, the fact that children have minimal relevant experience with language and yet acquire it (Beckwith & Rispoli, 1986). Thus, the question became: How does one

go from limited experience to a very complex rule system? UG then was re-conceptualized in terms of a subsystem of principles, where these principles are associated with parameters that must be fixed by experience. These parameters must have the property that they can be fixed by quite simple evidence, because this is what is available to the child. Therefore, one may think of UG as an intricately structures system, but one that is only partially wired up. The system is associated with a finite set of switches, each of which has a finite number of positions. Experience is required to set the switches, so that when they are set the system functions. Thus the transition from the initial state to the steady state is a matter of setting the switches.

What we know innately then are the principles of the various subsystems of the initial state and the parameters associated with these principles. What we learn are the values of the parameters and the elements of the periphery (i.e., vocabulary). The language that we know then is a system of principles with fixed parameters, along with a periphery of marked exceptions. Therefore, the problem of language acquisition is not a problem of acquiring rules, but one of fixing parameters in a largely determined system.

Pinker (1994) proposes that language develops from the interaction of both innate ability and the environment. He states that learning is not an alternative to innateness because without an innate mechanism to do the learning it could not happen at all...Pinker suggests then, that the human brain is the immediate cause of all perception, learning and behavior.

He proposes a model whereby heredity is thought to build innate psychological mechanisms, including learning mechanisms. The environment then provides input to the innate mechanisms. It is these mechanisms which in turn cause behavior and develops

skills such as language. The concept of this general, multipurpose learning device rests on the assumption that individuals have an innate ability to generalize according to *similarity*. That is, individuals learn from being able to generalize from examples. For example, children who observe that German shepherds bite should generalize to Doberman pinschers and other similar dogs. More specifically with respect to language, children generalize to sentences that are similar to their parents' sentences not to their sentences exactly.

Pinker (1994) suggests that the innate similarity space that allows children to generalize from sentences in their parents' speech to the similar sentences in the rest of the language is guided by a Universal Grammar that built into the learning mechanism. The Universal Grammar then allows for the analysis of speech into nouns, verbs, and phrases. Without an innate mechanism defining which sentence is similar to which other one, the child would have no way of correctly generalizing. Therefore, learning a grammar from examples present in the environment requires a special innate similarity space defined by Universal Grammar.

Pinker's view then of language acquisition is similar to Chomsky's view in that both believe that humans are equipped with an innate mechanism for learning and that experience with the environment is necessary in order to acquire skills. Pinker, however, believes that the innate mechanism is a general, multi-purpose device that will acquire various skills, whereas Chomsky believes that an innate mechanism specific for language acquisition exists.

The study of generative grammar and universal grammar represented a significant shift of focus in the approach to problems of language (Chomsky, 1986). The shift of

focus was from an individual's behavior or the products of behavior to states of the mind/brain that enter into behavior. In comparison to the behaviorists, who believed that language was a system of habits or skills acquired through mechanisms such as conditioning and associations, the nativists believed that the mechanism involved in learning language is innate. However, both the behaviorists and the nativists stress the role of the environment in language acquisition, although to a different degree.

Lenneberg's Critical Period Hypothesis

Lenneberg (1967) also assumed that language development is innately determined and that its development is dependent upon both exposure to language and neurological maturation. The notion of cerebral dominance emerging in the mid-1950s led Lenneberg to propose the idea of a critical period for language acquisition (Strozer, 1994).

According to the critical period hypothesis, the primary acquisition of language is predicted upon a certain developmental stage, which is outgrown at the age of puberty.

Lenneberg (1967) based the argument for the critical period hypothesis on two sets of observations: 1) the development of aphasia (a language disorder where language is not lost but that its proper organization, in either the receptive or expressive forms or both, is interfered with) in persons of different ages, and 2) the development of language in persons with intellectual disabilities. Thus, he reviewed the differences in recovery from aphasia for children versus adults, and the differences in language acquisition in individuals with intellectual disorders that began to acquire language before versus after puberty.

With respect to aphasia, Lenneberg first found that aphasia striking very young children during or immediately after the age at which language was acquired (between 20

to 36 months of age) resulted in them losing whatever language they had acquired. However, soon the child began to re-acquire language, passing through all the stages of infant vocalization at a faster stage, beginning with babbling, single-words, and followed by two-word phrases, until perfect speech was achieved. Second, Lenneberg found that between the ages of four and ten, children experienced no evidence of permanent linguistic damage from lesions producing aphasia. If language had developed before the onset of the disease and if the lesion was confined to a single hemisphere, language would invariable return to a child. Finally, Lenneberg noted that aphasias that developed by puberty or that had not had time to clear up completely by this stage commonly left a deficit in language that the person could not overcome. Such people regained language and were able to carry on a conversation, but there would be odd hesitation pauses, searching for words, or the utterance of inappropriate words or sound sequence that could not be inhibited.

With respect to individuals with intellectual disabilities, Lenneberg, Nichols, and Rosenberger (1964; as cited in Lenneberg, 1967) studied the differences in language acquisition in participants with down syndrome of different ages (age range was from 6 months to 22 years). They found that progress in language development was only recorded in children younger than 14-years-old. Children in their later teens were the same in terms of their language development at the beginning as at the end of the study. This observation seemed to indicate that even in the absence of gross structural brain lesions, as in individuals with aphasia, progress in language learning comes to a standstill after maturity. Therefore, based on the evidence from persons with aphasia and those

with intellectual disabilities, Lenneberg inferred that language learning would only take place between the ages of two and 13 years of age.

Lenneberg (1967) proposed a biological mechanism to account for these observations. He proposed that the ability to acquire a language ends with the completion of lateralization or cerebral dominance. Lateralization refers to the fact that the two hemispheres in the human brain are differentially specialized. Ordinarily the left hemisphere is more specialized in speech and language functions. The right hemisphere, however, is not totally passive with respect to verbal communication. Apparently there is a period in infancy during which the hemispheres are still equipotential. Thus, he suggested that after puberty, the brain loses its plasticity and reorganizational capacity necessary for language acquisition.

Lenneberg (1967) based the notion of lateralization on the following research studies. A study conducted by Basser (1962; as cited in Lenneberg, 1967) revealed that in half the children with brain lesions sustained during the first two years of life, the onset of speech was delayed whereas for the others it developed normally. This distribution was the same regardless of the hemisphere that was injured, indicating that during the first two years of life cerebral dominance is not yet established. However, when the lesions occurred after the onset of speech, left-sided lesions resulted in disturbed speech more than right-sided lesions. Therefore, at the beginning of language development, both hemispheres seem to be equally capable of developing language, however, the right hemisphere seems to become progressively less involved in language development in the absence of lesions to the left hemisphere. If, however, the left hemisphere is not functioning properly, the right hemisphere takes over its role.

Basser (1962; as cited in Lenneberg, 1967) also looked at the effects of performing a hemispherectomy (i.e., removing an entire hemisphere) on patients with uncontrollable seizures. He found that the consequences of a hemispherectomy depend on the age at which the original insult occurred. If a young child had a lesion in the left or right hemisphere, speech was eventually confined to the remaining hemisphere. However, adults who acquired lesions, and had hemispherectomies subsequently, had permanent aphasic symptoms if the operation was done on the left side and no aphasia if it was done on the right side.

According to Lenneberg then, language cannot begin to develop until a certain level of maturation has occurred (Lenneberg, 1967). Between the ages of two and three language emerges by an interaction of maturation and self-programmed learning. Between the ages of three and the early teens, language can still develop because individuals still seem to be sensitive to stimuli and seem to preserve some of the innate flexibility for the organization of brain functions involved in language acquisition. After puberty, however, the ability for the brain to organize itself in order to acquire language quickly declines. Therefore, the basic language skills not acquired by that time usually remain deficient for life.

The critical period hypothesis has been interpreted in a number of ways since Lenneberg (1967) first proposed it (Singleton, 1989). First, if language acquisition is bound by a critical period, it implies that language development cannot occur before this period begins and that language development will not occur if it has not begun before the period ends. Second, the critical period hypothesis can mean that even if language development has begun within the period, it will not continue beyond the end of the

period. Finally, the critical period hypothesis can also be interpreted to mean that language develops more efficiently within the critical period and that its development becomes progressively more difficult beyond this period even though it does not become impossible to acquire language (Singleton, 1989). Much research has been conducted in order to establish whether a critical period for language acquisition exists and if it does which one of these interpretations of the critical period hypothesis is correct.

Three circumstances have been studied in detail in order to determine whether learning a language in childhood produces better outcomes than learning a language later in life: social isolation during childhood, second-language learning, and the severely and profoundly deaf (Mayberry & Eichen, 1991). Recently, researchers have also studied children with autism (Windsor, Doyle, & Siegel, 1994) and children with intellectual disorders (Reid, Rotsztein, & Zelazo, 1997) in order to assess this issue. Evidence from these four domains will be reviewed and will indicate that Lenneberg's critical period hypothesis needs to be modified.

Evidence from Four Research Domains

A Case of Social Deprivation

Genie, an adolescent girl who went through severe social deprivation for the first thirteen years of her life, provides us with some of the data necessary to test Lenneberg's critical period hypothesis (1967). At the time of her discovery "she was an unsocialized, primitive human being, emotionally disturbed, unlearned, and without language" (Fromkin et al., 1974, p. 84). The case of Genie is directly related to the critical period hypothesis, since Genie was already pubescent when she was discovered and had very limited language skills.

As described in Fromkin et al. (1974) and Curtiss (1977), Genie was engaged in the process of learning language. Over a period of two years, Genie developed comprehension of structures such as singular-plural contrasts of nouns, negative-affirmative sentence distinctions, possessive constructions, modifications, prepositional usage, conjunction with *and*, and comparative and superlative forms of adjectives. With respect to speech production, phonological development approximated that of normal children. In addition, Genie learned to combine words in two-, three-, and four-word strings, produce negative sentences, strings with locative nouns and prepositions, verb plus verb-phrase strings, add the progressive aspect marker “ing” to verbs, use plurals and possessives, and compound noun phrases. Genie’s ability to spontaneously generate novel utterances and to produce sentences showed that she had acquired language and the ability to use it to communicate (Fromkin et al., 1974).

However, Genie’s language acquisition differed from that of normal children in a number of ways. First, Genie had a large competence/performance distinction (Curtiss, 1977). Genie’s linguistic competence (i.e. her grammar) was similar to the level of competence observed in children aged two to two and a half years old, however, with respect to performance on expressive language, Genie’s ability was much poorer. On another level of performance, namely written language, Genie’s ability exceeded that of normal children at a similar level of competence. She was able to print letters, read printed words, and assemble written words into grammatically correct sentences (Curtiss, 1977).

Second, Genie had a larger than normal comprehension/production disparity (Curtiss, 1977). For normally developing children, language comprehension often

exceeds language production, however, for Genie this disparity was larger than that usually observed in children.

Third, Genie's rate of development was slower than that of normal children in that some of the syntactic aspects of language were still lacking in her speech (Curtiss, 1977). For example, there were no question words, demonstratives or particles evident in her speech (Fromkin et al., 1974). Also, no movement transformations were revealed. An example of a transformational rule would be one that moves a negative element from the beginning of a sentence to a place after the auxiliary verb (e.g. "No can go" to "I can't go"). Genie still formed negative sentences by adding the negative element to the beginning of the sentence, such as in "No more ear hurt" and "No stay hospital" (Fromkin et al., 1974, p. 93).

Finally, Genie's vocabulary was much larger than that of normal children whose language exhibited the same level of syntactic complexity (Fromkin et al., 1974). Furthermore, her vocabulary included words that were cognitively more sophisticated (e.g. color words and numbers) than one would find in the descriptions of first vocabulary words. The authors suggest that these findings indicate a partial independence of cognitive and linguistic development. Overall, then, Genie's language development was different from that of normal children, however, her case suggests that some form of language acquisition is possible beyond the critical period.

The relationship between language acquisition and the development of lateralization can also be assessed in Genie (Fromkin et al., 1974). The fact that Genie acquired some language leads to the question of whether lateralization had already taken place. Fromkin et al. used the dichotic listening procedures to answer this question.

During this test, a participant is presented with competing simultaneous stimulus pairs in both ears. It was found that with the use of verbal stimuli, the items presented in the right ear are reported more accurately, indicating left hemisphere dominance for language. With non-verbal stimuli, however, the items presented in the left ear were reported more accurately.

The results from Genie's tests indicate that there was an extreme left ear advantage with verbal stimuli. This shows that Genie's right hemisphere was dominant for language. In addition, Genie's left ear also showed an advantage for non-verbal stimuli. Thus, Genie's right hemisphere was processing both verbal and non-verbal information. It is clear then, that lateralization had taken place already.

Fromkin et al. (1974) suggests that Genie was in fact a normal child with the potential for left hemisphere dominance for language. However, the isolation she experienced during the first thirteen years of her life resulted in inadequate language stimulation. This interfered with the language aspects of left hemisphere language development. Therefore, whatever amount of stimulation Genie did receive was apparently sufficient for right hemisphere development thereby being able to acquire the aspects of language previously described.

These results then, modify Lenneberg's theory of the critical period for language acquisition. The claim that the left hemisphere must be linguistically stimulated during a specified period of time in order for language to develop *normally* still stands. However, if such stimulation does not occur, some form of language acquisition may still be possible. Language acquisition will depend on the right hemisphere and will proceed less efficiently due to the specialization of this area for other cognitive functions.

Genie's case may not, however, be the best test of the critical period hypothesis. Mayberry and Eichen (1991) suggest that her linguistic difficulties may have been compounded by the cognitive and emotional deprivation she additionally suffered. Let us turn now to the evidence for first-language learning.

Deaf Individuals and First Language Learning

Newport (1990) argues that language learning operates under a set of internal/maturational constraints: Given similar input, learners in different maturational states do not achieve the same outcome. She proposes a mechanism to account for the nature of maturational constraints, called the "Less is More" hypothesis. It suggests that language learning declines over maturation precisely because cognitive abilities increase.

The "Less is More" hypothesis suggests then, that the more limited ability of a child will be advantageous for tasks, such as language learning, which involve componential analysis. If children perceive and store only component parts of the language, while adults perceive and store whole parts of the language, children may be in a better position to locate the components. The adult's more complete storage of complex words and sentences, may make the internal components of a language and their organization more difficult to locate, placing the adult at a disadvantage compared to the child.

The hypothesis is based on the observation of the types of errors that native learners of American Sign Language (ASL) make and those made by late learners. Late learners produce mainly two types of errors. First, they produce structures in which whole-word, unanalyzed signs are produced and second, they produce highly variable and inconsistently used structures. Native learners, instead, make mostly componential errors,

where structures are produced only in part, with whole morphemes (i.e. added units of meaning such as noun plurals, as in coats, noun possessives, as in Daddy's book, and verb tense markers, as in walking) omitted.

Much of the research on first language acquisition and maturational constraints comes from studying the acquisition of ASL. The deaf population varies widely in the time they were first exposed to ASL and therefore, offer the opportunity to observe the effects of age of exposure to a first language on the competence one achieves in that language.

Newport and Supalla (1990) and Newport, Supalla, Singleton, Supalla, and Coulter (1990) (as cited in Newport, 1990) have studied deaf participants who fall into three age groups of first exposure to ASL: *Native* learners, exposed to ASL by their deaf signing parents; *Early* learners, first exposed to ASL by deaf peers at age 4-6; *Late* learners, first exposed to ASL by deaf peers at age 12. The researchers studied both production and comprehension of a variety of structures in ASL syntax and morphology.

The results from these studies indicate that there was no effect of age of first exposure to ASL on basic word order (Newport, 1990). Subjects in all age groups performed virtually perfectly. However, the scores of seven tests on ASL morphology all show significant effects of age of exposure on language learning. Native outscored early learners, whom in turn outscored late learners.

Mayberry and Eichen (1991) studied the effects of age of acquisition on sign language processing. They measured the immediate recall of signed, long and complex stimulus sentences in three groups: *Native* learners, exposed to sign language beginning

at birth; *Childhood* learners, exposed to sign language between the ages of 5-8; and *Adolescent* learners, exposed to sign language between the ages of 9 -13.

Mayberry and Eichen (1991) found that the age of acquisition significantly affected subjects' tendency to recall the lexical stems (the root of a word in ASL) of the stimulus sentences in a verbatim fashion and also significantly affected the proportion of lexical stems the subjects completely forgot. Trend analyses revealed that native learners recalled a greater proportion of lexical stems verbatim than childhood or adolescent and that childhood and adolescent learners forgot more lexical items than native learners.

It was also found that adolescent learners made significantly more phonological lexical changes than the childhood learners, who in turn made more phonological lexical changes than native learners did (Mayberry & Eichen, 1991). An example of a phonological lexical change would be changing the stimulus "The approaching man who is deaf doesn't know American *sign* because he lives in England" to "The approaching man who is deaf doesn't know American *but* because he lives in England". In ASL, the sign for *sign* and the one for *but* are phonologically related, that is, they have similar handshape and location, but different movement, however they have very different meaning. Therefore, phonological lexical changes nearly always result in meaningless responses.

Native learners, however, made more semantic lexical changes than adolescent learners did (Mayberry and Eichen, 1991). For example, the stimulus sentence, "The approaching *man* who is deaf..." was changed to "The approaching *person* who is deaf..." by a participant. The stimulus sign *man* is phonologically unrelated to the sign *person* in ASL, however, the change or error is a semantically sound one.

Therefore, signers who acquired sign language from birth made errors in terms of the meaning of the stimulus (semantic lexical errors) independent of the surface phonological structure. Signers who acquired sign language after childhood also made semantic errors but were just as likely to make phonological errors that are derived from the surface structure of the stimulus.

In terms of grammar, it was found that native learners ordered the grammatical constituents of the stimulus sentences more accurately than either childhood or adolescent learners and they gave grammatical responses more often. These results indicate that age of acquisition is associated with the tendency to be grammatical in sign language processing, in addition to the tendencies to be lexically and syntactically accurate.

In summary, native learners primarily make lexical errors derived from the meaning of the stimulus (semantic lexical errors) and they are grammatical. Late learners, on the other hand, make unique lexical errors derived from the surface pattern structure of the stimulus (phonological lexical errors) and are often ungrammatical. These results demonstrate that language acquisition in childhood is advantageous and is not unique to spoken language. The linear characteristics of these age of acquisition effects shows that the critical period for language acquisition is not an all-or-none phenomenon. One's ability to establish efficient language diminishes with time, but does not necessarily come to an end at puberty. Thus, these results for the most part do not support Lenneberg's (1967) hypothesis for a critical period in language acquisition.

Mayberry (1993) determined whether the long-range outcome of language acquired after childhood is the same regardless of whether it is the first language acquired or the second language acquired. The *first-language (L1) timing hypothesis* predicts that

the timing of language acquisition may have greater effects on the outcome of first-language acquisition than second-language acquisition. Specifically, subjects for whom ASL is a late-first language should perform more poorly than those for whom ASL is a late-second language.

In order to study this hypothesis, Mayberry (1993) assessed four groups: *Late-second language learners*, who had normal hearing and acquired English throughout early childhood, but unfortunately became deaf after puberty and therefore acquired ASL between the ages of 9-15 as a second language; *Late-first language learners*, who were born deaf, but began to acquire ASL after childhood between the ages of 9-13; *Childhood learners*, who were born deaf and began to acquire ASL between the ages of 5-8; and *Native learners*, who were born deaf and began to acquire ASL in infancy.

Mayberry (1993) found that native learners recalled significantly more lexical stems than either the childhood, late-first, and late-second language learners. In addition, the degree of semantic lexical substitutions decreased with increasing age of first-language acquisition, while the degree of phonological lexical substitutions decreased. As for late-second language learners, they made mostly semantic lexical substitutions and few phonological ones, a pattern resembling that of the native learner. Thus, even though late-first and late-second language learners began to acquire ASL at the same ages, the linguistic pattern of their lexical substitutions differed. These findings support the L1-timing hypothesis, namely, the age at which a *first* language is acquired has lasting effects on processing in later adulthood.

Age of acquisition also affected the recall of syntactic constituents: Native and late-second language learners recalled the order of the constituents more accurately than

the childhood and late-first language learner group. It was also found that the late-first language learners gave significantly fewer grammatically acceptable responses than the native, childhood, and late-second language learners. With respect to preservation of stimulus sentence meaning, it was found that (1) natives performed better than childhood learners, who in turn performed better than late-first language learners; and (2) late-second language learners' performance was comparable to that of the native learner. These results are consistent with the L1-timing hypothesis.

Multiple aspects of ASL sentence processing were found to be related to the timing of the acquisition of a *first* language. This is further supported by the fact that late-second language learners significantly outperformed the late-first language learners even though both groups began to learn ASL at approximately the same age.

The effects of age of acquisition on the neural systems mediating ASL were studied (Neville, Coffey, Lawson, Fischer, Emmorey, & Bellugi, 1997). More specifically, the neural systems mediating ASL semantic and syntactic (grammar) development were assessed. In order to study semantic development, Neville et al. looked at open class words such as nouns, verbs, or adjectives, whereas syntactic development was studied by looking at closed class signs including pronouns, conjunctions, propositions, and auxiliaries.

The event-related potential (ERP) technique was used to record scalp electrical activity in order to determine the nature and extent of similarities and differences between four groups: *Deaf native signers* – learned ASL as a first language from their deaf parents; *Hearing native signers* – born to deaf parents and learned ASL as their first language; *Hearing late learners* – born to hearing parents, learned English as a first

language, and ASL after the age of 17 as a second language; and *Hearing nonsigners* – native English speakers with no knowledge of ASL.

Neville et al. (1997) found that there are differential effects of age of acquisition on the development semantics and syntax in ASL. It was found that hearing *native* speakers of English, and hearing and deaf *native* ASL signers, displayed a similar pattern of ERP responsiveness. Anterior brain areas were found to be more active during the processing of grammatical information while the posterior areas had a greater role in the processing of semantic information. These results suggest that there are similarities in the organization and activation of the neural systems that mediate the processing of language by native users, independent of the modality through which the language is acquired.

The results from *late* learners, however, indicated a depressed ERP response to closed class elements (grammatical information), whereas the ERP response to open class signs (semantic information) was unaffected by age of acquisition. The differences between the participants who acquired ASL early and those who acquired it later suggests that there may be a critical period on the recruitment of different brain areas in the processing of different aspects of ASL. It appears that grammatical development in ASL becomes more difficult with increasing age of exposure to it.

Overall, the evidence from ASL first-language learners suggests that a critical period for acquiring *normal* language does exist. Persons who learn ASL from birth score better on tests of morphology, recall more lexical stems, make fewer phonological substitutions and more semantic errors, order grammatical constituents more accurately and make more grammatical responses than persons who acquire ASL later on in life. No

differences for obtaining basic word order were found, suggesting that some form of language acquisition is nonetheless possible after puberty.

Grimshaw, Adelstein, Bryden, and MacKinnon (1998) report on the development of the comprehension and production of spoken language in a 19-year-old male, E.M., who acquired hearing aids at the age of 15 years, 9 months. This case allows us to assess the learning of a first language in an individual who is beyond the proposed critical period for language development. E.M.'s case is similar to that of Genie, in that he also experienced an extended period of linguistic isolation and began to learn spoken language in adolescence. However, E.M. developed in a normal social environment and therefore his case is not confounded with the emotional factors present in Genie's case (Grimshaw et al., 1998).

E. M. did not receive much formal education. At age nine, he was placed in a regular school where an attempt was made to teach him to read. In addition, several months were spent in a school for the deaf at age 12, where oral training was provided. E. M. was found to communicate with his family using a homesign, a system of iconic gestures. The system consists of gestures for actions, linked by points in space and structures that seem to function as pronouns or classifiers. For example, E. M.'s sign for "the dog jumped over the bed" consisted of a classifier for animal (a four-legged sign produced with the right hand) jumping over the classifier for flat object (a flat left hand, palm down). E. M.'s cognitive ability was assessed at age 19 with the Wechsler Adult Intelligence Scale-Revised (WASI-R), producing a performance IQ of 85. Since E. M. has been fitted with binaural hearing aids he has not had any formal language instruction, however he has been hearing and learning verbal Spanish within the family context.

Grimshaw et al., (1998) report that with respect to language production, E. M. had great difficulty with articulation, and seldom spoke spontaneously. After 48 months, E. M. was still relying heavily on gesture for communication. E.M. was administered the Verbs of Motion Morphology Production subtest of the test battery for the American Sign Language Morphology and Production test at 16 and 48 months of aided hearing. The test consisted of 40, 3-second video clips that depicted the movement of an object from one location to another. At the 16-months assessment, E. M. produced gestural responses for all 40 video clips, whereas at the 48-month assessment, he also produced speech (identified the subject noun) for 18 of the 40 items in addition to gestures. In most instances the verbal noun represented an object that had not previously been identified explicitly in homesign, therefore speech added a new dimension to E. M.'s communication. In addition, there were several instances where speech changed the homesign. For example, the sign for "aeroplane" became less specific when E. M. verbalized the word "aeroplane". Finally, only one example of a two-word utterance, "aeroplane stop", was reported in E. M.'s language production over a period of four years.

With respect to language comprehension, it was found that E. M. understood simple/complex modifications, singular/plural distinctions, the use of possessive pronouns, the comparative/superlative forms of adjectives, and the use of single pronouns in a sentence. However, he lacked consistency with the comprehension of the conjunctions *and/or*, he did not master any single verb tense, had difficulty with spatial prepositions, multiple pronouns in a sentence, the reflexive and simple negation.

It can be seen that E. M's language acquisition is atypical in a number of ways. Having been fitted with hearing aids at such a late stage did not allow E.M. to develop normal language. This case shows that language acquisition beyond puberty will probably not develop normally, however some language acquisition is possible after puberty.

The critical period hypothesis for language acquisition is the major theoretical rationale for the debate about whether prelingually deafened children should receive cochlear implants (Vernon & Alles, 1994). The assumption is that the sooner children are exposed to spoken language the better their chances of learning to speak. However, in order for a cochlear implant to be considered successful, it should enable the child to hear speech well enough to understand conversation, to develop intelligible speech, and competence in English. Unless surgery provides these results, it will not alter a deaf child's life significantly (Vernon & Alles, 1994).

According to Lane (1993; as cited in Vernon & Alles, 1994) researchers on cochlear implant outcomes studies have a tendency to report "improvement" or "statistically significant" results compared to hearing aid or tactile aid users. These results however, have no true pragmatic benefits for the child who is prelingually deaf. The results have not been shown to help these children understand spoken language and in turn develop intelligible speech. In addition to the lack of empirical support for cochlear implants in prelingually deafened children, the costs of the procedure and follow-up rehabilitation are enormous, and some of the medical risks involved in the surgery are life-threatening. The risks may include wound infection, meningitis, pedestal

infection, intraoperative respiratory problems, and complications from anaesthesia (Cohen et al., 1993; as cited in Vernon & Alles, 1994).

Socially privileging the adoption of certain communicative practices over others (e.g., publicly funding cochlear implant programmes over sign language and community education programmes) serves to shape the adoption of certain communication techniques by parents of deaf children and newly deafened adults (Hogan, 1997). This places a moral pressure on such individuals to remake their children or themselves, in the case of newly deafened adults, as hearing people in order to be able to function in everyday life. The assumption is that deaf individuals are incapable of success in our society.

It is the position of The National Association of the Deaf (NAD) that prelingually deaf children are being used as human guinea pigs for a procedure that has been shown to be ineffective in producing real gains in the children (Anon, 1990; as cited in Vernon & Alles, 1994). The NAD also raises the issue of whether the parents' and children's investment in and hopes for the procedure will serve to further the delay of acceptance of deafness, delay the acceptance of the child by the parents, and delay the learning of sign language and involvement in the deaf community. Furthermore, the fact that only a few prelingually deaf adults opt for the implant, and few deaf parents of deaf children choose to have their own children implanted, is a powerful statement against implant surgery for children born deaf (Vernon & Alles, 1994). These issues stress the importance of studying language development before and beyond the proposed critical period. Let us turn to the knowledge that second language research provides us with.

Second Language Learning

Johnson and Newport (1989) suggested two ways in which to form the critical hypothesis. The *exercise hypothesis* states that humans have a superior capacity for acquiring languages early in life. If this capacity is not exercised during this time, it will decline with maturation. However, if it is exercised, language learning abilities will remain intact throughout life. The *maturational state hypothesis* also assumes that humans have the capacity to learn language early in life, but this capacity declines with maturation regardless of whether it is exercised or not. The exercise hypothesis predicts that children will be superior to adults in acquiring a *first* language. With respect to second language learning, though, children and adults should be equally able because since they have already acquired a first language, their language learning abilities will remain intact throughout life. The maturational state hypothesis, on the other hand, predicts that children will be better than adults in learning *any* (first or second) language because children are still within the boundaries of the critical period (Johnson & Newport 1989).

In order to test these hypotheses, Johnson and Newport (1989) assessed the grammar of a second language learned as a function of age of exposure to that language. They studied Chinese and Korean native speakers who learned English as a second language and varied according to when they learned it. Johnson and Newport found a negative correlation between the age of arrival in the US (age of learning English) and performance on an English grammar test. Thus, performance declined as age of arrival increased. In addition, Johnson and Newport report that subjects who arrived in the US before the age of seven reached native performance on the test. For arrivals after that age, there was a linear decline in performance up through puberty. After puberty however,

performance did not continue to decline with increasing age. Some rules of grammar were more profoundly affected by age of acquisition than others. Johnson and Newport report that the basic word order of language and the present progressive (-ing) were acquired by all the subjects. In contrast, late learners had difficulty with aspects of syntax and morphology. The researchers draw the parallels between this study and the case of Genie. They point out that Genie only acquired basic word order and the present progressive, which was similar to the subjects who acquired the second language at a late age.

These results support the maturational state hypothesis, in that the capacity to learn a language declined with maturation only over the period in life during which maturational changes occur (during childhood). In adulthood, when maturational changes have ceased, no systematic relationship between age of arrival and performance occurred. Thus, the ability to acquire language is not spared from the maturational effects by exposure to another language early in life.

Hurford (1991) points out that one cannot reason quite so easily from second language results to a critical period for first language acquisition. Johnson and Newport's results could be interpreted in light of the interference hypothesis and not necessarily the maturational state hypothesis. The *interference hypothesis* states that second language learning is to some extent inhibited by prior attainment in a first language. This hypothesis does not necessarily entail a critical period for first language acquisition. It merely suggests that the first language learned may affect the second one learned. Johnson and Newport's study of second language acquisition suggests the possibility of a

critical period in first language acquisition, however, it cannot be seen as conclusive until the interference hypothesis can be falsified.

Lenneberg (1967) hypothesized that normal language acquisition could only occur between the ages of two and puberty. At puberty, he claimed that language learning abilities greatly diminished. However, Johnson and Newport (1989) did not find this. Language learning abilities began to decline at age seven until puberty and then levelled off. It is important then to determine the exact point at which language learning begins to decline in future research. Johnson and Newport also found that language does not become totally unlearnable after puberty. The late learners in this study all scored significantly above chance on all aspects of the grammar test. Therefore, it seems that many aspects of a second language are learnable at any age, even though problems begin to emerge with increasing age.

Johnson and Newport (1991) carried out a study to determine to what extent critical period effects could also be found for universal properties of language considered to be innate. Most studies, up to this date, have tested the parts of grammar that are thought to be specific to a language. It might be that only language specific properties are influenced by maturational constraints, whereas universal properties are maintained throughout life. On the other hand, maturational constraints may influence the learning of both language-specific structures and a universal property of language.

The universal syntactic principle called subadjacency was studied in the acquisition of a second language (Johnson & Newport, 1991). The subadjacency principle places restrictions on the types of sentences that can accommodate wh-question formation. It was hypothesized that if the subadjacency principle was not affected by maturational

constraints, adult learners of English would have similar scores to those of native learners. If subadjacency was affected by maturation, then native learners would outperform adult learners.

The results revealed that adult learners performed significantly more poorly on a test of subadjacency violations than native. This result suggests that the subadjacency principle is not as accessible to the adult learner of a second language as it is for the native learner of the language. Thus, this universal syntactic principle is not spared from the maturational constraints found for language-specific structures at any age of acquisition.

Johnson and Newport (1991) also studied the effects of age of acquisition on the universal principle of subadjacency. A continuous decline in performance on subadjacency was found with increasing age. The ability to obey the subadjacency principle undergoes a gradual decline with age of arrival. These results are consistent with the research on critical periods and language-specific rules (Johnson & Newport, 1989). Subadjacency and language-specific rules show comparable declines with age of acquisition.

The evidence from second-language acquisition also points to the existence of a critical period for normal language acquisition. Persons who learned the second language early in childhood received better scores on grammar tests (syntax and morphology) and performed better on tests on the universal principle of syntax called subadjacency. Thus, they outperformed late-learners in both the learning of language specific structures and a universal property of language. No differences were found, however, for the acquisition of basic word order and the present progressive. Again, this suggests that some form of language is obtainable after the critical period.

In addition to having studied cases of severe social isolation, second-language learning, and the profoundly deaf, researchers have also studied individuals with autism (Windsor et al., 1994) and intellectual disorders (Reid et al., 1997) in order to find answers to the critical period question. Before reviewing this research, however, a synopsis of language development in individuals with autism and intellectual disorders is presented.

Language Learning in Children with Autism and Intellectual Disorders

Both non-verbal and verbal communication is affected in children with autism (Wicks-Nelson & Israel, 1997). Overall, children with autism use fewer non-verbal signs, such as eye contact, social smiles and facial expressions, compared to children with language disorders, intellectual disorders, or no disabilities. In addition, deficiencies in joint attention interactions have been observed. This involves gestures such as pointing, showing, and eye contact that focus the child's and the caretaker's attention on a common object or task (Wicks-Nelson & Israel, 1997).

With respect to verbal communication, some children with autism never speak or never produce spontaneous utterances, whereas others never say more than words or simple phrases (Wicks-Nelson & Israel, 1997). In addition, impairments such as echolalia and pronoun reversal are evident. In echolalia, the child echoes back what another person has said, either immediately or at a later time. This occurs more frequently when the child's setting or task is unfamiliar, aversive, or fearful. In pronoun reversal, the child refers to others as *I* or *me*, and to the self as *he*, *she*, *them*, or *you*. Thus, in asking for a toy, the child might say, "He wants the doll". Finally, the most remarkable impairment involves the pragmatic use of language – the ability to adapt

communication to different listeners and situations. Children with autism fail to use greetings, interrupt speakers, persevere on a topic, fail to develop conversation, fail to advance in the give-and-take of communication, and in the amount of new information they add to the conversation (Wicks-Nelson & Israel, 1997). We have seen then, that some children with autism acquire minimal verbal communication skills, while others do not acquire any verbal skills. The research on language development in individuals with intellectual disorders reveals a different pattern.

Rosenberg (1982) reviewed much of the literature on the language development of individuals with intellectual disorders. The studies reviewed included evidence about the development of the individual aspects of language such as syntax, semantics, phonology, and pragmatics, and the development of language in general. Despite the limitations of the literature reviewed, some tentative conclusions were drawn. First it was found that the mental age (MA) of individuals with intellectual disorders tended to predict performance on linguistic tasks better than chronological age (CA). More specifically, MA tended to predict syntactic performance better than CA in individuals with intellectual disorders.

Second, in comparison to individuals with no intellectual disorders in the same CA range, language development in general in individuals with intellectual disorders showed the following characteristics: later onset, slower progress, lower level of final achievement, retardation in all aspects of language functioning, but similar stages of acquisition. This pattern emerged for the syntactic, semantic, and phonological aspects of language (Rosenberg, 1982).

These conclusions, however, cannot be applied to pragmatic development because little research exists on this aspect of language development in individuals with intellectual disorders (Rosenberg, 1982). However, research does show that individuals with intellectual disorders use language appropriately such as in conversational turn-taking, greeting exchanges, and question-answers interactions. Second, speakers were observed to use both verbal and non-verbal means to attract the attention of others. Third, speakers made use of context in their conversations and finally, appropriate responses to requests for clarification on the part of the speaker were evident. Therefore, individuals with intellectual disorders experience a developmental lag with respect to language development, however, they use the language acquired in a functional manner (Rosenberg, 1982). Let us now turn to the research concerning language development in individuals with autism and intellectual disorders approaching the end of the critical period.

A child with autism.

Windsor et al. (1994) conducted a 16-year longitudinal case study of a mute woman (Ann) with autism from age 10 to 26. The case study documented Ann's language development at an age that approached the end of the critical period for language development, thereby allowing us to assess the hypothesis.

Ann was engaged in an intervention program from age 10-12, after which she received services through her public school district. Follow-up assessments were conducted at age 20 and 26. The intervention used with Ann focussed on two domains: vocal and written, however, this discussion will only concentrate on the progress of Ann's vocal language development. Thus, in order to help Ann acquire language, the

program focussed on 1) the imitation of consonants, vowels, and consonant-vowel combinations and 2) the introduction of a functional vocabulary designed to serve basic spoken communication needs and subsequent introduction of semantic relations and morphological markers.

The intervention program initially focused on trying to improve Ann's speech (Windsor et al., 1994). She was systematically taught to first imitate single consonants, single vowels, and eventually consonant-vowel (CV) and vowel-consonant (VC) combinations. The researchers spent 30 minutes of each weekly one and a half hour session shaping these vocalizations and placed an emphasis on obtaining and maintaining eye contact first and then making the demand for a vocalization.

After three months, Ann produced a number of phonemes consistently and thus she was taught CV syllables. In order to facilitate this task, Windsor et al. used techniques such as exaggerating and prolonging productions and using physical acts to accompany the vocalization. Eventually, the CV syllables were modified to approximate real words. For example, "m" and "u" were modified to "moo" and "b" and "e" were modified to "bee". After several months of training, the program shifted to a verbal emphasis with functional, single-syllable vocabulary as the main goal.

During the second year of intervention, multisyllabic functional words were added to her vocabulary, followed by multi-word utterances. In addition, activities designed to teach Ann to initiate conversations, maintain topics, and to communicate more effectively during conversations were implemented.

Prior to the implementation of the language program, Ann was found to have very limited productive skills, and appeared unable to imitate spoken productions. In addition,

her receptive vocabulary, as measured by the Peabody Picture Vocabulary Test (PPVT), was at a 3-year-old level (3:0), and her comprehension of grammatical and syntactic relations, as measured by the Test for Auditory Comprehension of Language (TACL), was at an age level of 2-years and 7 months (2:7).

By the age of 12, and after two years of intervention, Ann produced two- to three-word utterances in elicited tasks and expressed a range of syntactic relations in her multi-word utterances. Her vocabulary included mainly nouns, with some adjectives and adverbs, and few verbs. She also showed some use of plurals, tense markers, and prepositions. However, she consistently omitted conjunctions, articles, and auxiliaries and had difficulty with word order. In addition, Ann rarely spoke spontaneously and was often unintelligible. With respect to comprehension, Ann's score on the PPVT increased to an age-level score of 10:0 from 3:0 and her score on the TACL increased to 5:7 from 2:7.

During the first follow-up assessment, at age 20, Ann's MLU was calculated to be 1.89 morphemes in length. However, 60% of her utterances were one morpheme long. Ann demonstrated some use of several grammatical morphemes such as plurals, regular past tense, present progressive, articles, and prepositions. In addition, she was able to expand single word responses to grammatically complete sentences when prompted. However, Ann, sometimes experienced difficulty with word order and sentence structure. No significant changes were observed in Ann's comprehension skills.

Similar results were obtained during the second follow-up assessment, at age 26, with respect to spoken language. However, her comprehension score on the PPVT decreased to 6:9 from 10:0 at age 20, while the TACL score remained unchanged. These

results indicate that some language development is possible for a child with autism who is close to the end of the critical period for language acquisition.

A child with intellectual disorders.

Young children presenting delayed language acquisition provide another avenue for assessing the critical period hypothesis (Reid et al., 1997). Reid et al. examined the effectiveness of a parent-implemented treatment program, (Zelazo, Kearsley, and Ungerer, 1984) for stimulating expressive language in a child with intellectual disorders at an age (8 years, 4 months) that approached the latter end of the critical period for language acquisition - late pre-puberty.

The results demonstrate the acquisition of a working vocabulary and multi-word sentences. An increase in the total number of words (both spontaneous and imitative) produced over test sessions and an increase in the total number of different words produced was observed after 14 months of intervention. The dominant form of speech after one year of intervention was essentially single word utterances with occasional two-word utterances (MLU = 1.23). The single-word utterances consisted of mostly nouns and some verbs, while the two-word utterances more often followed the verb-object and subject-verb pattern. Two-word spontaneous utterances first appeared after two months of treatment (average two per 12-minute session) and increased sharply after 14 months (average nine per 12-minute session).

Three-word spontaneous utterances first appeared after 10 months of treatment and four-word spontaneous utterances first appeared after 12 months of treatment. The sentences produced followed the normal subject-verb-object word order. Thus, the child's spontaneous speech revealed the acquisition of basic word order. These results

indicated a clear upward trend in the child's level of performance. With respect to receptive language, however, minimal gains were achieved on the PPVT-R.

In addition to the improvements incurred in expressive language, the child also experienced improved scores on conventional measures of intelligence, such as the Griffiths Developmental Scales. The expected rate of development for a child with an IQ of 32 would be an IEI of 0.33 (a gain of 4 months over a 12-month period). However, the child developed at a normal rate over the two-year intervention period (IEI=1.0). Thus, he gained 12 months over a 12-month period, increasing his general IQ score. After one year of treatment, the child's general IQ score moved from the severely delayed range (32) to the moderately delayed range (41). By the second year follow-up, the child's IQ increased to 45, maintaining him within the moderately delayed category (IQ = 40-52).

These data reveal the possibility of language acquisition in a boy at the tail end of the critical period (Reid et al., 1997). He acquired spontaneous spoken vocabulary and simple spontaneously generated communicative sentences, which contained appropriate word order. Furthermore, the improvement in expressive language appeared to increase the child's intelligence scores.

Overall, then, language acquisition in children with autism and intellectual disorders also seems possible once the end of the critical period for language development has been reached. The generalizability of these results is questionable, as with all case studies (Reid et al., 1997). Until the sample of children studied increases, these studies only suggest the possibility of teaching children who are at the end of the critical period for language acquisition to speak.

The studies reviewed partially support Lenneberg's (1967) critical period hypothesis. It seems that in order for language to develop normally, children need to be exposed to it early in life. With increasing age of exposure to a language (especially a first language), normal language development becomes increasingly difficult. Lenneberg's hypothesis, however, needs to be modified because he suggested that all forms of language acquisition cease after puberty. The research presented has clearly shown that some language acquisition is possible after puberty. Therefore, does a critical period for language acquisition exist? It does, in that some aspects of language become progressively difficult to acquire with increasing age. On the other hand, some language acquisition is still possible after this time (see Table 1 for a summary of the evidence from the four research domains).

Table 1

Summary of Evidence from Four Research Domains

Research Domain	Evidence
The Case of Genie	
Fromkin et al. (1974)	<ul style="list-style-type: none">- Performed dichotic listening procedures on Genie and found an extreme left ear advantage with verbal stimuli and non-verbal stimuli- Results indicate that Genie's right hemisphere was processing both verbal and non-verbal information
Curtiss (1977)	<ul style="list-style-type: none">- Studied Genie's language development and found:<ul style="list-style-type: none">- Large competence/performance distinction- Larger than normal comprehension/production disparity- Rate of language development slower than that of normally developing children- Vocabulary was much larger than that of normally developing children at a similar level of syntactic complexity
Deaf Individuals and First Language Learning	
Newport (1990)	<ul style="list-style-type: none">- Studied native, early, and late learners of ASL- No effect of age of first exposure to ASL on basic word order was found- Tests on ASL morphology show significant effects of age of exposure on language learning: Native learners outscored early learners, whom in turn outscored late learners
Mayberry & Eichen (1991)	<ul style="list-style-type: none">- Studied native, childhood, and adolescent learners of ASL- Native learners recalled more lexical stems verbatim than childhood or adolescent learners- Childhood and adolescent learners forgot more lexical items than native learners- Native learners made lexical errors derived from the meaning of the stimulus (semantic lexical errors) and were grammatical- Adolescent learners made lexical errors derived from the surface pattern structure of the stimulus (phonological lexical errors) and were ungrammatical

- Mayberry (1993)
- Hypothesised that persons for whom ASL is a late-first language should perform more poorly than those for whom ASL is a late-second language
 - Studied late-second language learners, late-first language learners, childhood learners, and native learners
 - Late-second language learners made mostly semantic lexical substitutions and few phonological ones, a pattern resembling that of the native learner
 - Native and late-second language learners recalled the order of the syntactic constituents more accurately than childhood and late-first language learners
-
- Neville et al. (1997)
- Studied the effects of age of acquisition on the neural systems mediating ASL
 - Studied deaf-native signers, hearing-native signers, hearing-native signers and hearing-nonsigners
 - Results indicate differential effects of age of acquisition on the development of semantics and syntax in ASL
 - Native learners of ASL and English displayed a similar pattern of electrical brain activity while processing both semantic and syntactic information
 - Late-learners had depressed electrical activity when processing syntactic information, but a similar pattern of activity as native learners of for semantic information
-
- Grimshaw et al. (1998)
- Studied E. M., a 19-year-old male who acquired hearing aids at the age of 15 years, 9 months
 - E. M. experienced difficulty with articulation and seldom spoke spontaneously
 - After 48 months of having acquired the hearing aids, E. M. produced speech to identify the subject noun in 18 of 48 video clips
 - One example of a two-word utterance was reported

Second Language Learning

- Johnson & Newport (1989)
- Studied Chinese and Korean native speakers who learned English as a second language and varied according to when they learned it
 - Found that participants who learned English before age seven reached native performance on grammar tests
 - After age seven there was a linear decline in performance up through puberty at which point it remained stable
 - Some rules of grammar, such as basic word order and the present progressive (-ing) were acquired by all subjects regardless of age of acquisition

- Late-learners had difficulty with aspects of syntax and morphology

Johnson & Newport
(1991)

-
- Studied the universal syntactic principle of subadjacency in the acquisition of a second language
 - Adult learners of English performed significantly more poorly on a test of subadjacency violations than native learners
 - The ability to obey the subadjacency principle underwent a gradual decline with age of arrival
 - Results show that this universal principle is not spared from the maturational constraints found for language-specific structures

Language Learning in Children with Autism and Intellectual Disorders

Windsor et al. (1994)

- Assessed the effects of an intervention designed to elicit language in a 10-year-old child with autism
- Prior to beginning the intervention, the child had limited productive skills, a receptive vocabulary at a 3-year-old level, and the comprehension of grammar and syntactic relations at a 2-year, 7-month level
- By the age of 12, after two years of intervention, the child produced two- and three-word utterances, however, she rarely spoke spontaneously
- The child's receptive vocabulary increased to an age level score of 10 years, and her comprehension of grammar and syntactic relations score increases to 5 years, 7 months

Reid et al. (1997)

-
- Examined the effects of a parent-implemented program for stimulating expressive language in an 8 year, 4 month old child with an intellectual disorder
 - Results indicated an increase in the total number of words and the total number of different words produced over 14 months of intervention
 - Single-word utterances with occasional two-word utterances were the dominant form of speech after one year
 - Three- and four-word utterances first appeared after 10 and 12 months of treatment respectively, and followed the normal subject-verb-object word order
 - Scores on conventional measures of intelligence improved
 - The child's general IQ scores moved from the severely delayed range (32) to the moderately delayed range (45) by the second year follow-up

Rationale for Present Study

The main goal of this case study is to stimulate expressive language in a 15-year-old boy with an intellectual disorder who has never spoken before. This study will be using a parent-implemented cognitive-behavioral treatment program designed for children with pervasive developmental delays (PDD) and autism (Zelazo et al., 1984; Zelazo, 1997b). As mentioned, the treatment program has also been shown to be effective in a child with an intellectual disorder (Reid et al., 1997).

The treatment program consists of two major parts (Zelazo et al., 1984), however, before being able to implement the treatment program parents obtain training. They are required to read *Learning to Speak* (Zelazo et al., 1984), a detailed manual for the treatment program, before therapy begins and they receive additional training by meeting with a professional trained in the use of this approach during the course of therapy. Therefore, parents receive continual coaching throughout their child's therapy program.

The first part of the treatment program involves 12-minute structured teaching sessions that are conducted five days of seven per week by one of the child's parents (Zelazo et al., 1984). These sessions are conducted according to operant conditioning principles, where behaviors are shaped through contingent positive reinforcement. Observation of children with PDD and autism in structured teaching sessions with their parents reveal that their major problem lies in their non-compliant and resistant form of behaviors. For example, temper tantrums serve to terminate parental demands, thereby allowing the child to escape. When a child escapes from a task demand, stress is reduced and the behaviors producing the escape are reinforced. These types of behavior patterns can reduce the learning opportunities that aid the child in developing expressive language

and object use. Therefore, the treatment program places initial emphasis on gaining compliance, first with actions and then with words because it is easier for a language-delayed child to perform motor actions than it is to speak on demand (Zelazo et al., 1984). Compliance, then, is seen as a "keystone" behavior in this treatment program (Rogers, Zelazo, Mendelson, & Rotsztein, 1998). By fostering compliance first, tolerance to stressful task demands increases and therefore, children learn to regulate their behavioral and emotional responses to the task demands. With increasing stress tolerance, children's learning opportunities increase and development occurs. Therefore, compliance is seen as a pivotal behavior around which other behaviors that promote or enhance learning are organized.

In addition to the above-mentioned applied behavioral techniques, the program also emphasises early child development research, such as the development of information processing ability, object use, play, and early language acquisition (Zelazo, 1997b). This developmental foundation determines the critical set of behaviors to be targeted during the treatment sessions. More specifically, a developmental profile of the child is determined using a combination of conventional tests, the information processing procedure, a vocabulary checklist, observations of play, and structured parent-child interactions. This profile is then used to determine what constitutes familiar and easy material versus new material, which is used to increase the difficulty level during the teaching sessions. Thus, the targeted material during a teaching session is determined from the child's developmental level at that time and guided by developmental research.

The second part of the treatment program involves systematic generalization of the material learned during the session to other contexts in and outside of the home

(Zelazo et al., 1984). While the teaching sessions enable a child to learn new words and practice them, generalization techniques teach the child to talk outside the sessions in order to communicate verbally.

The theoretical assumption underlying this intervention program stems from the notion that it is possible for a child to display delayed development on conventional tests of mental ability, but yet possess the ability to process information normally (Zelazo, 1997a & b). Traditional tests require 1) age-appropriate gross and fine motor skills, 2) expressive language and 3) compliance with an examiner, in order to obtain a score of mental ability (Zelazo, 1997a). All three of these areas of development are not only affected in children with PDD and autism, but also represent the defining characteristics of the disorders. The DSM-IV defines autism as a subcategory of PDD. It is characterised by severe impairments in reciprocal social interactions and communication, the presence of stereotypical behaviors, interests, and activities and usually some degree of mental retardation. A range of behavioral symptoms including hyperactivity, short attention span, impulsivity, aggressiveness, self-injurious behaviors and temper tantrums may be present.

Therefore, missed items due to non-compliance or expressive language or neuromotor delays will depress the child's score of mental ability (Zelazo, 1997a). A lowered score of mental ability has implications for parental expectations, which in turn affects child performance. Lowered mental ability, produces lowered parental expectations and correspondingly poorer child performance.

In order to overcome these limitations, Zelazo and Kearsley designed an assessment procedure that distinguishes mental activity from confounding performance

measures such as expressive/communicative behaviors (Zelazo, 1997a). This procedure, called the central information processing procedure, provides greater diagnostic precision. Using only conventional developmental tests will not only suggest PDD or autism, but an intellectual disorder which is a disability with no known cure. The identification of intact information processing ability implies normal intelligence and difficulty with expressive development, implying that the child has the capacity to overcome the delays.

In order to assess a child's information processing ability, the child's capacity to form mental representations for visual and auditory events and the rate at which these representations are formed is measured (Zelazo, 1997a). Through repetitions of an event, known as the Standard Phase, the child is allowed to build an expectancy. Then the child assimilates changes to the Standard during the Transformation Phase and, finally, recognises the reappearance of the Standard following the change during the Return Phase. The first recognition cluster to occur announces that the child has created a mental representation. This information is used to draw inferences about the speed with which the visual and auditory information is processed and the mental representation retrieved for comparison with a moderately discrepant stimulus.

The information processing assessment takes place in a room resembling a puppet theatre (Zelazo, 1997a). The child sits on his/her parent's lap in front of a brightly-lit stage. The assessment, which lasts approximately 40 minutes, includes three auditory and two visual events, and resting periods for the child and parent. Behavioral measures, such as visual fixation, auditory search, smiling, fretting, clapping, vocalizing, pointing and reaching are recorded on a button box by two people observing the child from behind the

stage. The child's heart rate is also recorded with surface leads placed on his/her chest. The behavioral measures and the heart rate are recorded on a computer, which is synchronized with the stimulus event. Thus, one can assess exactly what happened, when it happened during an event. A clear advantage over conventional testing is that the behaviors and heart rate measured during the assessment are more likely to be intact in the presence of developmental disabilities than expressive language or age-appropriate object use. The information processing measures are less disrupted by developmental delays than traditional measures.

Studies were conducted to validate this assessment procedure (Zelazo, 1997a). First, a cross-sectional comparison study was conducted to see whether children with PDD and autism improved spontaneously with time. The development of 22- and 32-month-old children was compared to the development of 37- and 49-month-old children who had documented evidence of PDD at 22 and 32 months respectively. It was found that the children in the four age groups had comparable rates of mental development, however, the magnitude of their delays in mental age were found to increase with age. This showed that the children did not experience spontaneous improvement, rather they were more likely to display larger delays as they got older.

The next step in validating the assessment procedures was to identify children who had intact information processing ability (Zelazo, 1997a). It was hypothesized that if their delays were expressive in origin, then providing treatment to remedy their delays should lead to improved scores on conventional tests. For the impaired processors, on the other hand, treatment should not improve their scores because, presumably, their delays were central in origin, indicative of an intellectual disorder. It was found that, in fact, the

intact processors reduced their delays over testings whereas the impaired children did not. This finding validates the assessment procedure in detecting a child who has intact processing versus one who does not. Moreover, it validates the treatment that was provided since we know that children with PDD and autism did not improve spontaneously. It was also found that 76% of the children in the sample were found to be intact processors, whereas all children had been labelled as having an intellectual disorder by conventional means. These results support the hypothesis that intact processing reflects normal intelligence despite the developmental delays, while impaired processing indicates an intellectual disorder. The implications of these findings are profound. It could be that children who have been labelled as having an intellectual disorder are in fact intact processors with the ability to overcome their delays with proper treatment.

The effectiveness of the parent-implemented cognitive-behavioral treatment program (Zelazo et al., 1984) was established in terms of reduced delays on conventional tests, increased rates of mental development, the quantity and quality of expressive language, and the amount and quality of play in young children with PDD and autism (Zelazo, 1997b). A cross-lag design was used to compare intact information processing children, as assessed from the information processing procedures who entered the program at 22 months and received treatment for 10 months with untreated intact information processing children who entered the program at 32 months. It was found that the mean delays were smaller for treated children than the untreated children and the mean rates of mental development for treated children were higher than the rates for untreated children. In terms of the quantity and quality of expressive language, treated children produced three times more total word utterances and more complex utterances

(multiple word aggregate) than untreated children. Finally, in terms of the amount and quality of play, it was found that immature, stereotypical play decreased and the quantity and quality of functional play and number of appropriate uses for toys increased over treatment. This research strongly supports the use of the parent-implemented cognitive-behavioral treatment program to improve the development of children with PDD and autism.

Because the information processing procedure was designed to assess children up to 42 months, it is impossible to establish whether the adolescent in question, in this case study, is an intact processor or not. More importantly, however, is the issue of whether this boy can acquire language at his age, using an intervention program that has been shown to be effective in stimulating expressive language development in younger children with similar presenting problems.

The ethical impossibility of experimentally manipulating the age of exposure to a first language restricts the empirical study of a critical period for language acquisition. This case illustrates a naturally occurring case of a child who has not developed language and serves as part of the database for making inferences about critical periods for language acquisition and the development of language in individuals with intellectual disorders. More specifically, the following research questions were addressed during the course of this study:

- 1) Is language development possible beyond the critical period for language acquisition in an adolescent with an intellectual disorder?
- 2) What is the quality of language development in an adolescent with an intellectual disorder?

- 3) Is the parent-implemented cognitive-behavioral treatment program (Zelazo et al., 1984) effective in producing increased scores on conventional tests of mental development in an adolescent with an intellectual disorder?
- 4) What is the clinical utility of using a parent-implemented cognitive-behavioral treatment program with an adolescent with an intellectual disorder?

METHOD

Participant

The participant was a 15 years, 4 month old adolescent male with an intellectual disorder and no verbal communication skills. The participant was referred to the Montreal Children's Hospital because of severe communication problems. The following case history was compiled from the participant's hospital file, which included mainly medical and psychiatric/psychological reports and some parental reports.

Early Childhood

The participant was adopted as a 5-month-old boy from war-torn Lebanon. He had been found on the steps of a hospital in Lebanon, at which point he was placed in a nursery without environmental stimulation. In 1982, the participant was adopted by a middle-aged couple and was an only child. The participant was found to be extremely agitated as a baby and ignored objects as well as people. During the night it was common for him to experience nightmares and these were usually accompanied by screaming.

At 17 months, the participant's mother requested help from a developmental clinic with respect to his general developmental delay (especially his delays in speaking), temper tantrums, nightmares, and fear of noises. The participant's mother reported him able to understand the meaning of different activities such as eating, bathing, drinking,

sleeping, and going on outings. She also reported that the participant became upset or confused by changes in routine, he became easily distracted and frustrated, and that he had temper tantrums.

An assessment conducted at 20 months of age, revealed that the participant presented a delay of cognitive development reflected in a play behavior of about 10-12 months and a language development that was even more immature. He also presented age-appropriate gross-motor development, but considerable delays in fine motor, and socio-emotional development.

At 20 months the participant's play consisted mostly of manipulatory and visual exploration, banging and some beginning of functional play such as drinking from a cup. With respect to language, the participant produced mostly guttural sounds with little intonation and did not babble. In terms of motor development, it was reported that the participant sat at 9 months, began to crawl between 9-11 months and walked at 14 months. At 20 months he was able to pick up tiny pieces of bread indicating the development of the pincer grasp. In addition, the participant was able to feed himself with a fork, but did not use the spoon properly. He did not dress/undress himself, and had no signs of bowel or bladder control. Finally, with respect to socio-emotional development, interpersonal interactions often occurred at a distance over visual contact and seldom via close contact behaviors. At about 16-18 months, he began to show some positive affection towards his parents and started to pay attention to toys.

The participant was seen at a Day Treatment Centre (DTC) at 20 months. A stimulation programme in order to advance the child's development was implemented.

The programme focussed on the development of functional play, fine/gross motor development, socio-emotional development, and cognitive and communication skills.

At 24 months the DTC assessed the participant and diagnosed him with global developmental delays and disturbed emotional development. More specifically, with respect to motor skills, the participant functioned at the 18-month-old level. The participant walked sturdily, however, he often tripped. He also was able to perform some activities with a ball and tricycle. The participant was also found to have a strong pincer grasp, however, activities such as block building, scribbling, and placing pegs in holes were achieved only with assistance.

With respect to cognitive development, the participant functioned at the 10-12-month age level. He was able to locate a hidden object and had some beginning form of symbolic meaning of objects (e.g., recognized sounds of a truck, put a spoon to a doll's mouth). In terms of expressive and receptive language development, the participant demonstrated a 6-12 month level. The participant infrequently responded to simple instructions such as "come here", and was found to have almost no imitative skills. The participant expressed his needs by loud shrieks. He babbled occasionally with a small range of inflection. The participant would become very stimulated by musical toys and loud trucks and responded by tensing all his body and squealing loudly.

With respect to socio-emotional development, the participant was closely bonded with his mother and was experiencing only acute separation anxiety when she would leave him. He also responded warmly to his sitter and father. However, the participant did not acknowledge other children in the DTC and his responses were immature, wishing to pull hair or grab toys. When annoyed the participant was in the habit of biting

anyone including his parents. The participant refused any limits on his behavior. Emotionally, the participant was extremely labile, and it was often impossible for his mother to know why he was screaming. He would still wake up once or twice a night, several times a week, having severe night terrors.

The participant achieved daily living skills at the 10-12 month level. He was able to feed with a fork, however, he did not spoon feed or drink well from a cup. He swallowed solid or semi-solid food without difficulty, but he regurgitated and ruminated throughout the day.

An electroencephalograph (EEG) performed at 24 months revealed that the participant was just within the normal range. An evoked response audiometry test also indicated that the participant had normal hearing and normal brain stem conduction.

At 28 months the participant began a new stimulation programme at Giant Steps, however, the child experienced difficulty in separating from his mother and therefore discontinued the programme 3 months later at 31 months. The DTC resumed its services and successfully implemented a programme designed to help the participant separate from his mother.

With respect to progress in the DTC, the participant showed little response to structured cognitive and language stimulation, and no generalization of learning over time. Some skills previously acquired appeared to be no longer in his repertoire. This was thought to indicate factors other than environmental deprivation alone as being responsible for his significant global developmental delay. In terms of socio-emotional development, the child displayed gains for interactional skills, such as eye contact and physical contact. The child also made good progress in functional play behaviors such as

putting hats on himself and others, and pushing a toy truck back and forth. However, little improvement was observed with respect to cognitive and verbal communication skills, although the child seemed to understand what was being said to him (e.g., he respected the instruction “do not touch”). The participant also began to respond to “Show me what you want with your finger”, by stopping screaming and pointing to what he wanted at 31 months. With respect to his behavior, his psychoeducator at the DTC reported that he did everything on his own terms and his timing, and when he was forced to do something he would fall apart. The child was in the habit of screaming and tantruming. It was also noted that at 31 months the child had said the word “maman” for mother in French and “yon” for crayon.

At 36 months, the participant’s parents employed a private educator to work in the home. Within 4 months the participant appeared to be calmer, happier, and had developed a few pre-language skills and some fine motor abilities. He also began a behavioral training programme designed to elicit specific motor responses. His response was at first encouraging, but did not persist and did not generalize to different situations.

At 3 years 2 months, the participant was terminated at the DTC and was followed in another hospital. He was then diagnosed with global developmental delay with autistic features. The participant was found to have made only minimal gains in all areas of development and was functioning between 12 months (language) and 2 years (gross motor). His behavior was found to have many autistic features and he remained an extremely active and difficult child to manage. The participant was often non-compliant and refused to do many of the tasks in the assessment. In addition, the participant had a short attention span and was unable to focus on an activity for a long period. Temper

tantrums were still common, especially when the child's diapers had to be changed or when the child was not being understood.

With respect to cognitive development, the participant demonstrated the appropriate use of object and the development of some symbolic play skills (e.g., sitting people in a toy bus, dialing a telephone number and speaking in the receiver). In terms of language, the participant communicated his needs by pointing to objects, altering his facial expression, shrieking or groaning. However, the participant seemed to understand simple verbal instructions (e.g., "give me", "sit down"). In addition, he was able to identify a number of objects (e.g., animals and animal body parts, ball, car, and flute). The participant's receptive language then was more advanced than his expressive language.

With respect to gross motor development, the participant often tripped over objects lying on the floor. In addition, his equilibrium was poor. Fine motor development was also delayed. The participant was able to scribble, however, he held the pencil inappropriately. In addition, he had difficulty using a pair of scissors.

It was recommended that the participant join the DTC at this hospital in order to facilitate social development and the development of symbolic and constructive play. In addition the use of Ritalin was suggested in order to ameliorate the participant's concentration.

At 4 years of age the participant was seen at a speech and language clinic. The therapist reported that linguistic development was compromised because of the participant's lack of attention and behavioral problems. It was also noted that the participant vocalized frequently, however, he did not verbally imitate others. At 5 years 5

months the therapist recommended that the participant attend a school for special needs children and that an alternative mode of communication be established with the child (e.g., Amerindian Sign Language).

At 5 years of age the participant was still found to be extremely hyperactive and did not speak any words. Although he had been previously considered to have autism, no evidence of autism was found at that point. The participant communicated with his parents and the surroundings although not verbally. The participant was then considered to have an intellectual disorder of an unknown etiology. A karyotype was performed in order to rule out any genetic causes of the disorder such as fragile X syndrome. The results indicated a normal male karyotype.

Middle Childhood

When the participant was 8 years 5 months old, his parents were still concerned about his lack of concentration and eye contact with others. They felt that although he had some understanding he did not seem capable of using this. The participant seemed to understand short and simple sentences. In addition, he was hyperactive and was not able to amuse himself alone for any time and was very demanding of his parents. Attempts to help his behavior with Ritalin and Cylert were unsuccessful due to negative side effects. With respect to the participant's linguistic development, the parents were concerned that the problem was due to dyspraxia such that he could not learn to open his mouth in an appropriate manner to speak. They were concerned that there was a physical impairment to his speech rather than a cognitive one.

Emotionally, the participant was able to sleep at night without interruption and appeared to be a happy child full of life and emotions. His emotional outbursts of joy

were accompanied by jumping, screaming and pinching. The participant had days at a time or one day at a time when he was extremely listless and seemed unwilling to do anything. There were occasions when he would just sit down in the street and refuse to go any further. If he were provoked into an activity during these days he would become very aggressive. Aggressiveness was a problem with the participant as he often punched or scratched others. He also displayed inappropriate behaviors, such as taking off his pants when angry.

A report about the things that the participant was not able to do at this age included blowing out a candle, blowing his nose, opening his mouth when asked to, drinking with his tongue under the glass, jump or kiss. However, the participant was able to partially dress himself, control his fork and spoon well, and ride a tricycle. He was also toilet trained during the day, but still wet at night.

At this point the participant was admitted to a hospital for investigation under sedation (injection contained Atarax (hydroxazine), Droperidol, and Demerol). An EEG was done which was reported as a normal sleep tracing with no lateralizing features or epileptiform potentials. A CT scan of the brain was also normal. An EMG (electromyography) also showed no evidence for abnormalities in motor or sensory nerve conduction and no denervation of muscle. It was concluded that the developmental pattern that the participant presented was consistent with an autistic syndrome. The EMG, CT scan, and EEG showed no abnormality, which was the usual in such children. The use of medication to help the participant's behavior was considered when the participant became calmer and easier to manage several days after his hospitalization for the studies under sedation.

At the age of 9 years a psychologist assessed the participant and reported him to be a “hyper” child who was easily distracted and had a short attention span. He was found to be disturbed by change and had poor frustration tolerance. He would have a temper tantrum if he were not given what he wanted quickly. The participant was not interested to socialize with other children and was not able to play alone and so was constantly supervised by his parents. The assessment showed that the participant had an intellectual disability at the moderate level, a defect in expressive communication, and extreme motor disinhibition.

At 11 and a half years of age, the participant’s behavior was reported to have improved due to the institution of Trexan (Naltrexone hydrochloride) 18 months earlier. The participant had been attending school and was managing there. In addition, a student sitter worked with the participant very successfully. The participant still had major problems concentrating and difficulty maintaining eye contact with others. His fine motor skills continued to be poor. He was able to sleep well and his toilet training had been completed. He was able to feed himself with a fork and spoon, however, he did not manage a knife. He was able to dress himself, managing the zippers, but having trouble with the buttons. The communication that the participant achieved was through gesturing and pointing out what he wanted in a book. His school worked on a communication board where the participant would point to what he wanted. Socially, the participant seemed to respond well to both his parents and to his sitter. However, he had some manneristic hand flapping when he was excited.

Adolescence

At 14 years, 10 months of age the participant was referred for an evaluation to determine his general level of cognitive functioning in order to begin the described therapy program. Due to the participant's limited attention and communication skills, and behavior problems, no formal testing was possible. Therefore, the psychologist drew from a number of different instruments and observation sessions (see the Results section for pre-treatment assessment results). Over the course of the study, the participant attended a school for special needs children. In addition, three different individuals tutored the participant at home over the 20-month period. Both school teachers and home tutors focussed on developing the participant's sense of autonomy by teaching him how to bathe, get dressed, cook certain foods, and sort items. Also, both his teachers and tutors took the participant on a numerous excursions. Minimal cognitive stimulation was provided to the participant due to the notion that any attempts to teach him were going to be fruitless.

Procedure

The Treatment Program

The parent-implemented cognitive-behavioral treatment program (Zelazo et al., 1984) consists of two major parts: teaching sessions and systematic generalization. However, before being able to implementing the treatment, parents require training.

Parental training.

Parents are trained in implementing the treatment program in two ways. First, they are required to read *Learning to Speak* (Zelazo et al., 1984), a detailed manual for the treatment program, before therapy begins. Parents receive additional training by

meeting with a professional trained in the use of this approach. These meetings serve to monitor progress, refine behavioral and language targets and parental intervention skills, resolve behavior managing issues, and provide support.

Teaching sessions.

First, 12-minute structured teaching sessions are conducted five of seven days per week by one of the child's parents. These sessions are conducted according to operant conditioning principles, where behaviors are shaped through contingent positive reinforcement. This means that successive approximations of the desired behaviors are rewarded with reinforcers such as praise, objects and edibles.

The program emphasizes beginning and ending the session with familiar, easy tasks so that the child does not become overwhelmed at the onset of the session and frustrated by the end of it. The introduction of new and more difficult material takes place during the middle part of the session. Therefore, the session is divided into three phases: a "warm-up phase", during which easy words or tasks are rehearsed and rewarded, a "working phase", during which new and more difficult words or tasks are introduced and rewarded, and a "review phase", during which both old and new words or tasks are rehearsed and rewarded. An illustration of a teaching session (see Appendix A), taken from Zelazo et al., (1984, p. 53), clarifies the shaping procedure.

A number of preparations must be made prior to beginning a teaching session to ensure success. First, a time of the day and place must be chosen where the child is alert and able to concentrate. Second, a word list must be prepared in order to remember the words that the child knows well and those that are going to be taught. Third, the session must be organized so that the child starts and ends with success. Fourth, the food rewards

and the props (e.g. toys, books, puzzles, etc.) used to teach the words should be nearby. Finally, one should be prepared to record the language produced during the 12-minute session.

The use of reinforcements, such as social praise, objects, and edibles play a central role in motivating children. The types of social praise that children enjoy may include clapping, smiling, hugging, patting, and saying “Good boy” or “Good girl”. Objects such as a toy doll, car, truck, bus, dog, or cat are useful because they are appealing to children and are easy words to say. With respect to the food rewards, they should be such that the child likes to eat them, and may include chocolate chips, pieces of potato chips or crackers, some dry cereal, raisins, bits of fruit, or juice. When a particular food reward has been chosen, it should be given only during the teaching sessions, so that its value as a motivator does not diminish by being available at all times. Receiving a reward should be contingent upon a correct response. An effective way to use the food rewards, taken from Zelazo et al. (1984, p. 60) is shown in Appendix B. In addition, see Appendix C for a discussion about the relationship between the use of rewards and their effects on intrinsic motivation.

During a teaching session non-compliant behaviors and resistance to the adult’s requests may occur. Non-compliance may include behaviors such as the child ignoring adult requests by staring blankly, smiling distractingly, or reaching for a different object while resistant responses may include crying, headbanging, or tantruming. These behaviors are extinguished by removing the rewards that support the unwanted behavior. Three techniques are suggested in order to decrease non-compliant and resistant behaviors. First, one can remove themselves from the situation. If no attention is given

to the behavior, it will become ineffective and stop occurring. A second way to reduce non-compliant and resistant behaviors is to remove the activity from the child. For example, if a child has a tantrum while playing with a set of toys, the toys should be removed until the child displays calm behaviors. By losing the toys, the child learns that tantrums are inappropriate. The third strategy involves removing the child from the situation by placing him or her in the corner until calm behaviors occur. It is important to tell the child the reason for being placed in the corner and to say that he/she will return to the activity when a quiet state is obtained. The amount of quiet behavior that is demanded should range anywhere from 15 seconds to 2 minutes. Once the child is removed from the corner, it is important to demonstrate the kind of behavior that was required, so that the child not only learns what is inappropriate behavior, but also learns what is appropriate.

Systematic generalization.

The second part of the treatment program involves systematic generalization of the material learned during the session to other contexts in and outside of the home. Techniques that promote generalization of learned material include 1) asking questions, 2) real-world contingencies where the child must use a word to get something, and 3) informal language stimulation.

The first technique, answering questions, teaches a child about the giving and taking during conversations and it increases the likelihood of developing spontaneous language. Answering questions should be taught during the teaching sessions, but should be asked throughout the day as well. A first question to teach a child to answer is "What's this?". This is a question that can be asked of anything in the child's

environment. By prompting the correct response and repeating the question, children learn the meaning of this question. An illustration of this process, taken from Zelazo et al. (1984, p. 98), is reprinted in Appendix D.

Setting real-world contingencies, the second technique, involves requiring the child to use the words that he/she has learned in order to obtain the desired object. For example, if a child has learned to say the word “juice”, then he/she should be required to say juice before obtaining it. As in the teaching sessions, having the question repeated and the correct response prompted helps the child. It is important, however, that once the request for the word is made, the object is withheld until the correct word is spoken.

The third technique, informal language stimulation, involves talking to the child, using simple language, about daily activities as they are occurring. For example, while preparing a snack, say “I wash the apple”, “I cut the apple”, or “I pour the milk”. If the child repeats words or answers questions during informal situations, it is important to reward the child with praise.

Clinical Meetings

The adolescent, his parents, and his tutor met the psychologist and the investigator at the Montreal Children’s Hospital (MCH) on a weekly basis for the first three months and bi-weekly subsequently. In addition, bi-weekly visits by the investigator to the participant’s home provided continuity of therapeutic goals. Therefore, the investigators’ responsibilities included: 1) modelling 12-minute teaching sessions at the MCH and at the participant’s home, 2) providing technical support for generalization of learned material to the home environment, and 3) being the liaison between the home environment and the MCH.

The meetings at the MCH lasted approximately 1 hour. The psychologist, the investigator, and the participant's parents and home tutor first discussed the events of the previous week. The discussion revolved around any behavioral problems that may have occurred and the language gains made by the participant. In addition, the participant's progress on functional behavioral tasks (e.g., puzzle making, ball games such as rolling, throwing, and kicking a ball, sorting tasks, and paper and pencil activities such as cutting, tracing shapes, letters, and numbers, colouring, drawing lines to match items), and any event relevant to the participant's development occurring in the home or school context was discussed. The investigator was taped while conducting a 12-minute teaching session with the adolescent. Observing behind a one-way mirror, the parents, the tutor, and the psychologist reviewed the teaching techniques that were used in the session. These sessions were used 1) as a benchmark measure in order to document the child's progress in the program and 2) as a model teaching session for the parents to learn from. After the modelled session, a teaching session, conducted by the parent was observed through the one-way mirror. Feedback from the psychologist was provided to the parent concerning his/her teaching techniques and the behavioral and language goals were adjusted for the following weeks. As mentioned, behavioral and language goals are adjusted according to the child's developmental profile and his/her progress in the program. For example, in terms of language, a child progresses from "simple imitation to naming; from single-syllable nouns to functional verbs and concepts; from single-word utterances to two-word noun-verb, object-action combinations; and eventually to spontaneously constructed three-word communicative utterances" (Zelazo, 1997b, p. 6). It is important to note that the treatment plan was the critical part of the therapy and that

it was adjusted at every meeting. The treatment plan directed progress and weekly or bi-weekly meetings were timed to optimize efficient progress.

On alternate weeks, the investigator went to the participants' home. Home visits also lasted approximately 1 hour. As during the clinical meetings, the investigator, and the participant's parent and tutor first discussed the events of the week, in terms of behavioral problems and the participant's progress with language and behavioral tasks. The investigator then proceeded to conduct a 12-minute teaching session while the parent and the home tutor observed from across the room. The investigator then highlighted for the parent and the tutor the teaching techniques used in the session and answered any questions about the procedure. Systematic generalization of learned material to different contexts was carried out. For example, during snack time the investigator would ensure that the adolescent was asked (by his parent or tutor) to use his newly acquired words in order to receive a particular food or drink. In addition, the behavioral tasks implemented by the participant's parent or tutor were supervised in order to assure that they were taught in a developmentally appropriate fashion and shaped through contingent positive reinforcement. For example, the adolescent was taught to solve progressively difficult puzzles, beginning with simple 6-piece insert puzzles, followed by more complex insert puzzles, and finally solving simple jigsaw puzzles. Similar steps were recommended in order to teach the other behavioral tasks mentioned.

Data Collection

All parent-implemented and therapist-implemented (myself) teaching sessions observed at the Montreal Children's Hospital, in the psychology department, were recorded on videotape. The data used for this report consists of the initial weekly

sessions occurring during the first three months of intervention and the subsequent bi-weekly sessions occurring during the last 17 months of intervention conducted by myself, at the Montreal Children's Hospital. The intervention period analysed in this report therefore covers a period of 20 months. A total of 45, 12-minute sessions ($n = 45$) were recorded and coded according to the scheme outlined below.

In addition, the participant was administered a battery of conventional tests of mental development (described below) before beginning treatment (pre-treatment) and at the end of the 20-month period (post-treatment). This was done in order to assess whether the gains or lack of gains experienced by the participant are evident on conventional tests of mental development. These tests were administered by an independent professional in the psychology department, at the Montreal Children's Hospital.

Informed Consent

Parents provided informed consent for the implementation of this treatment protocol as described in Appendix E, including what was expected of the participant and the duration of involvement. Parents were informed both through the consent form and verbally that they could discontinue their participation in the research project at any time without jeopardizing the quality of the therapy received by the participant. In addition, in the case of publication of the research findings, they received assurance that their identity and the identity of the participant would be kept strictly confidential.

Measures

Behavioral Measures

Expressive language was reduced from the therapist-implemented videotaped sessions, using the coding scheme developed by researchers at the MCH. Language was coded according to four mutually exclusive categories including clear words, word approximations, sounds, and vocalizations. Language was also coded according to whether it was produced spontaneously or by imitation (see Appendix F for coding scheme and form).

Intra- and Inter-rater reliability.

Intra-rater reliability was determined by having the investigator code a third of the therapist-implemented sessions twice, whereas inter-rater reliability was determined by having an independent coder, trained in using the coding scheme developed at the MCH, reduce the same sessions that the investigator coded. Therefore, two individuals coded 15 sessions. Two-tailed Pearson product moment co-efficients were calculated in order to determine intra- and inter-rater reliability.

The intra-reliability co-efficients ranged from 0.93 to 1.00 for the various categories of language measures. Inter-rater reliability was also obtained between the 0.95 to 1.00 range on the different categories.

Measures of Mental Development

The participant was administered the following conventional tests of mental development, before beginning treatment (pre-test) and after 20 months of parent-implemented intervention (post-test), in order to assess whether the changes in the participant's development are evident on conventional measures of mental ability.

Peabody Picture Vocabulary Test (PPVT).

The PPVT (Dunn, 1965) measures receptive vocabulary by having the child point to a series of pictures, labelled by the tester, from a choice of four different pictures on a card.

Griffiths Mental Development Scales.

This developmental test provides a score of global development as well as scores to six subscales that cover the main areas of development. These include the Locomotor, Psychosocial, Hearing and Speech, Eye-Hand Co-ordination, Performance and Practical Reasoning subscales. The developmental quotient (DQ) for each subscale is obtained by dividing the child's mental age (MA), obtained by the number of items passed on each sub-scale, by the child's chronological age (CA) and multiplying by 100. The average of all the sub-scales provides a General Intelligence Quotient. In addition, the Intervention Efficiency Index (IEI), which factors out maturation and time of testing from the effectiveness of treatment, indicates how rapidly developmental change has occurred over the period of intervention.

Vineland Adaptive Behavior Scales.

The Vineland Adaptive Behavior Scales assess the personal and social sufficiency of individuals from both childhood to adulthood and lends itself as a diagnostic tool and it allows one to prepare educational, habilitative, or treatment programs. Direct administration of tasks to the individual under question is not necessary, rather a respondent familiar with the individual is interviewed.

Four domains of adaptive behavior are assessed: Communication (receptive, expressive, and written), Daily living skills (personal, domestic, and community), Socialization (Interpersonal relationships, play and leisure time, and coping skills) and

Motor skills (gross and fine motor skills). In addition, an Adaptive Behavior Composite can be derived comprising the four adaptive behavior domains.

RESULTS

Analysis of Behavioral Measures

General Analysis Over 20-Months of Intervention

Over the 20-month intervention period, the participant acquired a total of four different words and 35 different word approximations. His vocabulary consisted mostly of nouns (27), and included some verbs (5), adverbs (3), and an article (1) (see Table 2 for a list of the vocabulary acquired).

In addition to the single-word utterances acquired, the participant spontaneously generated four two-word approximation phrases and one three-word approximation phrase over the 20-month intervention period (see Table 2). A look at the composition of these phrases reveals the use of correct sentences structures. Finally, the participant also generated 18 different sounds. He produced 7 different oral vowels, 3 different nasal vowels, 3 different semi-vowels, and 5 different consonants over the 20-month period (see Table 2).

Analysis Based on Visual Inspection

Visual inspection is the most commonly practised method for evaluation of single-case experiments (Kazdin, 1982). Kazdin (1982) outlined four criteria for proper analysis of single-case data through visual inspection: 1) Noting the differences in the means; 2) Noting the change in the level of performance; 3) Noting the changes in trend and 4) Noting the latency of change.

The first two criteria describe the data in terms of magnitude. The difference in means across phases refers to shifts in average performance, whereas changes in level refer to the shift or discontinuity of performance from the end of one phase to the beginning of the next phase. The third and fourth criteria refer to the characteristics of the data that describe rate of change. The trend or slope refers to the tendency for the data to show systematic increases or decreases over time. Finally, the latency of change refers to the period between the termination of one condition and changes in performance. That is, the rapidity of the change at the point where the intervention is introduced. The more closely in time that the change occurs after the experimental conditions have been altered, the clearer the intervention effects (Kazdin, 1982).

Changes in means, levels, and trends and variations in the latency of change are often present simultaneously within data (Kazdin, 1982). However, they are separate characteristics of the data and can occur in isolation. In addition to the above mentioned data characteristics, other factors influencing visual inspection should be noted. Factors such as the variability of performance within a particular phase, the duration of a phase and the reliability of the data influence whether a particular effect will be considered reliable.

Baseline measures of language acquisition were established using the more conservative strategy of comparing test sessions from the first four months of treatment with later ones rather than data from observations gathered before the intervention was implemented (Kazdin, 1982). Therefore, the data represented during the baseline period consists of the treatment sessions conducted during the first four months of treatment,

while the data represented during the intervention period consists of the sessions conducted during the last 16 months of treatment.

The measures used for analysis were reduced from the first 12 minutes of the therapist-implemented sessions. They included 1) the total number of words, 2) the total number of different words, 3) the total number of word approximations, 4) the total number of different word approximations, 5) the total number of two-word approximations, 6) the number of sounds produced, 7) the number of vocalizations produced.

Analysis of words.

Table 3 reveals a change in the mean number of total words and the total different words produced per session during the baseline and the intervention period. During the baseline, the participant produced an average of 0.2 total words and 0.2 total different words per session. During the intervention however, the total words produced during a session increased to 1.0 per session and the average total different words produced increased to 0.7 per session. Therefore, a positive increase in the mean number of total words (0.8 increase) and total different words (0.5 increase) produced per 12-minute session was obtained.

A closer look at the total words acquired by the participant shows that the participant produced 0.2 spontaneous words per session and no imitative words during the baseline, whereas during the intervention period he produced an average of 0.8 spontaneous words and 0.2 imitative words per session. Thus, he produced 0.6 more spontaneous words and 0.2 more imitative words per session during the intervention

period than during the baseline. Therefore, the participant produced mostly spontaneous words per 12-minute session rather than imitative words.

Although the mean number of total words and total different words increased over time, a negative trend in the total words and total different words acquired during intervention is evident from Figure 1. Therefore, the rate of word production decreased over time. In addition, no change in the level of performance occurred from the end of the baseline to the beginning of the intervention period. Finally, the latency of change is difficult to determine due to the variability in the data.

Analysis of word approximations.

Single-word approximations. Table 3 shows an increase in the mean number of total word approximations produced from baseline (5.1 per session) to intervention (12.4 per session). With respect to the trend for total word approximations, Figure 2 shows no trend during the baseline and a positive trend during the intervention period, indicating a positive increase in the rate of total word approximation production. Figure 2 also shows a change in the level of performance for total word approximations from baseline to intervention, and the latency of change appears to be gradual indicating steady increase in the total word approximations produced.

More specifically, with respect to imitative and spontaneous word approximations, the participant produced an average of 5.7 imitative word approximations per session during the intervention period and only 3.3 imitative word approximations during the baseline. This results in a mean increase of 2.4 imitative word approximations per session during the intervention period. A look at the trend for imitative word approximations also shows a positive increase in the rate of production. A

similar pattern emerged for the spontaneous word approximations produced. The mean number of spontaneous word approximations produced during the intervention was greater (6.7 per session) than the mean number produced during the baseline (1.8 per session). This results in a mean increase of 4.9 spontaneous word approximations produced per session during the intervention period. The trends for spontaneous word approximations also show a positive increase in the rate of production.

The mean number of total different word approximations also increased over time. The participant produced 1.9 total different word approximations per session at baseline and 5.2 total different word approximations per session during the intervention period. With respect to the trend for total different word approximations, Figure 2 shows a positive trend during the baseline and a slightly less positive trend during the intervention, indicating a decrease in the rate of total different word approximation production over time. No change in the level of performance is evident from Figure 2 and the latency of change appears to be gradual suggesting gradual improvement in performance.

Two-word approximations. The participant produced a mean of 0.8 total two-word approximations per session during the intervention period, whereas he did not produce any during the baseline period. A slightly negative trend resulted for total two-word approximation during the intervention period indicating a decrease in the rate of two-word approximation production over time. No change in the level of performance is evident from Figure 2 and the latency of change appears to be gradual suggesting gradual improvement in performance.

Analysis of vocalizations and sounds.

Table 3 also contains the mean number of total vocalizations and total sounds produced by the participant during the baseline and intervention periods. The mean number of total vocalizations produced per session increased slightly from baseline (39.8 per session) to the intervention period (41.0 per session). However, the change in the trend from baseline to intervention shows a vast decrease in the rate of total vocalizations produced over time (see Figure 3). In terms of level of performance, Figure 3 shows a slight increase in vocalizations immediately after baseline. In addition, the latency of change appears to be gradual suggesting a gradual decrease in the amount of vocalizations produced.

The mean number of sounds produced during the intervention period (39.8 per session) was slightly higher than the sounds produced during the baseline period (32.9 per session). However, Figure 3 shows a decreasing trend for the total sounds produced during baseline and a positive one for the total sounds produced per session during the intervention period. This shows that the rate of sound production increased after baseline. Minimal changes in the level of performance were evident immediately after baseline. The latency of change however, was difficult to determine due to the variability in the data.

Table 2**List of Words, Word Approximations, and Sounds Acquired during Intervention**

Category and type	Utterances	Total
Words		5
Nouns	Eau, Main, Nez, Jus	
Adverbs	Oui	
Word Approximations		35
Nouns	Allô, Auto, Avion, Bateau, Bébé, Bus, Camion, Chapeau, Dents, Ernie, Gateau, Jus, Lait, Lion, Lit, Main, Maman, Maison, Musique, Nez, Papa, Pain, Pied, Pomme, Tête, Train	
Verbs	Assis, Boit, Laver, Nager, Sauter	
Adverbs	Encore, Non, Oui	
Articles	Une	
Two-word approximations		4
Verb-Object	Boit jus, Boit lait	
Subject-Verb	Bébé laver	
Subject-Object	Papa jus	
Three-word approximation		1
Subject-Verb-Object	Bébé boit lait	
Sounds		18

Oral Vowels	a[a], i[i], o[o], o[ɔ] é[e], è[ɛ], u[y]
Nasal Vowels	an[ã], in[ɛ̃], on[ɔ̃]
Semi-vowels	y[j], ou[w], u[u],
Consonants	m[m], n[n], l[l], t[t], j[ʒ]

Note. This table contains utterances heard during the therapist-implemented sessions, the parental teaching sessions, and the sessions conducted at home.

Table 3**Comparison of Means and Trends during the Baseline and Intervention Periods for the Different Language Categories**

Category	Baseline		Intervention		Change	
	Mean	Trend	Mean	Trend	Mean	Trend
Words						
Imitative	0	0	0.2	0	0.2	0
Spontaneous	0.2	0.4	0.8	-0.1	0.6	-0.5
Total	0.2	0.4	1.0	-0.1	0.8	-0.5
Total different	0.2	0.4	0.7	0	0.5	-0.4
Word Approximations						
Imitative	3.3	-0.1	5.7	0.3	2.4	0.4
Spontaneous	1.8	0.1	6.7	0.7	4.9	0.6
Total	5.1	0	12.4	1.0	7.3	1.0
Total different	1.9	0.6	5.2	0.4	3.3	-0.2
Total two-word approximations	0	0	0.8	-0.1	0.8	-0.1
Total	39.8	21.2	41	-3.7	1.2	-24.9
Vocalizations						
Total Sounds	32.9	-8.2	39.8	0.5	6.9	8.7

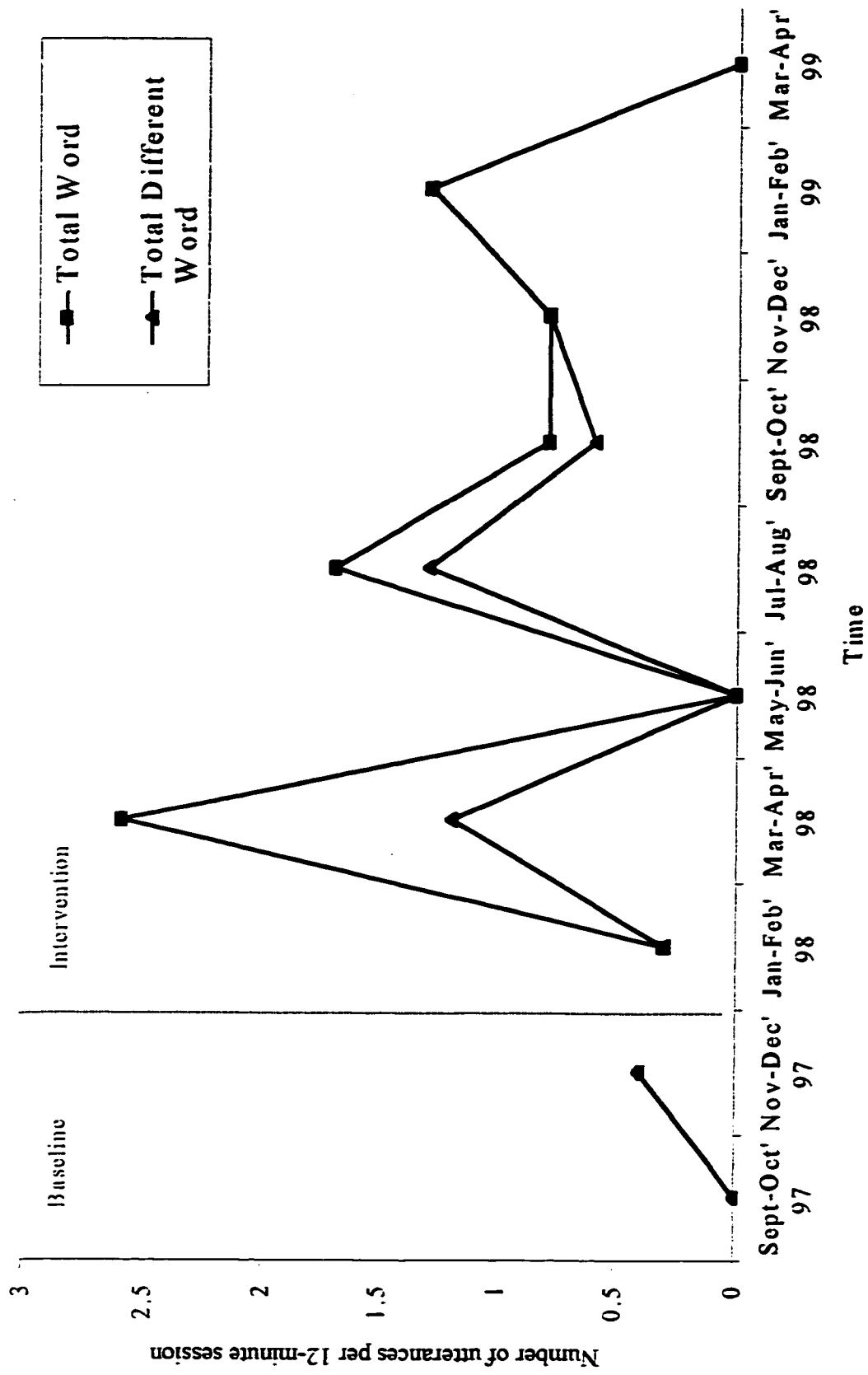


Figure 1. Mean number of total words and total different words produced bi-monthly per 12-minute session.

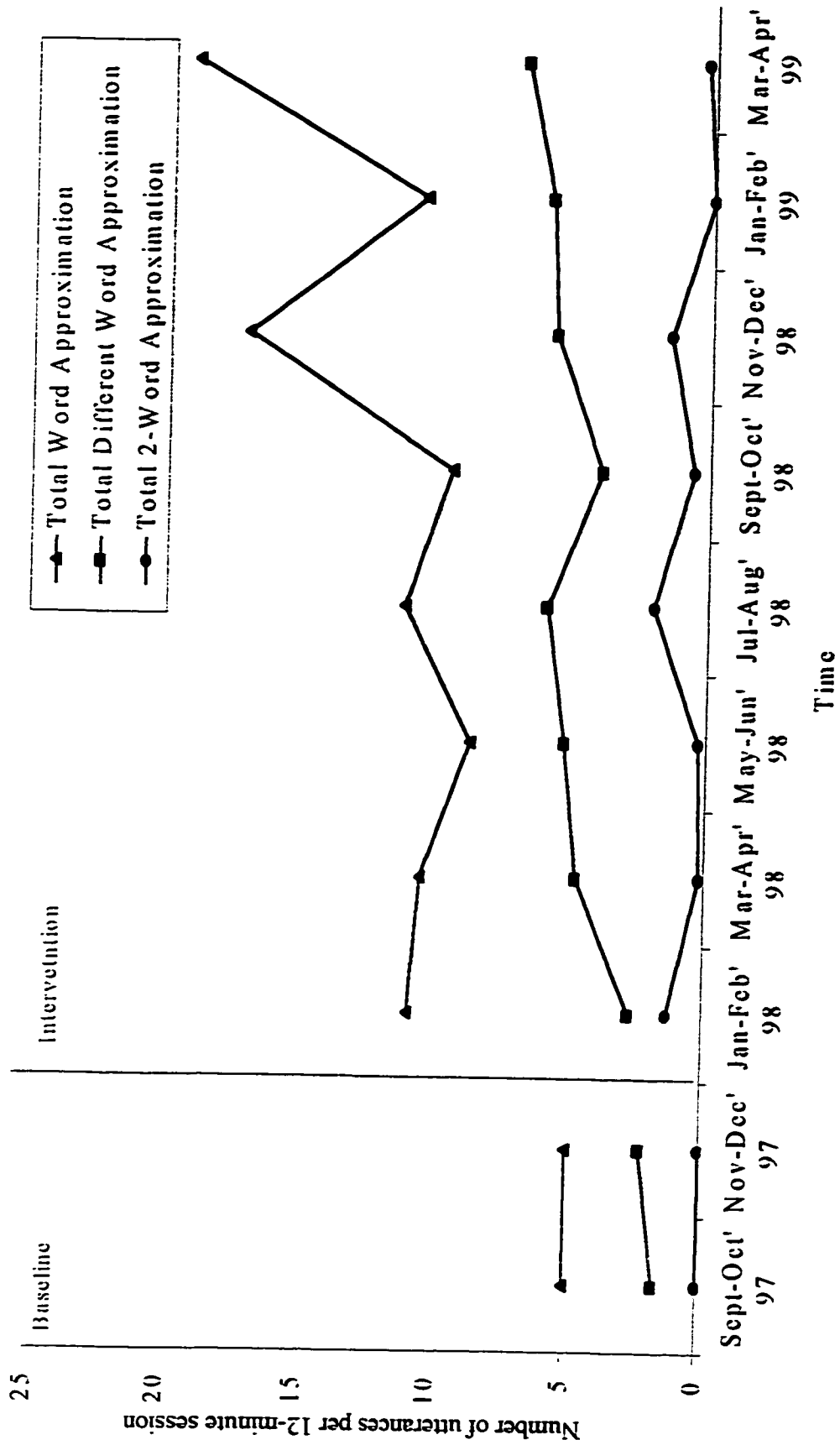


Figure 2. Mean number of total word approximations, total different word approximations, and total two-word approximations produced bi-monthly per 12-minute session.

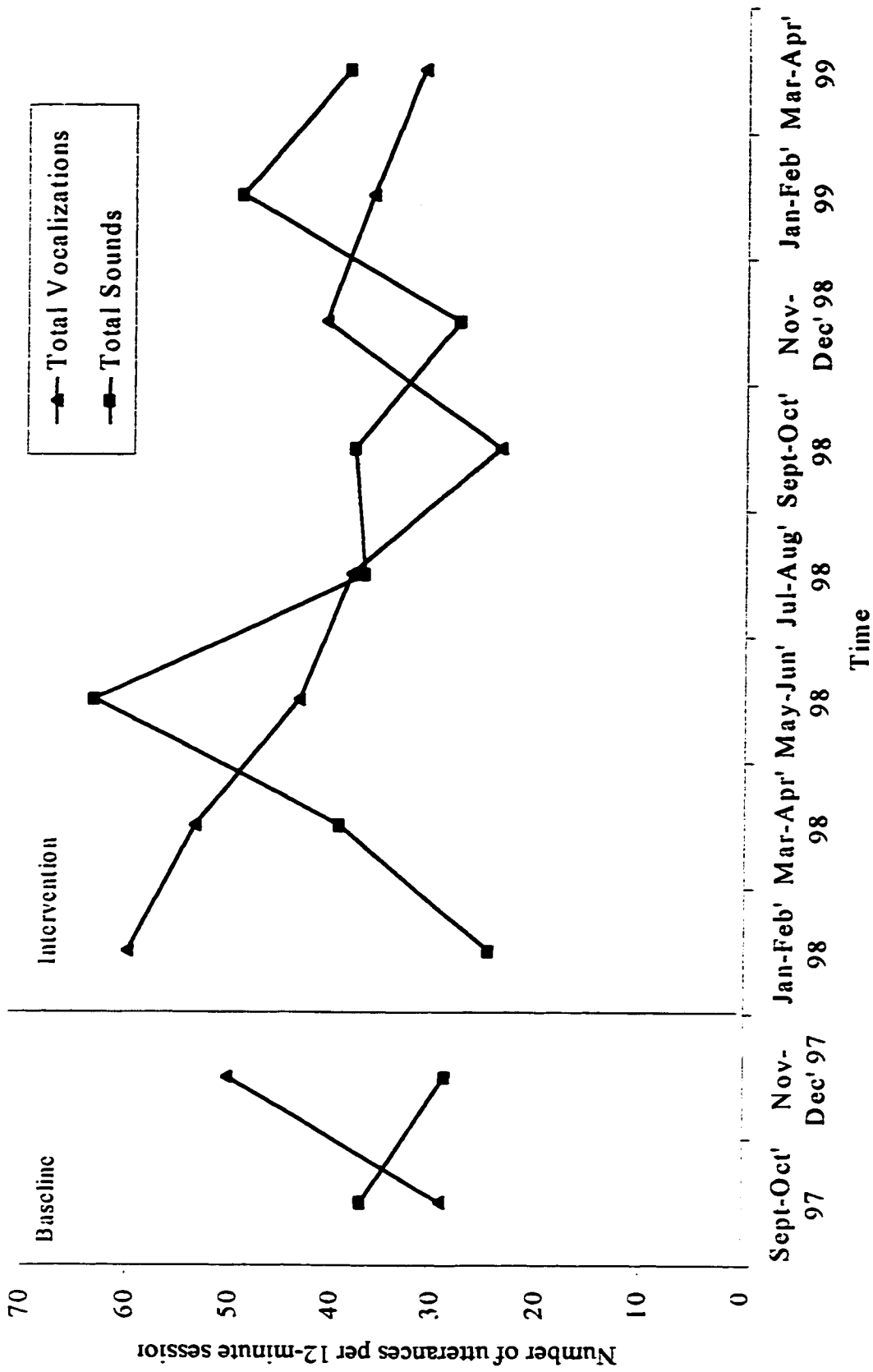


Figure 3. Mean number of total vocalizations and total sounds produced bi-monthly per 12-minute session.

Analysis of Measures of Mental Development

Pre-treatment

At 14 years, 10 months of age, an independent psychologist assessed the participant's general level of cognitive functioning. The assessment was based on the use of a number of different instruments, such as the Peabody Picture Vocabulary Test, the Griffiths Mental Development scales, and the Vineland Adaptive behavior Scales, and observation sessions. Due to the participant's limited attention and communication skills, and behavior problems, no formal testing was possible. However, the following conclusions were drawn.

The psychologist reported that the participant suffered from dyspraxia and that his difficulties were not due to sheer non-compliance. They were thought to be due to the inability to follow because he was overwhelmed, confused, could not focus, could not control his movements, and could not express himself. The participant's general level of functioning appeared to be at about 2 to 3 years of age, with visual memory being somewhat better. The participant's movements were clumsy and he could not bring both sides of his body to the midline. Particularly, sequences of movements were difficult for him.

During the assessment, the participant grabbed whatever was within his reach, made constant vocal sounds as if he was singing (i.e., vocalizations), and rocked himself. He tended to adequately use the objects that he encountered, but quickly lost interest and then either dropped them to get another one or just manipulated them at random. As soon as the participant encountered minimal difficulty, he abandoned the object and reached for another. His attention span was said to be no more than a few seconds.

When he tried to imitate speech, only remote approximations were uttered. The participant seemed to understand simple, contextual instructions when they were accompanied by gestures. The participant himself gestured to communicate with others. He still did not identify the genders consistently, could not make comparisons among objects other than bigger/smaller, and did not identify the colours. He could not complete a six-piece inset puzzle, could not inhibit motor responses sufficiently to imitate lines, had simple pretend skills, and imitated inconsistently. He could not attend more than briefly, could not occupy himself and needed constant supervision, and was dependent for dressing/undressing and other daily life routines.

It was concluded then that the participant's main difficulty was his dyspraxia and short attention span, rather than his compliance. It seemed that anything that taxed his ability to attend led to random responses and frustration.

Post-treatment

Two years later at 17 years and 1 month of age, the participant was re-assessed by the same psychologist. The psychologist's conclusions were based on two conventional tests of mental development, that is, the Griffiths Mental development Scales and the Vineland Adaptive Behavior Scales.

The participant obtained a mental age of 24.4 months on the Griffiths Mental Development Scales, while his chronological age was 17 years. This resulted in a general cognitive index situated in the "Profound" range of mental deficiency. These results were further supported by his performance on the Vineland Adaptive Behavior Scales. Thus, the gains achieved over the 20-month intervention period were not sufficiently robust to be reflected on conventional assessments of mental development.

With respect to language, he was found to gesture to communicate simple needs as well as to indicate the function of several familiar objects (e.g., brush, pencil, car, and hammer). The participant did not identify the colours and had not acquired simple verbal concepts pertaining to size, length, height, or weight. He had not acquired the concepts of number, time, or money. The participant did not know the letters and could not identify common signs (e.g., toilet, stop, and fire). However, he followed simple instructions requiring a sequence of actions (e.g., get up and open the door). The participant used a communication board although frequently in a random manner.

Regarding eye-hand co-ordination, the participant was able to build a tower of eight blocks and to use scissors to cut paper. He still had difficulty with tasks that required bi-lateral co-ordination such as buttoning/unbuttoning, threading, and using a fork and knife simultaneously. For non-verbal reasoning tasks, the participant used a trial and error approach to problem solving. He became confused when more than three stimuli were present. Also, he did not imitate simple spatial constructions, did not group according to colour, and had difficulty with figure-ground puzzles. Finally, with respect to self-knowledge, the participant was able to identify the major body parts and knew his name. He identified the genders, but did not know his own.

Clinical observations revealed that the participant's on-task behavior improved dramatically and that he was able to remain seated for a long period. When the demands of the task taxed his competence, he would abandon the task and turn his face away. However, it was not difficult to regain the participant's attention to the task at hand. Compared to the pre-treatment assessment, the participant did not constantly produce vocal sounds (i.e., vocalizations) and he did not rock himself. He was found to control

his impulses much better and it did not seem difficult for him to wait for instructions with minimal prompts. In addition, he did not require that the instructions be accompanied by gestures for him to understand them. It was also reported that his language comprehension skills significantly improved and that he was more attentive to verbal messages. His oral expressive skills were found to have improved but not to a meaningful degree such that he became autonomous. He was found to imitate readily and eager to co-operate when the demand was understood and within his competence. Thus, despite the lack of progress as measured by conventional tests of mental development, the participant did nonetheless improve with respect to certain skills.

Clinical observations by the psychologist during the assessment revealed some crucial improvements with respect to certain cognitive skills and behaviors. Improvements such as increased attention to task, increased impulse control, increased language comprehension, and increased attention and compliance to verbal instructions, serve as prerequisites if cognitive gains are to be achieved (Zelazo, 1997a). Therefore, although cognitive gains have not yet been achieved to the extent that they are apparent on conventional tests, the prerequisites for cognitive gains to occur appear to have been instilled.

DISCUSSION

Assessment of Research Goals

This case study sheds light upon 1) the issue of a critical period for language acquisition and 2) the quality of language development beyond the critical period for individuals with intellectual disorders. These findings add to the body of literature regarding critical periods for first language acquisition and the literature concerning

language development in individuals with intellectual disorders. In addition, the study assesses 3) the effectiveness of the parent-implemented cognitive-behavioral treatment program (Zelazo et al., 1984) in producing increased scores on conventional tests of mental ability and 4) the clinical utility of using the treatment program with an adolescent with an intellectual disorder.

The first two aims of the study will be discussed first. After almost two years of intensive cognitive-behavioral intervention, the participant acquired a few words and many different word approximations, which he spontaneously used in appropriate contexts. Visual inspection indicated that the participant's rate of performance on the production of word approximations gradually increased over time. In addition to the single words and word approximations, a number of different two- and three-word approximations were spontaneously generated and used appropriately by the participant. Finally, over time, the participant showed a decrease in the rate of vocalization production and an increase in the rate of production of sounds appropriate to the French language.

Overall then, the findings suggest the beginning of the use of verbal communication for an individual with an intellectual disorder who is beyond the critical period for language acquisition. These findings are consistent with the literature on language acquisition and the notion of the critical period (Fromkin et al., 1974; Curtiss, 1977; Johnson & Newport, 1989; Newport, 1990; Johnson & Newport, 1991; Mayberry & Eichen, 1991; Mayberry, 1993; Windsor et al., 1994; Neville et al., 1997; Reid et al., 1997; Grimshaw et al., 1998). The research literature presented earlier showed that for language (i.e., spoken or sign language) to develop *normally*, persons needed to be

exposed to it early in life. If for some reason language was not acquired early in life, it was seen that it became increasingly difficult to learn the language as native speakers had learned it. Therefore, it was possible for persons beyond the critical period to acquire language, although to a different degree than native speakers. Thus, it was suggested that Lenneberg's (1967) critical period hypothesis for language acquisition be modified. Lenneberg's hypothesis stated that no language acquisition was possible beyond puberty, however, research has shown that some form of communication is possible. Perhaps late learners of a language will never master the language to the degree that the native learner has, however, linguistic communication with late learners will still be possible.

The present case study adds to the literature on language acquisition and the critical period and supports the need to modify Lenneberg's hypothesis. The adolescent in this study displayed the ability to retrieve a range of sounds and combine these sounds into words and word approximations at an age well beyond puberty. In addition to combining sounds, he also spontaneously generated two- and three-word phrases with the appropriate word order to communicate his needs. It was also found that the participant's skills generalized to numerous different contexts. The participant used his newly acquired words, word approximations, and multi-word approximation utterances to describe situations and to communicate his needs during teaching sessions as well as in the home and the school context. For example, he would say an approximation for "papa" (i.e., "daddy" in French) in the presence of his dad or ask for juice by approximating the phrase "boit jus" (i.e., "drink juice" in French).

As it pertains to the third and fourth aims of the study, it was found that the participant's gains were not powerful enough to produce increased scores on

conventional tests of mental development. However, clinical observations by the psychologist during the post-treatment assessment revealed some crucial improvements with respect to certain cognitive skills and behaviors. These point to the clinical utility of using the parent-implemented cognitive-behavioral treatment program (Zelazo et al., 1984). Improvements such as increased attention to task, increased impulse control, increased language comprehension, and increased attention and compliance to verbal instructions, serve as prerequisites if cognitive gains are to be achieved (Zelazo, 1997a). Therefore, although cognitive gains have not yet been achieved to the extent that they are apparent on conventional tests, the prerequisites for cognitive gains to occur appear to have been instilled. Thus, the clinical utility of the treatment program with adolescents has implications for the way in which intellectual disorders are conceptualized. That is, the limitations imposed on an individual by their intellectual disorder may slowly be overcome with proper intervention. Thus, this study provides professionals and parents of individuals with intellectual disorders with new means in which to promote their patients/children development. The parent-implemented cognitive-treatment program was shown to be effective in promoting key skills (e.g., increased attention to task, increased impulse control, increased language comprehension, and increased attention and compliance to verbal instructions) necessary for further mental development.

Limitations and Future Directions

In reviewing the clinical data, a number of extraneous variables, potentially affecting the outcome of the study, become apparent. These include 1) the effects of parental teaching ability on treatment outcome; 2) the effects of parental expectancy and

motivation on treatment outcome; and 3) the effects of lack of consistency in carrying out the treatment program.

Parental Teaching Ability

Parental teaching ability or teaching style may influence a child's performance on subsequent tasks. Williamson and Silvern (1986) found that children of directive parents (i.e., parents who tended to move at their own adult pace and allowed children very little input to the learning/teaching process) performed best on a generalization task compared to children of facilitative parents (i.e., parents who seemed comfortable with proceeding at their child's ability level and encouraged their children to take the initiative). In addition, it was found that encouraging parents to proceed at the child's pace (i.e., be more facilitative) did not influence the degree of directiveness in the teaching situation. Thus, it appears that parental teaching styles are difficult to alter. In terms of the present study then, parental teaching style may have influenced the child's learning. Parental teaching style or ability was not measured, and therefore any negative results might be attributed to the ineffectiveness of the parent in implementing the treatment program and not as an indication of the participant's inability to acquire language. Although parental teaching ability was not directly measured, weekly meetings with professionals trained in the treatment program ensured that therapy was properly implemented. Nevertheless, negative results must be interpreted carefully. For future research, then it may be useful to measure parent teaching ability and determine the effects of different parental teaching abilities or style on treatment outcome. Furthermore, methods designed to increase the effectiveness of implementing the program might be worthwhile.

Parental Expectancy and Motivation

As reported in a previous section, the participant had been assessed by a number of different individuals and had been involved in a number of different treatment programs. The lack of progress in the participant over time may have led his parents to develop negative expectations of the participant ever progressing. In turn, these expectations may have influenced parental commitment to implementing the two components (i.e., the teaching sessions and generalization of the learned material) of the treatment program adequately. This, in turn, may have influenced treatment outcome.

Numerous studies have investigated the impact of pre-treatment expectancies and found a positive relation between favourable expectancies and final treatment outcome (Bowden, Schoenfeld, & Adams, 1980; Collins & Hyer, 1886; Wilkins, 1973; as cited in Wass & Anderson, 1991). Research in domains such as the treatment of social phobia has shown that expectancy for positive treatment outcomes predicted improvement (Safren & Heimberg, 1997). Furthermore, the research literature on the relationship between outcome expectancy and treatment acceptability (i.e., the extent to which an intervention is perceived as appropriate, fair, and reasonable) (Wass & Anderson, 1991) is relevant to this study. Wass and Anderson found that outcome expectancy and treatment acceptability were related constructs and that they influence commitment to treatment and treatment efficacy. Therefore, it seems appropriate to consider an individual's outcome expectancy and their evaluations of acceptability when implementing a treatment program.

Another factor that may have influenced treatment outcome was parental motivation. A study conducted by Moxley-Haegert and Serbin (1983) found that receiving developmental education enabled parents to discriminate small developmental

gains, thus keeping them motivated to continue working with their children. They found that the children whose parents received developmental education gained a greater number of skills, and that their parents participated more in the assigned home treatment.

In terms of the present study then, the extremely slow nature of the participant's progress (perhaps due to his age) may have made it difficult for his parents to discriminate the small, yet valuable gains. Therefore, high parental motivation may have been difficult to maintain throughout the intervention period. This may have led them to conduct less than the required number of weekly sessions (i.e., 5 of 7 days) and to be less adamant about carrying out systematic generalization of the material learned during the teaching sessions. Furthermore, the effects of lowered motivation on treatment outcome may have been compounded by the potential negative expectancy for treatment outcome. Therefore, both parental expectancy and parental motivation may have influenced the degree of involvement or commitment to the treatment program, which in turn affected the outcome of the treatment.

In the therapeutic setting then the importance of gauging parental expectancy of outcome and parental motivation should not be undermined. Both these factors may lead to less effective implementation of the treatment program. Furthermore, the value of dispensing more developmental education (i.e., in addition to the information received during clinical meetings and that obtained through the treatment program manual) to parents might be considered. In terms of research, it may be useful to measure parental expectancy and motivation in order to rule out their effects when drawing conclusions about the efficacy of the treatment.

Lack of Consistency

The final factor possibly affecting the outcome of the study may have been the lack of consistency among the participant's various environments. Throughout the intervention period, the participant attended a local school for special needs children and received private tutoring at home by various educators. The clinical data obtained during the bi-weekly meetings suggested that these different environments might not have been consistent with the treatment program, thus compromising the outcome of the treatment. Being consistent across the different environments means that every individual working with the participant needed to have similar expectations of the participant. For example, once the participant acquired a word or word approximation for an object he should have been expected to use this utterance from then on to require the object. In addition to having similar expectations, the participant's academic tasks should have been graded accordingly. Thus, the difficulty of the tasks employed in the school and home environment should have followed a developmentally appropriate sequence and the participant's progress in the tasks should have prompted the educators to increase the difficulty of the tasks. For example, at the beginning of the intervention period, the participant learned to solve simple insert puzzles (6-8 pieces), followed by more complex insert puzzles (20-25 pieces). Once he mastered these, the participant was introduced to jigsaw puzzles and learned to complete one with 6 pieces. The next step would have been to increase the complexity of the jigsaw puzzles that the participant worked on. Therefore, the task demands and the educator's expectations of the participant constantly changed as the participant progressed from one level of complexity to the next. The notion that the individuals in the school and the home environments may not have held

the same expectations of the participant may have influenced the outcome of the treatment.

Attempts to involve the school personnel and the home tutors were made, however, these attempts were met with some resistance. With respect to the school environment, one meeting took place during the eighth month of treatment, in order to discuss the participant's development. The meeting was initiated by the participant's social worker and mother, due to some concerns about the lack of change in the participant's educational plan over a number of years. Those who attended the meeting included the school staff (i.e., teacher, principal, vice-principal, psychologist and speech therapist), the team from the Montreal Children's Hospital (i.e., psychologist, clinical assistant, and investigator) and the participant's in-home consultant and social worker. Thus, the team from the Montreal Children's Hospital expressed their belief that the participant was capable of further development, while this was countered by the school's views that the participant was going to remain as he was and that his parents should accept him as such. Nonetheless, suggestions for the teachers were provided such that the participant should be exposed to tasks that were more cognitively oriented (e.g., puzzles, grouping tasks according to various categories such as size, colour, and shape) and that involved more fine motor co-ordination (e.g., threading beads, cutting). In addition, it was recommended that the participant's word approximations be generalized to the school environment. A list was provided to the staff members and they were to expect that the participant use them in order to receive the item.

First, as it pertains to the generalization of the participant's word approximations to the school context, it was reported by the participant's mother and one particular home

tutor, that the teachers were asking the participant to use some language. The extent of the demands, however, was difficult to determine. Second, follow-up meetings were suggested by school personnel, however, the Montreal Children's Hospital team was never contacted to schedule them. Judging from the lack of enthusiasm that was observed in the school staff with regards to the participant's development, it was thus felt that it would be too complicated to supervise the school's activities with the participant. Therefore, instruction with regards to functional activities was provided for the home tutors.

With respect to the home tutors, it was common for them to attend the bi-weekly clinical meetings and for them to be present during the home visits, thus it was easier to discuss the participant's developmental targets with them. Developmentally appropriate activities in order to facilitate cognitive development and increase compliance to various tasks were recommended and explained. These activities included gross motor (e.g., throwing, rolling, kicking a ball) and fine motor (e.g., threading beads, colouring within margins, cutting, and tracing shapes and letters) tasks. Cognitive tasks such as solving puzzles, sorting by categories (e.g., colour, shape, and size), and continuing a pattern or sequence (e.g., placing a red peg, then a blue peg, red, blue, etc.) were also suggested. Finally, the tutors were also advised to generalize the participant's word approximations to other contexts such as snack time (e.g., What are you eating/drinking?), during baths (e.g., What are you washing?), and while watching television/movies or during an outing (e.g., What did you just see?).

In terms of generalizing the participant's words and word approximations, it was reported and observed during home visits, that the participant was required to, and did in

fact, verbally communicate his intentions or needs. Second, although the home tutors reported that they practised many of the activities recommended it appeared that they worked on the tasks in a haphazard fashion. For example, if it was a nice evening for a walk, it was reported during the bi-weekly meetings and/or during the home visit, that the tutor would opt to walk for a long period rather than walk some and work some. Another example that was reported was that if the participant had been on an outing that day, it was assumed he was too tired to work, and an extended evening of television viewing and lounging around would ensure. These examples indicate that the activities that were suggested were not seen as being a priority. The opportunity to pursue extracurricular activities is not being dismissed here, however, a closer attention to the degree of cognitive tasks that the participant was involved with would have optimized his development. Therefore, it appears that the participant was never flooded with developmentally appropriate tasks in either the home or school context. This may have affected the participant's lack of numeric improvement on conventional tests of mental development.

These events allude to the importance of keeping the lines of communication among the different bodies working with children or adolescents wide open. The present study suggests that increased gains could have been achieved if the school, home, and therapeutic settings were in sync with respect to the participant's developmental targets. Thus, in future endeavours the value of communicating with all those involved with the child or adolescent should be exhausted.

Limitations and Advantages of the Case Study Method

Case studies have been criticised on a number of issues (McKinley-Runyan, 1982). First, they've been criticised for having low predictive validity. That is, it is difficult to rule out competing causal explanations for the observed phenomenon with case studies. In addition, case studies are also seen as having low external validity, such that it is difficult to generalize findings from single-case research to the rest of the population.

A number of measures were taken, however, to maximize the internal and external validity of the findings (Gall, Borg, & Gall, 1996; Merriam, 1988). In terms of internal validity, multiple sources of data were collected, such as the behavioral measures and the measures of mental development, and a number of individuals participated in gathering the data (e.g., the principal investigator, the independent psychologist, and the individual responsible for inter-reliability). The second check on internal validity was the fact that the behavioral data used in the study was gathered over a long period of time and over many different observation days. The third strategy used to ensure internal validity was to conduct peer examination whereby colleagues commented on the findings as they emerged (e.g., during the clinical meetings).

Measures were also taken to warrant some generalizations of the findings to similar cases (Gall, Borg, & Gall, 1996; Merriam, 1988). In order to help determine the applicability of the findings reported, to other cases, a detailed description of the participant's background and the context of the intervention process was included. Thus, comparisons between the present case and other cases may take place. However, until the sample of children studied increases, this study only suggests the possibility of teaching

children, who are at the end of the critical period for language acquisition, expressive language skills.

A number of advantages emerge from using single-case research designs (Franklin, Allison, & Gorman, 1996), and the case study method. First single-case designs and case studies allow researchers to study the process of change rather than simply the magnitude of change. By taking many measurements over time and being descriptive in reporting change, the researcher can assess dynamic aspects of change over time. The present study allowed us a glimpse at the developmental pattern in language learning. The participant first acquired sounds, then single word approximations. He later combined these in two- and three-word approximations. This pattern is typical in normally developing children. Second, single-case designs allow researchers to assess, in detail, the effectiveness of intervention programs for particular individuals and their respective situations. They are useful for describing individual experiences, for developing ideographic interpretations of that experience, and for developing context-specific prediction, plans, and decisions (McKinley-Runyan, 1982). Finally, single-case designs can be useful in the early stages of group research as a means of generating pilot data (Franklin et al., 1996). As such, the detail included in the present report allowed for the development of tentative hypotheses or suggestions that might help structure future research, thus advancing the field's knowledge base.

CONCLUSION

Colombo (1982) suggested that the idea of a critical period for language acquisition is not discredited in the face of interventions that facilitate language in

individuals beyond puberty. He provides the following analogy to support his view.

Suppose the

“application of some substance during a period of fetal development produces a heart defect that can be corrected by later surgery. The fact that his intervention produced recovery from critical period exposure to this substance does not refute the existence of a critical period during some late fetal period in which the organism is vulnerable to the substance” (p. 270).

Therefore, according to Colombo the fact that some later special intervention produces recovery is irrelevant as to whether a critical period exists or not.

This study shows that it is not irrelevant. The concept of a critical period for language development has educational and clinical implications for those who work with children with developmental disabilities. Since some verbal communication does take place after puberty, the usefulness of the concept of a critical period for language acquisition comes into question. The idea of a critical period for language acquisition might lead educators and clinicians to prematurely draw conclusions about an individual’s developmental potential. That is, the concept places constraints and limitations on children and adolescents with developmental difficulties because the adults surrounding these individuals cease to have expectations concerning their development as they approach the so-called critical period. Previous research studies have shown that some language acquisition is possible beyond puberty. In addition, the present study also suggests that verbal communication may be established with an adolescent beyond the critical period. Therefore, perhaps the whole concept of a critical period for language acquisition should be challenged. That is, is the concept of a critical period for language

acquisition a beneficial or detrimental way of conceptualizing one's developmental potential. It is argued that the concept is in fact detrimental because it limits individuals with developmental disabilities approaching puberty, such that clinicians, teachers, and parents lower their expectations for these individuals. In turn, fewer developmental gains are achieved.

Overall, then, the present study has shown the acquisition of some language in an adolescent with an intellectual disorder using a very directive, and intensive, parent-implemented, cognitive-behavioral treatment program. After two years of treatment, the adolescent gained a few words, many different word approximations, and some two- and three-word approximations, which he spontaneously used in appropriate contexts. Finally, over time the adolescent showed a decrease in the random vocalizations produced and an increase in the rate of productions of sounds appropriate to the French language.

What remains to be seen now is the extent that the adolescent will retain the words that he acquired if his parents decide to terminate treatment or the extent that he will further develop linguistically with continued treatment. The notion of parental teaching ability, parental expectancy and motivation, and the need for increased communication among the different professionals working with an individual should be further explored. It was observed that the adolescent verbally communicated his intentions or needs in different contexts (e.g., during teaching sessions at the Montreal Children's Hospital and at home, during snack and meal times, during bath taking, and when on outings). This suggests that rote memorization of certain speech sounds in only one context did not occur. The adolescent displayed the ability to be flexible and apply

his knowledge in different situations. Thus, it appears that some essential skills (i.e., the ability to spontaneously generate and generalize utterances to different contexts) have been learned. However, the extent of this individual's linguistic development, with or without continued treatment, remains to be seen.

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Appendix A
Illustration of Teaching Session

Illustration of Teaching Session
(Zelazo et al., 1984, p. 53)

David and his mother sit at a table, while father sits across the room writing down what David says. David's mother is teaching him to name body parts. She begins the warm-up phase by rehearsing the parts of the body that David knows well, and proceeds to the working phase by teaching the names that David does not know.

- Mother: (Points to her nose.) "Nose. David, say nose."
David: "Noh."
Mother: "Good, David. You said nose." (Mother smiles and gives David a chocolate chip. Father writes down *noh* during minute 3 on the recording sheet.)
- Mother: (Points to her nose again.) "Nose. David, say nose."
David: "Nose."
Mother: "Good, David. You said nose." (Mother smiles and gives David another chocolate chip. This time father writes down *nose* during minute 3 on the recording sheet.)
- Mother: (Shows David a doll and points to its nose.) "Say nose."
David: "Nose."
Mother: "Good, David." (She smiles, gives David a chocolate chip and father Records his response - *nose*.)

David's mother finished the session by rehearsing both the new words that he learned and the old words that he knew previously.

Appendix B

Illustration of Effective Use of rewards

Illustration of Effective Use of Rewards
(Zelazo et al., 1984, p. 60)

Leslie's mother is teaching her to say the word "ball".

Mother: (Holds up a ball and points to it.) "Leslie, say ball."
Leslie: "Mm."
Mother: (Does not reward Leslie.) "Ball. Ball. Leslie, say ball."
Leslie: "Buh."
Mother: (Rewards Leslie by placing a raisin in her mouth as she praises her.)
"Good girl. You said ball."
Leslie: "Buh."
Mother: (Rewards Leslie by giving her another raisin as she praises her.)
"Good girl. You said ball. Leslie, say ball."
Leslie: "Ball."
Mother: (Rewards Leslie again. This time, mother gives Leslie a hug as she
praises her, gives her a raisin, and lets her throw the ball.)
"Yeah Leslie! You said ball!"

Leslie's mother did not reward her for saying "Mm", because it was too different from the target word "Ball". Not receiving the reward was an indication that the response was incorrect and motivated Leslie to try again.

Appendix C

Use of Rewards and Intrinsic Motivation

Use of Rewards and Intrinsic Motivation

Deci (1995) points out that rewards may increase the likelihood of behaviors, but only so long as the rewards keep coming. He notes that behavioral theory assumes that there is no inherent motivation to learn, however, he also points out that children ceaselessly explore and manipulate the objects they encounter. Therefore, children are not passively waiting to be drawn into learning by the power of rewards, but rather they are actively engaged in the process of learning. They are said then, to be intrinsically motivated to learn. This means that they engage in activities for its own sake, not for extrinsic reasons.

Deci (1971; as cited in Deci, 1995) studied the effects of receiving an extrinsic reward for doing an activity that was previously done willingly without the reward on participant's intrinsic motivation. The participants in the study were to solve block puzzles and either received a monetary reward for completing a certain number of them or did not receive a reward. Indeed, Deci found that those students who had been rewarded monetarily for doing the puzzles were far less likely to play with them "just for fun" in the free-choice period.

The impact of a reward should depend on how the person receiving it interprets it (Deci, 1995). If the reward is perceived as a form of control, then intrinsic motivation is undermined. Thus it was suggested that if instead of having the intention to control, the person administering them intends them as acknowledgement of good work it is possible that the receiver will not experience the reward as controlling, and so the reward should not undermine intrinsic motivation. Rewards should be merely used to acknowledge a

job well done or to signify appreciation. The more they are used as motivators are however, the more likely it is that they will have negative effects.

The problem then, according to Deci, is in the use of reward structures to motivate something that could be made exciting in its own right.

Now, the treatment program described in *Learning to Speak* (Zelazo et al., 1984) is consistent with this line of thought. When a child receives a reward, it is an indication that he/she produced the correct utterance or performed an action well. It is not suggested that the educator use the reward as a bribe in order to elicit more responses, but that it is used to show the child that he/she is on the right track. In addition, to receiving an edible, the educator is encouraged to praise the child and to allow the child to use the object he/she named, talked about, etc.

The use of extrinsic rewards is especially important with children with developmental delays and autism because they are not intrinsically motivated to learn. They are not motivated to play, speak, and interact with others appropriately. Furthermore, these children will not develop or catch up to their peers spontaneously if left without formal teaching (Zelazo, 1997a). These skills are fundamental to becoming an independent member of society.

It is hoped that initially providing an extrinsic reward for an activity (e.g., playing, speaking, etc.) that is not already an intrinsically valued activity for the child, will result in the child eventually becoming intrinsically motivated to perform the task. For example, if a child is not interested in playing with puzzles, rewarding the child for completing it will motivate him/her to play with it again, until eventually completing the puzzle for its own intrinsic value will motivate the child to pick one up and play with it.

With respect to language, rewarding the child with an edible and praise, for using words to ask for what he/she wants, will result in the child becoming intrinsically motivated to use the language that has been acquired.

Another aspect of the treatment program that guards against the child becoming dependent on the extrinsic reward for performing a particular task is the fact that the developmental targets that the child is working at are constantly updated and therefore change. For example, the child who can not complete an insert will first be rewarded for completing part of it, then be rewarded for completing all of it. Finally, when he/she has mastered the task, he/she will be rewarded for completing part of a jigsaw puzzle and no longer be rewarded for solving insert puzzles. The same procedure applies to language. The child who is initially rewarded for saying one word will no longer be rewarded for saying that one word when he/she has learned to say a two- or three-word phrase.

In order to assure then that intrinsic motivation is not undermined and that the child does not become dependent on extrinsic rewards for performing, the extrinsic reward should not be made salient, rather it should be discrete. Furthermore, it should not be used to bribe the child into performing. The rewards should be used to show the child that he/she is doing or has done a good job.

Appendix D

Illustration of Generating Spontaneous Language

Illustration of Generating Spontaneous Language
(Zelazo et al., 1984, p. 98)

Jonathan's mother chose objects that he could recognize and imitate. She chose a cup and a ball, but put the ball aside for the moment.

Mother: (Holds the cup in front of Jonathan.) "Jonathan. What's this?"
Jonathan: (Reaches for the cup, but says nothing.)
Mother: (Holds the cup in front of Jonathan, but out of reach.) "Jonathan. What's this?"
Jonathan: (Still says nothing.)
Mother: "Cup. Jonathan, say cup."
Jonathan: "Cup."
Mother: "Good boy, Jonathan." (Places a raisin in his mouth.) "Cup, Jonathan."
Jonathan: "Cup." (Reaches for the cup.)
Mother: "Good, Jonathan. This is a cup" (Places a raisin in his mouth.) "What's this? (Holds the cup in front of Jonathan.)
Jonathan: "Cup." (Reaches for the cup again.)
Mother: "Excellent. This is a cup" (This time she gives the cup to Jonathan and places a raisin in it while he holds the cup.)
Jonathan: (Takes the raisin out, eats it, and holds the cup by the handle.)
Mother: (Gently removes the cup and holds it up.) "What's this?"
Jonathan: "Cup."
Mother: "Good boy." (Holds the cup again.) "What's this?"
Jonathan: "Cup." (Reaches for the cup.)
Mother: "Excellent." (Gives Jonathan the cup and places a raisin in his mouth.)

Jonathan's mother then put the cup away, and repeated the same procedure with the ball until Jonathan could say "Ball" spontaneously when asked "What's this?". Next, Jonathan's mother alternated between the cup and the ball. If any of Jonathan's answers were wrong, his mother would have prompted the correct answer and repeated the questions until a correct answer was produced spontaneously.

Appendix E
Parent Consent Form

**Concordia University
Education Department**

**Montreal Children's Hospital - McGill University
Psychology Department**

**Parent Consent Form
Parent-Implemented Cognitive-Behavioral Treatment Program
Philip R. Zelazo, PhD**

Name of Child: _____

The above-mentioned treatment program involves the following:

- 1) 12 minutes of parent-implemented treatment sessions conducted at least five days of seven.
- 2) Weekly, one-hour meetings with parents, child and therapist for the first three months of treatment and bi-weekly meetings thereafter.
- 3) Therapist-implemented and parent-implemented sessions taking place during the meeting will be videotaped.
- 4) Agreement to proceed with treatment for at least 3 months.

I understand that my identity and my child's identity will be kept strictly confidential. I am willing to let my child's birth and medical records to be examined so that information relevant to this study may be used. The videotaped recordings of my child will only be viewed by members of Dr. Zelazo's clinical-research team for coding purposes (unless otherwise specified). I give consent for my child's results to be used for publication pertaining to the study.

I have read and understood the description of the treatment program and agree to receive treatment under these conditions. My child's participation in the study is totally voluntary and I am free to stop participating at any time.

Date: _____

Signed: _____
Parent

Signed: _____
Investigator

Signed: _____
Head, Dept. of Psychology

Appendix F
Coding Scheme and Coding Form

Words, Word Approximations, Sounds, and Vocalizations

Word

A *word* is coded if all appropriate sounds comprising the word are heard distinctly.

Example: Teacher: "Say cookie"
 Child: "Cookie"

Word Approximation

A *word approximation* is coded if at least one syllable or a fraction of a syllable of the requested word is distinguishable. The syllable has to occur either at the beginning or at the end of the word.

Example: Teacher: "Say banana"
 Child: "Ba"

A word approximation is also coded when a fraction of a syllable that makes up the beginning or end of the word is said.

Example: Teacher: "Say ball"
 Child: "Al"

A word approximation must be syllable in length, but cannot be a single letter as in the following example.

Example: Teacher: "Say lemon"
 Child: "Ll"

For single syllable words, a word approximation is coded if the child produces at least a fraction of the syllable.

Example: Teacher: "Dit nez"
 Child: "Ez"

Example: Teacher: "Dit lait"
 Child: "Ait"

For multi-syllabic words, the child must produce at least two of the sounds present in the word in order for it to be an approximation of the actual word.

Example: Teacher: "Dit maman"

Child: "Ah-ah"

Example: Teacher: "Dit avion"
Child: "Ah-on"

Sound

A *sound* includes any vowel, consonant or vowel-consonant combination from the language the child is being taught. A sound is not a reflexive reaction such as a burp, sneeze, cough, or grunt.

Example: Teacher: "Say ball"
Child: "Mo"

Example: Teacher: "Say lemon"
Child: "LI"

Example: Teacher: "Dit avion"
Child: "Ah"

Vocalization

A vocalization is coded if the child produces a series of random vocalizations, or humming.

Example: Child: "Eeeaaammaaaeee"

Imitative versus Spontaneous Utterances

Imitation

Imitation is coded when the child repeats a model verbatim, regardless of whether or not the child has been asked to say that word, word approximation, or vocalization.

Example: Teacher: "Say bus"
 Child: "Bus"

Example: Teacher: "This is a dog"
 Child: "Dog"

Example: Teacher: "Dit maman"
 Child: "Ah-ah"

Spontaneous

Spontaneous is coded for requests made by a child for a particular object or need.

Example: Child: "Juice"

Spontaneous is also coded when the teacher has modelled the requested response, which remains in the child's short-term memory (STM) and re-issues the request resulting in a spontaneous answer retrieved from the child's STM.

Example: Teacher: "What's this?"
 Child: no response
 Teacher: "Apple"
 Teacher: "What's this?"
 Child: "Apple"

Example: Teacher: "Say nose"
 Child: "Mouth"

Spontaneous is also coded when the response is generated from long-term memory.

Example: Teacher: "What's this?"
 Child: "Bus"

Example: Teacher: "How are you?"
 Child: "Fine"

Two-word Sequences and Beyond

Combinations of words and word approximations can be coded as follows:

Two-word Sequences

2 clear words
1 clear word & 1 word approximation

Example: Teacher: "Say boy run"
 Child: "Boy run"

Three-word Sequence

3 clear words
2 clear words & 1 word approximation

Example: Teacher: "Say girl read book"
 Child: "Girl rea book"

Four-word Sequences

4 clear words
3 clear words & 1 word approximation
2 clear words & 2 word approximations

Examples: Child: "Bo go upa slide"

Above Four-word Sequences

5 clear words
4 clear words & 1 word approximation
3 clear words & 2 word approximations

Example: Teacher: "Say man drive"
 Child: "Man drive to the store"

Language Reduction Coding Sheet

Name: _____ Date: _____ Tape: _____ Teacher: _____ Coder: _____

Min.	Spontaneous	Imitation
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

w: _____ wa: _____ s: _____

w: _____ wa: _____ s: _____

Total # of Words: _____

of dif. Words: _____

Total Word Approx: _____

of dif. Word Approx: _____

Total # of Sounds: _____

Total # of 2-Word Sequences: __ sp: __ im: __

Total # of 3-Word Sequences: __ sp: __ im: __

Total # of 4-Word Sequences+: __ sp: __ im: __