THE ACQUISITION OF GRAMMATICAL MORPHOLOGY
BY CHILDREN WHO ARE UNABLE TO SPEAK

by

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Abstract

Most augmentative and alternative (AAC) systems do not allow preliterate children to manipulate and select grammatical morphemes while producing language output. To determine if this lack of productive control impedes acquisition of grammatical morphology, the acquisition of three grammatical morphemes was explored in children who are nonspeaking. A picture-selection comprehension task and a grammaticality judgment task were given to 20 children who are nonspeaking and 20 typically developing children matched by age equivalent score on a test of content vocabulary comprehension. Children in the nonspeaking group exhibited significantly more difficulty on both these tasks than typically developing children at the same content vocabulary comprehension level. Literate children in both groups were also given a structured written output task. Children who are nonspeaking tended to omit grammatical morphemes in their written output, whereas children in the typical group tended to include them. To rule out the possibility that these findings would be seen in any group of children with low content vocabulary comprehension levels, regardless of their ability to speak, a group of 15 atypical speaking children with a similar mean chronological age and content vocabulary comprehension level was also given these tasks. The atypical speaking youngsters did not do as well as children in the typical group, but they did do better than the children in the nonspeaking group. Clinical and theoretical implications are discussed.
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This dissertation is dedicated to the memory of my father, Richard Joseph Blockberger (1928 - 1996), the best one-man fan club a person could ask for.
Some children, those with severe motor impairments due to cerebral palsy for example, are unable to speak despite having hearing and intellect adequate for the development of language. These children may be provided with augmentative and alternative communication (AAC) systems with which they are able to communicate. A typical AAC system for a preliterate nonspeaking child consists of a portable computerized device with synthesized or digitized voice output. To communicate, the child activates the device by selecting a picture or graphic symbol from an array on a "keyboard," thus causing the device to produce a spoken message.

AAC systems for preliterate children rarely provide opportunities for productive manipulation of grammatical morphemes such as possessive 's or past tense -ed. If individual morphemes are displayed on the AAC system, these are usually content words selected to maximize communicative power given the inevitable restrictions in vocabulary size. In addition to (or sometimes instead of) individual words, many AAC devices are preprogrammed with phrases in order to increase speed of output. Consider that if the child can select one keyboard location per second, the phrase "Can I have a turn?" would take 5 seconds to produce if each morpheme was stored separately. Unfortunately, this is so long as to limit usefulness in many social situations. A clinician will therefore often
store entire phrases such as this under one location on the computerized device, which enables the child to produce utterances in a more timely fashion. Although preliterate AAC users may have opportunities to produce prestored phrases which include grammatical morphemes, the productive manipulation and construction of utterances incorporating grammatical morphemes is usually not possible. Clinicians, charged with the responsibility of designing the AAC systems for young nonspeaking children, from time to time have wondered uneasily if this lack of productive control might negatively affect acquisition of grammatical morphemes (e.g., Nelson, 1992; Kraat, 1990).

In this dissertation I will explore the proposal that opportunities for productive manipulation and construction of language are important, particularly for the acquisition of grammatical morphology. I will suggest that production opportunities facilitate acquisition of grammatical morphemes by encouraging attention to these individual linguistic units and the rules governing their use and by enabling the child to test hypotheses about language segmentation and meaning. Following from this proposition I will test whether children who are nonspeaking and who do not have opportunities to produce grammatical morphemes exhibit relatively more difficulty in the mastery of this aspect of language.

In this first chapter, I will begin by situating my arguments within a theoretical orientation. After a brief discussion of the nature of grammatical morphemes, differences in the task of learning to comprehend language versus the task of learning to produce language will be considered, with respect to the impact on language acquisition in
general, and specifically with respect to the impact on acquisition of grammatical morphology. Consideration of the differences between these two types of language learning opportunities gives rise to predictions about grammatical morphology acquisition by children who are unable to speak. These predictions will be tested and results reported in subsequent chapters.

Theoretical Framework

Since the abandonment of behaviourism as an adequate explanation for language acquisition in the early 1960's, two broad theoretical perspectives have gained prominence. These are nativist theories (e.g., Chomsky, 1980; 1986; Pinker, 1994) and communication-based interactionist theories (e.g., Bates, Bretherton, & Snyder, 1988; Bates & MacWhinney, 1987; Bloom, 1993; Chapman, Streim, Crais, Salmon, Strand, & Negri, 1992; Clark, 1993). The nativist camp tends to emphasize the complexities of adult language and the imperfect nature of the linguistic input to young children, concluding that by and large the nature of language and the course of language acquisition are biologically determined. Those in the interactionist camp tend to focus on the child's cognitive construction of language, and on the interactive milieu and social functions of language acquisition. All but the most radical in both camps concede that both biological and environmental factors interact within the language acquisition process, but the two camps differ in the weight that they assign to these factors. The purpose of this research is not to test
these theoretical positions; rather it is to examine the impact of an atypical condition, the inability to speak, from within an interactionist theoretical orientation.

Like others who subscribe to an interactionist view, I presume that language acquisition is functionally driven by the communicative needs of the child, and that it involves active and interactive learning. Similarities in language acquisition patterns noted between individuals learning the same language, as well as generalizations about languages and language acquisition across languages, are presumed to be the result of two interacting sets of factors. These are (1) the broad similarities in the typical language learning opportunities afforded children and (2) similarities in the cognitive, perceptual, attentional, and motivational resources that children bring to these opportunities. Although characteristic patterns of language acquisition may be multidetermined and therefore quite robust, individual differences in child-intrinsic factors such as attention, memory, and motivation, and/or differences in language learning opportunities, such as care-givers' language input or interaction style, are presumed to cause some variability in patterns of language acquisition between children.

I will argue that the inability to speak is associated with differences in both child-intrinsic factors and language learning opportunities, differences that have a predictable impact on the course of language acquisition. Existing functional language acquisition theories have not considered this specific atypical situation. Instead, they have made predictions based on the usually reasonable and often unstated assumption that language
production is both an intrinsic motivational source and the ultimate goal of language acquisition. Furthermore, given that production is presumed to be the goal, productive measures are often employed as the measuring stick for success of learning. While these assumptions and measurement strategies are quite reasonable in almost every case, they obviously do not apply in the case of the child who is unable to speak, but who is nevertheless learning language. Therefore, although I situate myself within the interactionist camp, this work is not based on any specific interactionist theory. Rather, my hypotheses will be shown to derive from various interactionists’ perspectives on the probable processes and functions involved in language comprehension and production. These will be considered in terms of the implications for the child who is unable to speak.

Clinical Motivation

This work was first motivated by a clinical observation. Two children that I followed in my clinical practice were able to speak as preschoolers but, due to a degenerative condition, lost the ability to speak prior to developing written literacy skills. When these two children entered school and learned to produce text, I was impressed by the relative linguistic sophistication and grammaticality of their written communication. Specifically, these two children did not seem to exhibit the difficulty with grammatical morphology that I and others (e.g., Kelford Smith, Thurston, Light, Parnes & O'Keefe, 1989) had seen in the text output of children and adolescents who were congenitally nonspeaking.
Children who are unable to speak often have motor impairments, and as a result the production of written text is motorically difficult and time-consuming for them. Prior to my interactions with these two children, I had subscribed to a conventional clinical wisdom that omission of grammatical morphemes in the text output of nonspeaking children resulted from a strategy of producing telegraphic messages so as to conserve physical resources and/or to save time (von Tetzchner, 1985). This conventional explanation would have predicted that the two children described above would also omit grammatical morphemes. The fact that they did not led me to consider whether their unusual history, i.e. early experiences as language speakers followed by loss of the ability to speak, might have been a key difference. This in turn led me to consider the nature of grammatical morphemes, the nature of the language production task, and the impact that an inability to speak might have on child’s acquisition of grammatical morphology.

The Nature of Grammatical Morphemes

Grammatical morphemes are morphemes whose form is determined by their grammatical function. Most developmental studies of grammatical morphology has focussed on some or all of 14 grammatical morphemes originally selected for study by Brown (1973) and his colleagues. These included both free and bound morphemes.

Linguists traditionally distinguish between two types of bound morphemes, inflectional morphemes and derivational morphemes (Katamba, 1993).
Inflectional morphemes are described as syntactically motivated. They are assigned by the syntax depending on how a word interacts with other words in a phrase, clause, or sentence. Inflectional morphemes do not substantially change the referential meaning of the base word (walk and walked intuitively have the same essential meaning) and can usually be applied to all forms within a word category (e.g., -ed can be applied to almost all verbs). In contrast, derivational morphology is used to create new lexical items, by changing the meaning of the base to which they are attached (e.g., happy and unhappy, though related, do not mean the same thing) or by changing the word class that a base belongs to (e.g., sheep versus sheepish). They tend to be more circumscribed in their application (e.g., unhappy but not *unglad). Derivational morphemes are not usually considered grammatical morphemes, although their application can have grammatical consequences. Some formal tests of grammar include items probing acquisition of derivational morphology.

Although there are clear cases of both inflectional and derivational morphemes, there are also intermediate forms, and it has been difficult to devise rules that cleanly and reliably dichotomize morphemes into these two categories (Katamba, 1993; Matthews, 1991). For example, the suffix -ly, considered to be a derivational morpheme, can be widely applied to many forms in the adjective class, and hence does not seem to have the circumscribed application characteristic of derivational morphemes. Bybee (1985) suggests that there is not a discrete distinction between these two types of morphemes, but rather that both inflectional and derivational morphology fall on a gradient of expression types, varying in terms of the relevance of the meaning elements to each other and the generality with
which the process is applied. Expression types range from lexical expression, to expression via derivational morphology, to expression via inflectional morphology, to expression via free grammatical forms, to syntactic expression. What Bybee describes as inflectional morphology and free grammatical forms is subsumed here under the more general term of grammatical morphology.

Grammatical morphemes in English, then, include prepositions, pronouns, articles, auxiliary verbs, plural forms, and past tense forms. According to Brown (1973), grammatical morphemes are described by a partial convergence of a number of characteristics:

These morphemes are described as members of a closed class, in that they are small in number with relatively fixed membership (consider pronouns or prepositions). This is in contrast to so-called open class morphemes (consider nouns or verbs) which are very numerous, and where new members are added readily. Although small in number, grammatical morphemes appear with fairly high frequency in spoken and written language.

Grammatical morphemes tend to primarily fulfill a structural role in language, and for this reason they have been called functors as opposed to content words. Often they express intrapositional or intrasentential syntactic links or relationships. For example, in the sentence *The boy eats the cookie*, the *-s* links the verb phrase to the preceding noun phrase.
Grammatical morphemes can be homophonous, with several different grammatical morphemes sharing the same allomorphic form. For example, the -ed allomorphs /t, d, Id/ in English are used as the past tense (yesterday they painted...), to convert verbs to adjectives (the painted chair), and in passive constructions (this mountain is painted by many artists ...). As these examples illustrate, the function of the morpheme within the sentence is determined by the context.

Although not devoid of meaning, grammatical morphemes do tend to carry a light informational load. Grammatical morphemes tend to modulate the meaning of lexical morphemes in the utterance rather than provide entirely new information, for example indicating when an action happened relative to the moment of speaking rather than what particular action took place. Often, the information signaled by the grammatical morpheme is partially or wholly redundant with information provided elsewhere in the utterance. (Consider the contribution of -ed in the sentence "Last Tuesday I walked to work.")

Because they are limited in number, grammatical morphemes are also very predictable, particularly in simple sentences. Under circumstances where communication is costly (for example in telegrams), grammatical morphemes can usually be omitted with only a minimal impact on the clarity of the message.

In English, grammatical morphemes tend to have low perceptual salience (Brown, 1973; Morgan, Shi & Alloppena, 1996). They are often of short duration, and have low stress, low amplitude, and little phonetic substance.
Particularly in English, grammatical morphemes have a minimal number of syllables, and may be criticized, as when *I am* is contracted to *I'm*. Often they are bound morphemes.

Having considered common characteristics of grammatical morphemes -- i.e., frequently occurring syntactically determined elements in language, but with low perceptual salience and relatively low information load -- I will turn now to a consideration of the role that different types of language learning experiences might have in their acquisition.

**Comprehension Versus Production Experiences**

Bloom (1993, 1995) suggests that for typical individuals, language serves two related functions. Perceived through the interpretation of acoustic or visual signals, language is a means whereby individuals gain knowledge about the mental representations of others (language comprehension). Expressed in speech, manual signs, or print, it is a means whereby individuals make their internal mental representations knowable to others (language production). Different processes are involved in the task of learning to comprehend language and the task of learning to produce language (Bates, 1993; Clark & Hecht, 1983), but typical children are engaged in attempts to both understand language and produce it, often within the same interactive exchange (Chapman, Streim, Crais, Salmon, Strand & Negri, 1992).

To appreciate how these two types of language learning experiences -- comprehension and production -- may contribute to acquisition of
grammatical morphemes, and how the lack of production opportunities might affect acquisition by the child who is unable to speak, let us consider separately the impact of these two different tasks on the acquisition of language in general, and on the acquisition of grammatical morphology in particular.

Language Acquisition Through Learning to Comprehend

In the real-life language-learning experiences of children (as opposed to the laboratory of the language acquisition researcher) success in a task involving language comprehension is defined not as language comprehension per se, but rather as an appropriate response by the child to conversational input, as judged by the speaker. Bates (1993) and others have pointed out that for very young children, the comprehension task is a form of multimodal problem solving, where information from many sources including the situational context, gesture, and facial expression, combine with the child's extant world knowledge to suggest the most probable meaning for the linguistic input, and the expected response. Acquisition of lexical semantics is central to successful comprehension, but after the child has gained some semantic knowledge, the meaning of many of the utterances she/he hears can be deduced from semantic information and nonlinguistic context, without requiring comprehension of the syntactic forms and structures (Bloom, 1974; Brown, 1973; Pinker, 1984).

Young children not only can achieve successful comprehension as defined above by attending to semantic information and nonlinguistic content, it appears that this is what they typically do when comprehension tasks occur in natural contexts. For example, English-learning 2- and 3-year olds use
lexical understanding and knowledge of probable events, rather than word order cues, to guide their responses in comprehension tasks (Chapman & Kohn, 1978). This finding stands in contrast to work by Hirsh-Pasek & Golinkoff (1993), who, using a preferential looking paradigm, showed that children as young as 16 to 18 months do show some sensitivity to word order cues. This is not surprising, considering that there is evidence of knowledge of adult word order in the language productions of many children in this age range. Word order of children's first utterances tends to conform to that of the adult language models (Brown, 1973) and many of children in the 16 to 18 month range would likely be producing multiword utterances. The point is that although children know something about word order very early, they do not usually rely on that knowledge in comprehension tasks, depending instead on their lexical knowledge and knowledge of probable events to guess at the intention of the speaker. Hirsh-Pasek and Golinkoff made the point that it is because they carefully eliminated the usually potent semantic cues that the children responded as they did in their study.

Learning language involves learning which aspects of variation in the input to ignore, as well as which to attend to. Based on what we know about how children approach comprehension tasks, coupled with the nature of English grammatical morphemes (low information load and low perceptual salience) it is highly probable that early in the language acquisition process children tend to ignore the variation introduced by English grammatical morphemes when trying to comprehend the speaker. Since, in the language addressed to very young children, these morphemes usually contain either little crucial information or information that is
redundantly available from semantics or context, this strategy would initially have minimal impact on their probability of success, as defined above.

Eventually, of course, a strategy of ignoring grammatical morphemes in the comprehension task will prove to be problematic. Children may be confused about what the speaker wants them to do, or may guess wrongly, and be given subsequent feedback which draws attention to the grammatical morpheme. Context and world knowledge do not always provide unambiguous cues to what is meant or expected, particularly as children become older, and the language directed toward them becomes increasingly abstract and decontextualized. At the point where the child is unable to comprehend language input based on analysis of content words and context, the comprehension task would motivate the child to search the linguistic input more thoroughly, identify variations in the input which may be meaningful, and create and test hypotheses about what that meaning may be. However, for the child learning English, situations where comprehension necessitates attention to the significance of grammatical forms are likely to be very rare in the early stages of language learning, when the language directed toward the young child tends to be contextually supported and grammatically simple. Therefore, it is predicted that early on, language comprehension experiences will figure prominently in the acquisition of content words but will not provide a major impetus for learning about grammatical morphology. Following from this line of reasoning, children who are learning English solely through comprehension experiences are predicted to be at risk for delays in the acquisition of grammatical morphology.
Language Acquisition Through Learning to Produce

Let us now consider the task of learning to produce language. This is, of course, where the type of language learning opportunities afforded a child who is unable to speak differs significantly from that afforded the typical speaking child. These differences are quantitative: Even if nonspeaking children have AAC systems, they have fewer opportunities for language production, and of course if they do not have an AAC system, they have virtually no opportunity to produce language. There are also qualitative differences: Nonspeaking children are limited by the design of the AAC system as to what they can say and what types of linguistic components they can manipulate. Specifically, as noted above, most AAC systems do not afford children with opportunities to produce grammatical morphemes except in prestored phrases.

A consideration of the task of learning to produce language reveals a set of factors, enumerated below, which are inherent in learning to produce. All of these factors contribute to language acquisition, and some appear to be particularly important in the acquisition of grammatical morphology:

1. The intent to produce language may affect the level of attention to language:

The intent to attempt to produce language may motivate children to pay more attention to the details in language models (Bates, 1993), including grammatical morphemes, even though this is not necessary for communicative success in most early interactions involving language. Even if they are not intending to immediately produce (or reproduce) the
language they hear, typical children know that at some time in the future they may want or need to do so.

2. **Language production involves making decisions about linguistic elements:**

Children are motivated to produce language in order to make their internal mental representations knowable to others (Bloom, 1995; Golinkoff & Hirsh-Pasek, 1995). This involves seeking out, in the input of others, clues on how to express these mental representations. Grammatical morphemes can signal subtle meaning distinctions, such as the difference between "he walked" and "he's walked". As children mature and develop more sophisticated, complex mental representations there is a growing desire to express these types of meaning distinctions. When the speaking child formulates an idea, then struggles to express that idea linguistically, inherent in the production task is the need to make choices about when and how to use previously noticed linguistic elements, including grammatical morphemes.

3. **Language development is motivated by a desire for productions to sound more like language models:**

Change in language production is motivated by more than a desire to express increasingly complex ideas to others. Speaking children are also motivated to change their language systems so that their output matches the language of their environment. We see evidence for this in many normal language development phenomena (Clark, 1982): Children continue to struggle to master forms even though their ability to get across their message has not been seriously impeded in the past by their lack of
mastery; on occasion they spontaneously correct themselves before there has been any opportunity for a failure in communication to occur (Brown, 1973); U-shaped curves in the linguistic data are seen where previously correct forms are produced incorrectly for a period of time (Cazden, 1968). These observations suggest that typical children not only want to communicate increasingly complex ideas, they also want to communicate like their language models. This desire to talk like others is thought to motivate children to attend to differences between patterns in their output and what they hear or have heard in the input. To sound like the language models produced by the people they are emulating, typical children must eventually attend to and correctly use grammatical morphemes.

4. Language production enhances control of language learning situations: At the point where the typical child has segmented the speech stream, noticed a grammatical morpheme, and is working out how it is used, the ability to produce language allows the child to create and control hypothesis-testing linguistic events. Ingram (1972) notes that around the time of and just prior to the appearance of a grammatical form in their language output, children produce many more utterances that include obligatory contexts for that grammatical form. Rather than passively waiting for the linguistic environment to produce illuminating examples of the form of interest, the speaking child can actively influence that environment by using the grammatical morpheme in various situations and observing the effect, or by asking questions that hopefully will elicit use of the grammatical morpheme by others.
5. **Language productions inform caregivers about the child's linguistic and/or cognitive level:**

Children's productions provide caregivers with information about the child's level of cognitive and language development. In many cultures including ours, caregivers "fine-tune" their input to match the child's developmental level. There is some controversy about whether caregivers base the adjustments in their language to children on the child's productive language level, comprehension level, or cognitive level, and of course in typically developing children these three factors are highly correlated (see Snow, Perlman, & Nathan, 1987, for a review of the literature on this topic). These adjustments in input, many of which are also found in language addressed to foreigners and in child-to-child speech, appear to be by-products of attempts to communicate with a noncompetent speaker (Pine, 1994). Although the evidence is mixed, this fine-tuning is thought to facilitate language development.

6. **Language productions inform caregivers about the child's focus of attention:**

Language learning is enhanced when caregivers talk about what a child is attending to at the moment (Cross, 1977, 1978; Macnamara, 1972; Wells, 1980). In the prelinguistic period, caregivers use cues such as the direction of the child's gaze to determine the child's focus of attention (Brazelton & Als, 1977; Bruner, 1978). For very young children, joint attention has been shown to facilitate the acquisition of nouns (Tomasello and Todd, 1984). However, the child's gaze does not indicate what specific aspect of an object or event has captured the child's interest. For example, a child looking at a doll could be interested in its name, its facial expression, its curly hair, its...
possessor, its position, etc. Once the child reaches the stage of being able to
direct adults' comments by asking questions like "What's that?" or "What's she doing?" the child's utterances provide caregivers with more
illuminating cues on what specifically has captured the child's attention (Snow, 1984).

7. **Language productions can be expanded or recast by competent speakers:**
Children's productions create opportunities for caregivers to provide
semantically contingent responses such as recasts (where the adult
reformulates the child's utterance by adding a grammatical morpheme or
substituting one grammatical morpheme for another) or expansions
(where the adult repeats and adds to the child's utterance without changing it). These types of responses to a child's utterance are common in
the language input to children in Western cultures at least, and have the
effect of providing the child with a grammatically correct model,
expressing the same or similar information to the child's own immature
production, in close time proximity to the child's production. Expansions,
recasts, and topic continuations have been shown to facilitate the
acquisition of grammatical morphemes (Farrar, 1990; K.E. Nelson &

8. **Language production provides a forum for learning and reflection:**
Having heard an interesting or puzzling linguistic form, the speaking child
can repeat it, either immediately or at a later time, to extend or revisit the
information processing phase. Evidence that children do this can be seen
in their imitative utterances, which tend to be imitations of language forms
and structures that they are in the process of learning (Bloom, Hood, &
Lightbown, 1974). In language play situations such as crib talk, the child can also modify and substitute elements in order to explore the morphemes' distributional characteristics, and to compare old knowledge with new data. Although solitary language play undoubtedly fulfills many purposes, Kuczaj (1983) suggests that mastery of linguistic elements is one important function.

Thus it appears likely that the process of language production plays an important role in language acquisition and, furthermore, unlike comprehension experiences, early production experiences are likely to direct the speaking child's attention specifically to grammatical morphemes. Production experiences encourage attention to details in the linguistic input for the purpose of later productions and for the purpose of learning how to express internal representations. Production experiences also encourage attention to grammatical morphology as part of the effort to sound like the language models in the environment. Language production gives children the opportunity to actively test hypotheses about the rules governing use of grammatical morphology by controlling their introduction in communicative exchanges. Both the content and form of children's utterances can influence the subsequent language addressed to them by caregivers in ways which have been shown to facilitate language development in general, and grammatical morphology in particular. Finally production in language play situations such as crib talk soliloquies is thought to contribute to language mastery by enabling children to reauditorize linguistic data for the purposes of postinitial processing, to overtly explore language segmentation and distributional characteristics, and/or to compare new data to old knowledge. For all of these reasons,
language production opportunities are important for acquisition of grammatical morphemes.

Summary: Comprehension Versus Production Effects in the Acquisition of Grammatical Morphology
Considering the nature of grammatical morphemes, and the nature of the comprehension task versus the production task, I propose that although both comprehension and production experiences can play a role in pushing the acquisition of grammatical morphology, production experiences are likely to be more influential. The attempt to comprehend language motivates attention to grammatical morphology only when an acceptable gloss of the meaning cannot be deduced from other cues such as contextual, semantic or world knowledge factors. As the language directed toward the young child tends to be contextually supported and grammatically simple, there are few language comprehension experiences in the early stages of language development that are likely to push the child to acquire grammatical morphemes. In contrast, production opportunities -- even attempts to produce the simplest sentences -- do push acquisition of grammatical morphemes, providing motivation to attend to and master these aspects of language in order to express complex mental representations and to emulate language models. Language production also enhances the child’s influence on the language learning environment and allows for active hypothesis testing and overt language practise and play.
I have hypothesized that production experiences are important in the acquisition of grammatical morphology, and of course children who are nonspeaking do have some opportunities to produce language via their AAC systems. I will now examine in more detail the type of production experiences afforded children who are nonspeaking through typical AAC systems, in order to argue that these types of experiences probably do not have the same facilitative effect on the acquisition of grammatical morphology.

Assuming that there has been appropriate clinical intervention, children who are unable to speak usually have some production experience via their AAC systems. However, their experiences are typically both quantitatively and qualitatively different from the production experiences of speaking children. The language production opportunities of the child via an AAC system require attention to grammatical morphology if and only if the system is set up so that the child selects individual grammatical morphemes and produces them in the correct order along with the lexical morphemes in the utterance. As mentioned above, most AAC systems do not give the child this option. The vocabulary on most AAC systems for young children consists of prestored phrases such as "I need help" or "Tickle me" and/or individual words such as "juice" or "all-done".

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1 See Appendix A for a description of two types of AAC symbol systems which, when employed in an AAC system, do potentially give the user partial control over grammatical morphology. Neither of these systems is widely used in the Pacific Northwest.
Grammatical morphemes, and particularly bound grammatical morphemes, are almost never included as separate items.

In the previous section I discussed a set of factors inherent in learning to produce and contribute to language acquisition, especially acquisition of grammatical morphology. I will now consider the extent to which these factors apply to the language production experiences of the child who is nonspeaking and who communicates via a typical AAC system.

1. *Does the intent to produce language via a typical AAC system draw attention to the details of language, especially grammatical morphemes?* Children who are unable to speak have vastly reduced opportunities for language production. For a variety of reasons, AAC systems are usually not introduced in the first two to three years of life, and even once a child does have an AAC system, there are many situations (when getting dressed or undressed, or in the bathtub, for example) when it can be logistically challenging to incorporate the use of an AAC system. Therefore, whereas typical children are usually both language producers and language comprehenders in most situations, children who are nonspeaking spend the majority of their time in situations where they are language comprehenders rather than language producers. Children who are nonspeaking may not see themselves as active language producers, and so may not be motivated to attend to details in the language, especially those details with low perceptual salience that are not crucial for success in comprehension, that is, grammatical morphemes. The child's self-image as primarily a recipient of language input rather than a producer of language output may engender a less detailed analysis of the linguistic
material, in a manner somewhat analogous to the mindset of an individual approaching a recognition learning task versus a recall learning task.

2. Does language production via a typical AAC system involve making decisions about linguistic elements?

Children who are nonspeaking do make decisions about the use of those linguistic elements over which they have control -- that is, the vocabulary represented on their AAC systems. These elements rarely include grammatical morphemes unless these are embedded within prestored phrases. When children use their AAC systems to produce prestored phrases containing grammatical morphemes, they do so without having to make choices about when and how to use those grammatical morphemes. If a child has no possibility of conveying thoughts through the selection and production of grammatical morphemes, one important motivational force driving attention to and analysis of the rules governing the use of grammatical morphemes is eliminated.

3. Does language production via an AAC system allow children who are nonspeaking to match their productions to those of their language models?

Again, this is only possible to a very limited extent -- the extent to which the vocabulary on the AAC system allows for such matching to take place. If the child has no possibility of producing a particular linguistic form, as is usually the case with grammatical morphemes, there is of course no possibility of emulating language models incorporating that form. Thus another important motivational force that drives acquisition of grammatical morphemes for typical children usually does not apply for children who are nonspeaking.
4. *Does language production via an AAC system enhance control of language learning situations?*

An AAC system does enhance the control that a nonspeaking child has over the language learning situation, but again this is very limited, both by the fact that the AAC system is not always available and by the fact that most AAC systems do not allow the child to control the introduction of grammatical morphemes into a conversation. Whereas speaking children can use a grammatical morpheme in various situations and observe the effect, nonspeaking children usually cannot take such a direct, active role, but instead must wait for and analyze those fortuitous illuminating instances of the morpheme in the language input.

5. *Does language production via a typical AAC system inform caregivers about the child's linguistic and/or cognitive level?*

In the situation of a speaking child, logically the child's utterances are important sources of information about both comprehension and cognitive level (although of course nonverbal behaviours would also be informative). Therefore, whether the caregiver's fine-tuning is to the child's productive language level, comprehension level, or cognitive level, a child's inability to speak would impede this process. This is not alleviated by the provision of an AAC system, since the complexity of the linguistic output from the AAC system is strongly influenced by the system design. A bright child whose AAC system's vocabulary is predominantly nouns and verbs will produce telegraphic utterances, whereas a child with very significant cognitive impairments may produce complete grammatical phrases if these are what is preprogrammed into the AAC device.
6. *Does language production via a typical AAC system inform caregivers about the child's focus of attention?*

Caregivers of children who are nonspeaking get indications about the child's focus of attention from the AAC system output and/or nonlinguistic cues such as pointing or eye gaze. However nonspeaking children cannot talk about something that captures their attention unless some adult has anticipated their desire to do so and made available both the AAC system and the appropriate vocabulary on that system. Nonlinguistic cues such as pointing do not provide information on what aspect of the environment has captured the child's interest. Furthermore, because of concomitant physical impairments many nonspeaking children may be less efficient at using these nonlinguistic means to direct the caregiver's attention toward an interesting object or event. As a consequence, the language input of that child's caregivers is likely to be less finely tuned to the child's focus of attention.

7. *Can language productions via AAC systems be expanded or recast by competent speakers?*

A very common pattern in conversational exchanges involving an AAC user is that messages are coconstructed over several turns (Kraat, 1985), with the unaided listener expanding and elaborating on the message elements provided by the AAC user. For example, Kraat (p. 62) describes the following conversation between a caregiver and an AAC user (graphic symbol selections are enclosed in square brackets):

**AAC user:** [HOME]
**Caregiver:** "Home? What about home? Something about your sister?"
AAC user: (gesture) No. [DAY OF WEEK]
Caregiver: "Sunday? Monday? Tuesday? ... Saturday?"
AAC user: (gesture) Yes.
Caregiver: Something about home and Saturday. Are you going home on Saturday?"
AAC user: [MAN]
Caregiver: A man? Someone special is coming?
AAC user: (gesture) No.
Caregiver: "I should find out who this man is?"
AAC user: (gesture, emphatically) Yes.
Caregiver: "A relative? A friend? Someone in the Hospital?"
AAC user: (gesture) Yes.

After over 100 turns and about 20 minutes, this conversational dyad co-constructed the message "Can Carl (a security guard) possibly take me home on Saturday with the Hospital van?" There are many other examples of similar conversations in the literature (e.g., Collins, 1996; Light, Collier, & Parnes, 1985; von Tetzchner and Martinsen, 1996). These exchanges bear some similarity to the expansions and recasts that caregivers produce in response to speaking children's utterances, particularly to the expansions and recasts of early one- and two-word utterances. However primarily because of vocabulary limitations on the AAC system, co-constructions occur over many more turns than the typical child-caregiver utterance recast, the AAC user tends to contribute much less linguistic information to the co-construction than does the caregiver or conversational partner, and there is a much greater potential for misunderstanding. The efforts of the AAC user are focussed on conveying the content, which is often a very challenging task. It is not clear that these exchanges are facilitative for the acquisition of grammatical morphology as has been shown to be the case with caregivers' expansions and recasts of speaking children's utterances.
Can language productions via a typical AAC system be used for language practise and play, as forums for learning and reflection?

Provided they have access to their AAC systems when they are alone, AAC users could engage in solitary language play, and I believe I have heard AAC users do this. However, oftentimes AAC users do not have access to their AAC systems when they are alone. Even when they do, the AAC system design does not allow the child to "play" with grammatical morphemes by modifying and substituting these elements in utterances. Thus this potentially useful channel for language learning is by and large not overtly available to the nonspeaking child, although covert language practise would be possible.

In summary, the typical AAC system provided to a child who is unable to speak limits that child to a small finite number of productive options. Usually the options do not include productive control of individual grammatical morphemes. Given the way that most AAC systems are set up, the production task via the AAC system does not provide motivation to attend to grammatical morphemes, since for the child these are essentially "inexpressible" forms. The child's ability to control or influence the introduction of grammatical morphology in conversational exchanges is severely curtailed, limited to the grammatical morphemes that happen to be present in any prestored phrases. Even when prestored phrases that include grammatical morphemes are available for production, the child has not done the work of constructing these phrases, selecting and ordering the grammatical morphemes. Furthermore, the child is unable to explore the segmentation and recombination of these linguistic units in language play.
Preliminary Statement of the Problem

The acquisition of language can be characterized as an active and interactive learning process, with both production and comprehension experiences making contributions to this process. For grammatical morphemes, which in English are generally characterized by low perceptual salience and low information load, language production experiences contribute more to that learning process and language comprehension experiences less so. Language comprehension experiences, which are the type of language learning experience open to children who are nonspeaking, are more likely to push acquisition of the "content vocabulary" of lexical items, which tend to be more perceptually salient and which carry a much higher information load.

Children who are nonspeaking do have limited production opportunities via AAC systems, but these systems usually do not allow for productive control of grammatical morphology. Therefore, their opportunities to learn about grammatical morphemes are qualitatively and quantitatively different from those afforded the child who is able to speak. As a result, the acquisition of grammatical morphemes is predicted to be more problematic for nonspeaking children than the acquisition of content vocabulary.

Based on these considerations, in this dissertation I will address the following question: Do children who are unable to speak exhibit relatively more difficulty than speaking children in the acquisition of grammatical morphemes? By extension, will their level of acquisition of grammatical
morphology be less than would be predicted by their level of acquisition of content vocabulary?
CHAPTER 2
LITERATURE REVIEW

This literature review will begin with a brief discussion of research on factors affecting typical children's acquisition of grammatical morphology, followed by a description of what little is known about language acquisition and specifically the acquisition of grammatical morphology by individuals who are nonspeaking. Then, several studies on language acquisition in hearing children of deaf parents will be described. This can be an analogous situation to that of the nonspeaking child, in that some of these children are learning spoken language with very limited production opportunities. Next, research on the impact of the provision of AAC on speech and language development will be reviewed. Many children who are nonspeaking also have cognitive impairments, and so literature on the acquisition of grammatical morphology by children with cognitive impairments is also of interest and will be briefly summarized. This will lead to a refinement of the preliminary problem statement that closed the first chapter.

Typical Acquisition of Grammatical Morphemes

identified 14 grammatical morphemes that English language learners typically master in the preschool years, and that appear frequently in obligatory contexts (making their acquisition methodologically easier to study). He studied acquisition of these morphemes longitudinally in three children and noted regularities in the order of acquisition, which were subsequently largely confirmed in larger studies, including a cross-sectional study by deVilliers and deVilliers (1973) and a longitudinal study by Bates, Bretherton, and Snyder (1988).

Brown explored several possible explanations for these regularities in order of acquisition and concluded that both semantic and grammatical complexity appear to offer predictions generally consistent with the data. These two factors, as operationalized by Brown, were highly correlated with one another; presumably one or both of them operate to make the process of deducing the rules governing the use of grammatical morphemes differentially more challenging, once the morphemes have been noted (Pinker, 1981).

Development of the underlying nonlinguistic concepts expressed by grammatical morphemes has also been explored as a factor determining order and rate of acquisition. Johnston and Slobin (1979) examined the acquisition of one particular type of grammatical morpheme, locative prepositions, across four languages (English, Italian, Serbo-Croatian, and Turkish). A general order of acquisition predicted by nonlinguistic growth in concept development was seen across languages. However there was some crosslinguistic variation in the order of acquisition of specific lexemes. The authors attributed this variation to language-specific
characteristics, such as homonymity and morphological complexity, which determine the ease with which the child sorts out the way that a concept is encoded in the language once that concept has been acquired.

Brown also proposed that perceptual salience was one factor influencing the ease with which grammatical morphemes were acquired, presumably by affecting the likelihood that a grammatical morpheme will be noticed in the input and, hence, subjected to analysis. Both crosslinguistic studies (e.g., Slobin, 1973, 1985) and studies where children have been taught artificial miniature language systems (Johnston, Blatchley, & Streit, 1990; MacWhinney, 1983) have since supported the proposition that children appear to notice most readily morphemes that appear at the beginning or end of a speech unit, are stressed, syllabic, and uncontracted (Peters, 1985).

As with many other aspects of language, although general regularities exist, there is also individual variability both in the age of acquisition and in the order in which productive use of these grammatical morphemes emerges in typical children (Lahey, Liebergott, Chesnick, Menyuk, & Adams, 1992). Suggested reasons for this variability, in addition to errors introduced by sampling and/or measurement decisions, have included differences in the child's learning style (Bates, Bretherton & Snyder, 1988; Peters, 1983) and differences in frequency of occurrence in parental input (Moerk, 1980).

Brown explored the role of parental frequency of use and concluded that he had no evidence for an effect of frequency in input on order of acquisition. This conclusion has been both challenged (Moerk, 1980, 1981) and defended
(Pinker, 1981) through reanalysis of Brown’s data. There have been many correlational studies (e.g., Newport, Gleitman & Gleitman, 1977; Furrow, Nelson, & Benedict, 1979) which have looked for relationships between characteristics of maternal input at time 1 and measures of language development (including measures which partially reflect grammatical morpheme acquisition) at time 2. The results of these studies have been inconsistent and contradictory. Richards (1994) provides a thorough review of 28 correlational studies and discusses the many methodological challenges and limits to interpretation associated with this type of study. He makes a plea for more varied research designs including case-study and experimental approaches, and for more rigorous and critical analyses.

Although input frequency may not influence the timing of the acquisition in a simple, straightforward way, perhaps frequency in highly salient positions (e.g., auxiliaries in stressed, utterance initial position), or at particular times in the course of acquisition, may be influential (Gleitman, Newport, & Gleitman, 1984; Nelson, 1981, 1991). Probably the strongest evidence for a relationship between input characteristics and acquisition of grammatical morphology is found in the literature on caregiver recasts and expansions, some of which was reviewed in chapter 1. Both correlational studies (e.g., Farrar, 1990) and experimental studies (e.g., Nelson, 1977) have shown facilitative effects of recasts on the acquisition of specific targetted linguistic constructions involving grammatical morphemes. Farrar (1990) found that recasts were particularly facilitative for two bound grammatical morphemes, plural -s and present progressive -ing, but only for these two bound morphemes. He speculated that since bound morphemes are not perceptually salient and likely to be overlooked,
and since they are often the only element differing between the child's production and the adult's recast, the recast helps the child isolate the bound morpheme as a distinct lexical unit. The facilitative effect of expansions and topic continuations appeared to apply to grammatical morphemes in general, and may be a reflection of the facilitative effect of providing language models for whatever specific aspect of an environment or event has captured the child's attention and interest.

Although production in obligatory contexts is the traditional hallmark of acquisition of grammatical morphology, comprehension of grammatical morphemes and sensitivity to the presence or absence of grammatical morphemes have also been studied. Recent work has demonstrated that children under 2 years old show some sensitivity to correct versus incorrect usages of grammatical morphemes. For example, Gerken and McIntosh (1993) found that 21- to 28-month-old children who had an MLU of at least 1.5 morphemes were better able to select the correct picture for a grammatical sentence such as "Find the dog for me" versus an ungrammatical sentence such as "Find was dog for me." Awareness and marking of grammatical morphemes without full mastery has also been observed in the language productions of children in this general age range. For example, Peters and Menn (1993) noted that one 20-month-old child produced "phonologically vague filler syllables" in positions where grammatical morphemes would be expected in adult language. These and other observations suggest that acquisition of grammatical morphology is a gradual process; children can and do have sensitivity to linguistic information long before they exhibit mastery, in comprehension or production tasks (Hirsh-Pasek & Golinkoff, 1993; Sutton, 1996).
Several researchers have found evidence that typical children are influenced by the surrounding grammatical morphemes when hypothesizing about the meaning of novel words. In particular recently there has been interest in children's ability to use morphosyntactic forms and subcategorization frames to identify and learn verbs (see Gleitman & Gillette, 1995, for a discussion of the challenges of verb learning and several related proposals on the role of syntactic forms and structures in their acquisition). Several studies will be cited here as emblematic of this line of inquiry.

Behrend, Harris, and Cartwright (1995) found that 3-year-old children tended to interpret nonsense verbs as encoding actions when they were presented in the frame "Watch this person. She is pinting" and as results when they were presented in the frame "Watch this person. When I made this tape, she pined." They interpreted this result to mean that the children had noticed the indirect partial correlation between the meaning of past tense -ed and result verbs, and present progressive -ing and action verbs. Of course considerably more than the grammatical inflection was changed in the two sentence frames nevertheless the point remains that something about the two different sentence frames led the children to interpret the nonsense verbs as encoding the action in one linguistic context and the result in the other context.

Fisher, Hall, Rakowitz, and Gleitman (1994) found that 3-year-old children attended to prepositions, specifically to versus from, when interpreting the
meaning of an unknown verb. Children who heard the sentence "Mary zikes the ball to John" were likely to interpret the novel verb as something like give, whereas children who heard the sentence "Mary zikes the ball from John" were likely to interpret the novel verb as something like get.

Hirsh-Pasek & Golinkoff (1993) describe work they conducted with Naigles, L. Gleitman and H. Gleitman in 1988. These researchers showed that a group of 26- to 30- month-old children was sensitive to the presence of the preposition with, differentiating between the transitive sentence "Cookie Monster is turning Big Bird" versus the intransitive sentence "Cookie Monster is turning with Big Bird", as evidenced by looking time to the matching video versus the nonmatching video. These and similar studies suggest that by age 2 1/2 to 3 years, typical children know enough about the function and distribution of some grammatical morphemes to help them assign meaning and syntactic roles to unfamiliar words (Gerken, 1996).

Several studies have compared comprehension and production of grammatical morphology by typical children. These studies highlight the methodological challenges of designing equivalent comprehension and production tasks. They also support the notion that children draw on different strategies to decode language in comprehension tasks than to construct language in production tasks, as specific task effects introduce variability into order of acquisition data for different tasks.

Fraser, Bellugi, and Brown (1963) looked at 3-year-olds' ability to imitate, comprehend, and produce English morphological and syntactic forms. Ten
"grammatical contrasts" were evaluated, and for each contrast, two pictures were created to illustrate the contrast. For example, the contrast between present progressive tense and past tense was captured in utterances "The paint is spilling" versus "The paint spilled", and pictures were created to illustrate these sentences. In the comprehension task the experimenter showed the child the two pictures and spoke the two contrasting sentences without indicating which sentence went with which picture. Then the experimenter spoke one of the sentences and asked the child to point to that picture. In the imitation task the child first listened to both sentences and then was asked to repeat one of the sentences. No pictures were presented in this task. In the production task, the experimenter presented the two pictures and repeated the two sentences twice, without indicating which sentence went with which picture. Then the child was asked to describe each picture. Order of the three tasks was varied.

Fraser et al. found a tendency for production scores to be higher when the production task was presented second, and higher still when this task was presented third (versus second). There was also a positive correlation between age and total score, even in this restricted age range (3;1 - 3;7). Children performed best on the imitation task, followed by the comprehension task, followed by the production task. Fraser et al. interpreted the results as support for the notion that comprehension precedes production, and that sentences may be imitated without being within the child's productive repertoire or comprehension level. This study was subsequently criticized because the probability of giving the correct response by chance was not equal in these three tasks (Baird, 1972).
Anisfeld and Tucker (1968) studied 6-year-olds' ability to comprehend and produce the plural -s, which is variously realized as /s/ (cats), /z/ (dogs), or /lz/ (houses) and found different patterns of mastery in the comprehension versus the production data. Children were more successful in producing plurals marked by /s/ and /z/, but found /lz/ more difficult. They were more successful in comprehending plurals marked by /z/, and found /s/ and /lz/ more difficult. Anisfeld and Tucker explained these results by pointing out that in comprehension children could draw on other generalizations about the forms of English words, such as the fact that few singular nouns end in /lz/, whereas in production children had to draw on whatever information they had stored about the forms of noun plurals for English.

Keeney and Wolfe (1972) looked at 3- and 4-year-olds' acquisition of subject-verb agreement (i.e., use of third person regular -s). When comprehension was assessed by asking the child to point to a picture that matched a full sentence (e.g., "The bird flies"), the children were successful. When the same task was repeated using just the verb ("flies"), thereby eliminating the information about number contained in the noun phrase, the children performed more poorly. Keeney and Wolfe suggested that success on the first task was based on the children's knowledge of the plural marker on the noun, rather than on an appreciation of the significance of the presence or absence of the third person regular -s marker. Nevertheless the same children who did not attend to the third person regular -s when completing the comprehension task did consistently use this grammatical morpheme correctly in spontaneous language productions.
Rider (1979) compared typical 3-, 4-, and 5-year-olds' comprehension and production of prepositions, plural -s, possessive 's regular past tense -ed and irregular past tense forms. Somewhat different rank orders of acquisition were obtained for the comprehension versus the production task, and these were attributed to task design and task demand factors. Two examples of these factors are as follows: On the comprehension task children had difficulty selecting the target picture in items assessing past tense -ed despite using this morpheme productively. Rider attributed this result to the difficulty in capturing clear temporal sequences in picture form. On the production task, children substituted the possessive pronoun instead of the possessive 's marker. Rider concluded that the fact that there was an alternative manner to grammatically code this notion made the 's morpheme more difficult to acquire. An equally plausible explanation would be that given the context -- i.e. the examiner and the child looking at the same pictures together -- the use of the possessive pronoun would be pragmatically at least as appropriate as using noun + 's, if not more so. It is impossible to know whether the children's use of the possessive pronoun reflected a lack of knowledge about the possessive 's morpheme or not.

Rider's data also revealed a strong main effect for age, and a trend for children to do better on the comprehension task than on the production task, although this did not reach statistical significance for each age group. The order of task presentation affected scores on the production task, which were generally higher when this task was presented after the comprehension task. The same plates of pictures were used in both tasks, and given that the comprehension task format sensitized the child to the purpose of the study while providing models of sentences using the
grammatical morphemes being tested, it is not surprising that the child was then more likely to produce the target sentences in the production task.

In summary, acquisition of grammatical morphology in typically developing children is a gradual process. In some cases there are years between the first indication of sensitivity to the presence of the grammatical morpheme and total mastery of that morpheme in spontaneous speech. The relationship between input and acquisition of grammatical morphemes is complex and contested, with contradictory results in the literature. Probably specific types of input at specific points in development are needed or at least facilitative. In general, some knowledge of or sensitivity to grammatical morphemes precedes production. The nonlinguistic complexity of the concept being encoded, the perceptibility of the grammatical morpheme's allomorphs, the phonological complexity of the allomorphs, and the grammatical morpheme's semantic and syntactic complexity are all factors that appear to affect the ease with which grammatical morphemes are acquired. Order of acquisition information obtained in comprehension tasks can be different than order of acquisition obtained in production tasks. This may be because of task specific methodological factors, and/or because the strategies children undertake to complete comprehension tasks are different from those undertaken in the production task. In addition to sensitizing us to measurement issues, this observation also provides indirect support for the contention that comprehension experiences are significantly and qualitatively different language learning experiences than production experiences.
Acquisition of Grammatical Morphology
by Individuals who are Nonspeaking

There is very little information specifically about the acquisition of grammatical morphology by children who are unable to speak. However, several studies suggest that nonspeaking individuals exhibit difficulty in the acquisition of language in general. Smith, in her 1990 thesis, studied predictors of literacy for ten children with cerebral palsy who were nonspeaking and had nonverbal intellectual abilities within the average range. Six of these children scored below average on the *Test of Auditory Comprehension of Language* (1973), and seven scored below average on the *British Picture Vocabulary Scales*, (1982). These measures are not fine-grained enough to provide us with specific information on grammatical morphology, but they do point to the possibility that children who are nonspeaking have more difficulty with language than would be predicted by nonverbal measures of intelligence.

Berninger and Gans (1986) also studied individuals with normal intelligence who were nonspeaking in order to explore relationships between language and reading abilities of individuals with severe speech impairment. They administered a battery of language and reading assessments to a nonspeaking adult, adolescent, and child, all of whom had cerebral palsy. Both the adult and the adolescent exhibited very marked difficulty with a grammaticality judgment task. The child also exhibited some difficulty with the grammaticality judgment task, although the significance of this difficulty is unclear as there was no normative child data for the task. Success at this particular grammaticality judgment task
involved the metalinguistic ability to judge sentences based on their grammatical well-formedness instead of truth value, and sensitivity to various other aspects of grammaticality such as word order, in addition to knowledge of grammatical morphology. It is not possible to determine if the source of difficulty on this task lay in the individuals' knowledge of grammatical morphology or in some other aspect of the task.

Information specifically about mastery of grammatical morphology is provided by Kelford Smith, Thurston, Light, Parnes and O'Keefe (1989), who studied the written output of six AAC-using adolescents and young adults over a 4-week period. The only information about language comprehension level provided on these individuals was that their "receptive language skills were functional for daily needs" and no information was given about cognitive levels. Analysis of written output included the percentage of correct use of grammatical morphemes in obligatory contexts. All of the subjects demonstrated relatively high proportions of accurate use of grammatical morphemes, but all made some errors. Kelford Smith et al. concluded that although "most of the subjects showed some proficiency in their use of English morphemes and functors... [t]he failure of any subject to achieve 100% accuracy in this general measure... indicates that there were some difficulties in the use of these structures." (p. 120).

This conclusion could conceivably be questioned on the basis that error-free production is not considered to be a reasonable bench-mark for acquisition, since everyone occasionally makes grammatical errors. A more common criterion, and the one adopted by Brown in his original study, is 90% correct use in obligatory contexts. I applied this criterion to the Kelford-Smith et al.
data and found that, even when this more reasonable benchmark for acquisition is adopted, five of the six subjects did not meet criterion for use of grammatical morphology in their spontaneous written output. Does this level of proficiency represent more difficulty with grammatical morphemes than one would predict, given normative expectations? Without more information about these individuals' language comprehension levels, one cannot say for sure. However, considering that all of these individuals had achieved basic written literacy, one might expect that their knowledge of language would be sufficiently developed so that the grammatical morphemes examined would have been mostly mastered.

Finally, in an ingenious study, Sutton and Gallagher (1993) looked at knowledge of English past tense rules of two nonspeaking adults, both of whom grew up in English-speaking communities and communicated with 400-symbol Blissboards. A 4-digit code, indicated through eye gaze to an Etran\(^2\), referenced each symbol on the board. Prior to the study, both subjects coded past tense by indicating a 4 digit code for a PAST symbol. The subjects were taught a new strategy of repeating the last digit of a code to indicate regular past tense -ed, and were instructed to continue to mark irregular past tense by using the PAST symbol. After teaching to criterion on a subset of regular and irregular verbs, the authors looked at subsequent patterns of use with "untrained" verbs, and found no pattern of use which distinguished regular from irregular English verbs. They interpreted this

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\(^2\) An Etran is a clear plexiglass rectangle with a large rectangular opening in the middle, and with symbols, letters, or in this case numbers displayed in the corners. It is held or mounted so that it is between the AAC user and the communication partner at face height; the partner looks through the middle of the Etran to determine which symbol, letter or number the AAC user is looking at.
finding as support for the position that AAC users have restricted language abilities.

In contrast to these studies, others made a claim for unimpaired language comprehension and/or acquisition of grammatical morphology by individuals who are nonspeaking. As previously mentioned, there are several case studies where the claim is made for unimpaired language comprehension by individuals who are unable to speak. Most of these case studies either described adults (e.g., Fourcin, 1975) and/or presented anecdotal information about comprehension by a child (e.g., Lenneberg, 1962), and, therefore, cannot provide us with detailed information about the developmental course of the acquisition of grammatical morphology.

Kraat (1991) reported anecdotally on two children who rapidly acquired spoken language after using communication boards. The children, ages 4 and 7, were described as producing "complete and relatively complex grammatical structures" when speaking, whereas output via the AAC system before being able to speak and during the transition time was much less complex. Kraat suggested that aided output via the AAC system did not reflect what the children knew about language. This anecdotal report has been interpreted to support the successful acquisition of grammatical forms and structures in the absence of productive opportunities (Smith, 1996). However, more information about these two children indicates a situation that is much less clear (Kraat, personal communication, April 18, 1997). One of these youngsters had dysarthric speech that became intelligible to his family when he was a preschooer. He stopped using AAC for a period at that point but began to use it again when he entered
school and was speaking to less familiar partners. The language picture for the other child was complicated by the fact that he came from a Spanish-speaking family. For both of these youngsters, Kraat reported that the striking observation was the production of longer utterances with more critical elements included in their spoken output versus their AAC output. Kraat was less sure about the inclusion of grammatical morphemes, particularly bound morphemes.

Sutton and Dench (1996) also presented an inconclusive case study of a boy with cerebral palsy who used AAC systems in his early years, but developed connected speech after the age of five. At age 8;6, although his speech was still severely dysarthric, it was possible to assess syntax and grammatical morphology production. Based on evidence from a language sample and an elicited language test, Sutton and Dench concluded that this youngster’s grammatical development was slightly delayed in relationship to his chronological age, but "more advanced than would be expected based on his language production experience" (p. 196). However, presumably this child had roughly three years of experience as a speaking child at the time that his grammar production was assessed. One could argue that this experience, coupled with what he had learned about language through language comprehension experiences, would be sufficient to account for the level of mastery demonstrated.

Another relevant study was completed by Sutton and Gallagher (1995), who compared the performance of an AAC user, (SA), at 4;8 to two chronological age-matched children on two measures of comprehension of past tense, a discourse task, and a nonsense-enactment task. The purpose
of this study was to evaluate the utility of these two language comprehension assessment techniques. In the discourse task, mother-child dyads were videotaped and mothers were asked to talk about past time events in their shared history. Children's responses to these past time utterances were coded as either related or unrelated. A response was scored as related if the mother's subsequent comments indicated that she considered the child's response to be contingent to her past time reference. For example, in the following exchange, the child was credited with a related response:

Mother: What animals did we see on the way to gramma's?
SA: *points to [COW]*
Mother: A cow, yeah.

Initial analysis indicated that SA produced many fewer related responses to maternal past time utterances than the age-matched children. However, Sutton and Gallagher pointed out that SA's AAC system did not give her the option of responding "I don't know," "I can't remember," or "I don't want to talk about that," and this may have affected the number of responses coded as nonrelated. They also point out that the mother of the AAC user had many more multi-utterance turns, and that when only multi-utterance past time turns are considered in each dyad, the children's frequency of related responses was very similar.

The mothers mostly used irregular past tense forms or past tense auxiliary verb forms in their past time utterances, and only very infrequently used regular past tense -ed. Regardless of how the past time information was encoded in the mother's utterance, the child may have been giving related
responses based entirely on the semantic information in the mother's utterance. In the example above for instance, the child could be responding to the semantic information in "gramma" and "animal" by expressing an animal one sees at gramma's, without any understanding of the past time reference. The fact that there was no difference between the children in the frequency of related responses following maternal multi-utterance past-time turns could be because the mother's multiple utterances provided SA with more semantic cues.

The nonsense-enactment task in this study specifically evaluated comprehension of (verb) + past tense -ed in contrast to will + (verb). In this task, two figurines were presented, and the child was told "These two are both going to ___ (nonsense verb)." One figurine was made to perform an action for which there is no English word, and the child was then asked "Who ___-ed?" or "Who will ___?". The children responded by pointing to or looking at a figurine. At age 4;8, the nonspeaking child performed similarly to age-matched peers on this task, but any developmental difference here would be masked by the fact that all three children performed at or near ceiling level. It is not known if the nonspeaking child developed an understanding of the -ed morpheme at roughly the same age as the speaking children. It is also not possible to tell if the children were achieving success based on their understand of -ed, or based on their understanding of future tense will.

There is one report of a child who was nonspeaking and who demonstrated an impressive sensitivity to grammatical morphology. Stromswold (1994) described a preschool boy with a severe speech impairment but no other
significant physical impairment who was particularly adept at making grammaticality judgements. For example, at age 3;5 he demonstrated comprehension of plural -s by correctly choosing between two pictures, and at age 4;5 he was able to indicate the acceptability of sentences with correct versus incorrect subject-verb agreement (e.g., *The boy sit on the log* versus *The boy sits on the log*). Stromswold reported that this child's ability to judge these constructions was superior compared to her unpublished data for a group of typical speaking 4-year-old children on this task. According to Stromswold, this child not only failed to show evidence of difficulty in acquisition of grammatical morphology, he appeared to be unusually advanced in this area for a child of his chronological age.

There has also been one group study that failed to find impaired acquisition of grammar in individuals who are unable to speak, relative to individuals with similar disabilities but who were able to speak. Bishop, Brown and Robson (1990) compared a group of 12 anarthric adolescents, a group of 12 dysarthric adolescents, and a group of speaking adolescents with cerebral palsy to determine if there were differences in language comprehension acquisition between these groups. All three groups were matched for age and nonverbal IQ. Comparisons were conducted on three language comprehension tasks assessing phoneme discrimination, vocabulary, and grammar. *The Test for Reception of Grammar (TROG),* 1983, a picture-selection task, was used as the measure of grammatical comprehension. There were no differences between the speech-impaired and the matched controls on this test, and no differences within the speech-impaired group between the anarthric and the dysarthric individuals. The speech-
impaired group did, however, perform more poorly on the vocabulary test and on the phoneme-discrimination task.

Although at first glance the results of this study appear to contradict the prediction that individuals who are nonspeaking will have difficulty with grammatical morphology, there are two reasons not to leap to this conclusion. The TROG evaluates various grammatical forms and structures, including word order. Only 4 of the 80 items specifically evaluate comprehension of bound morphemes. The TROG is probably not a sensitive measure of acquisition of bound grammatical morphemes, and I will argue in chapter 3 that these are the type of grammatical morphemes most likely to pose difficulties for individuals who are nonspeaking. Also, all of these groups had mean age-equivalent scores on the vocabulary test of 8 years or more. Perhaps by this relatively advanced stage of language acquisition, any differences in the course of acquisition of grammatical morphology are no longer apparent.

Summarizing this section, studies have suggested that individuals who are nonspeaking may have more difficulty with language acquisition in general than would be predicted by measures of nonverbal intelligence (Smith, 1990; Berninger & Gans, 1986). Difficulties in the mastery of grammatical morphemes have been documented in the written output of AAC users (Kelford Smith et al., 1989), and one study has suggested that nonspeaking adults may not be sensitive to regular versus irregular past tense patterns (Sutton & Gallagher, 1993). In contrast, two recent case studies (Stromswold, 1994; Sutton & Gallagher, 1995) have presented children who are nonspeaking with normal nonverbal intelligence, and
made the claim that these children exhibit age-appropriate knowledge of grammatical morphology. The latter study is difficult to interpret due to methodological issues. Sutton and Dench, 1996, have presented yet another case study of a former nonspeaking youngster and have expressed the opinion that his grammatical development was more complete than would be expected based on his three years of language production experience. I believe that this child's experiences as a speaker prior to their assessment, coupled with what he learned about language through comprehension experiences, would account for the level of mastery demonstrated. A study by Bishop et al. (1990) has found that a group of nonspeaking adolescents performed comparably to age and cognitive level-matched controls on a standardized test of comprehension of grammar. The participants in this study were all adolescents with a fairly reasonable grasp of language, and the test used measures comprehension of other aspects of language in addition to grammatical morphology. It is possible that a more sensitive measure of acquisition of grammatical morphology administered earlier in the language acquisition process would show the predicted differences in the acquisition of grammatical morphology.

Acquisition of Grammatical Morphology by
Hearing Children of Deaf Parents

I will now briefly consider the literature on a clinical population with language learning opportunities similar to those of the nonspeaking child, to determine if there is evidence of impaired acquisition of grammatical morphology in that group. The group in question is hearing children of
deaf parents who are exposed to English through television, but who have limited or no occasion to speak it. In this situation, the child also experiences a language (English) strictly through comprehension tasks. It should be noted that this scenario is not typical of most hearing children of deaf parents, who do have opportunities to verbally interact with hearing relatives, baby-sitters, friends, and neighbours.

There have been at least two published case studies of hearing children of deaf parents who were raised with exposure to English through frequent T.V. watching, but with virtually no opportunities to interact with speaking individuals (Sachs, Bard & Johnson, 1981; Todd & Aitchison, 1980). In both cases the children were well cared for and had many opportunities to interact with hearing impaired individuals (and hence to learn ASL), and in both cases the children exhibited significantly impaired spoken language. Sachs et. al. described two siblings who were 3;9 and 1;8 when their spoken language delays were identified and intervention was begun. At the time of initial assessment, the older child was described as trying to express relatively complex ideas but using much shorter utterances than would typically be expected, with low use of grammatical morphemes and complex or compound sentences. The younger sibling’s language was also described initially as delayed, as he did not begin using single words until just before he was 2. However, as his spoken language developed, he did not show the unusual language patterns seen in the productions of his older brother. Of course from the age of 1;8 the younger brother engaged in spoken interactions with the researchers, his brother’s speech-language pathologist, and his older brother whose spoken language improved with intervention. Todd and Aitchison (1980) studied a child who learned ASL
but had little exposure to spoken language except from television before age 3. The child had very little spoken language at age 3. As he acquired English, Todd and Aitchison noted difficulties in syntax and grammatical morphology which they attributed to interference from ASL syntactic forms and structures.

Shiff and Ventry (1976) collected information on 52 hearing children of deaf parents and found that these children were at much greater risk of impaired spoken language, even after other risk factors had been eliminated. A standard speech and language assessment battery was administered, and only 23 of these 56 children were found to be developing speech and language normally. Eleven children were found to have speech and language problems with no other known contributory factors other than the deafness of their parents. Schiff and Ventry were unable to establish a clear relationship between the amount of time spent with hearing adults and speech and language difficulties in this group of children. Possibly, even limited opportunities for production will encourage the child to approach any language-learning opportunity from the standpoint of a potential speaker.

As this brief review indicates, the limited evidence available from this population does not provide definitive information about the role of production opportunities in language acquisition. However, the literature is not inconsistent with the hypothesis that production opportunities are important for language acquisition.
Impact of Production Opportunities on Children Using AAC

If lack of production opportunities leads to delays in the acquisition of grammatical morphology, then logically the provision of an AAC system that provides such productive opportunities should result in improved acquisition of grammatical morphemes. Unfortunately this proposition has not been explored in the research to date. Most discussion in the clinical literature has been focused on the question of whether the provision of an AAC system inhibits the development of natural speech, as this fear is often voiced by parents and teachers of children with severe speech impairments. Silverman (1989) summarized 23 published descriptive studies involving 338 subjects of varying ages and with a variety of medical diagnoses, and noted that only 2 individuals were reported to show a decrease in speech attempts following the provision of an AAC system. For 127 subjects, speech attempts were reported to have increased following AAC provision, and an additional three studies involving 80 subjects also reported anecdotally that "some" or "most" subjects showed an increase in speech attempts. Further descriptions of clinical interventions published since 1989 (e.g., Romski & Sevcik, 1996) have also noted no decrease, and in many cases increases in speech attempts following introduction of an AAC system.

The impact of the provision of an AAC system on language development (as opposed to speech) has not been systematically studied, although speculations have certainly been made. At the level of phonology, speculation has focused on the role of voice output in the development of phonological awareness and analysis. While studying factors related to
reading performance in adolescents and adults with severe speech impairments, Foley (1993) made an interesting observation. She was looking for evidence of phonological coding in short term memory, so she explored whether phonological similarity influenced retention of visually presented consonant sequences. Participants in this study fortuitously included some nonspeaking individuals whose AAC systems had voice output, and some whose AAC systems did not have voice output. Foley noticed that only those nonspeaking individuals in her study who used voice output communication aids showed an effect of phonological similarity on retention of visually presented consonant sequences, and she speculated that provision of an AAC system with voice output may have positively influenced the development of the phonological analysis skills of these nonspeaking individuals.

At the level of the lexicon, Romski and Sevcik (1992, 1993, 1996) reported the establishment of lexical comprehension abilities in youths with moderate or severe mental retardation following an intervention program that included the provision and modeled use of a voice output communication aid. There was no control group, but these researchers believe that, given that many of their subjects had long histories with virtually no demonstrable language comprehension skills, it is unlikely that the acquisition of lexical comprehension was merely coincidental with the AAC intervention (Romski, Sevcik, Collier, & Hartsell, 1992). They suggested that the graphic symbol and synthetic speech output may have assisted in segmenting words from the natural stream of speech, facilitating the process of matching symbol to referent. Romski and Sevcik (1996) also note an obvious relationship between type of vocabulary provided on the voice output aid and
type of augmented output produced. When social regulatory vocabulary 
(e.g., *please, help*, etc.) were added to an initial set of referential vocabulary 
items (e.g., *cereal, magazine, ice cream*) two-symbol combinations were 
immediately produced. The complexity of the utterances produced 
depended to a large extent on the vocabulary available on the AAC device.

Although there are several AAC systems (see appendix A) that provide 
children with at least partial productive control of grammatical 
morphology, the impact of these productive opportunities on the acquisition 
of grammatical morphology has not been studied to date. The one exception 
to this statement is the 1993 study by Sutton and Gallagher, summarized 
above, where two nonspeaking adults did not show awareness of regular 
versus irregular past tense distinctions after being taught a method of 
indicating this distinction with their AAC systems. Of course the adults in 
this study had for years been expressing both regular and irregular past 
tense via the same method on their AAC systems. Perhaps if they had been 
younger, or if they had been given more training and or feedback, they 
would have begun to correctly use the two different methods of encoding 
past tense in their spontaneous output

Acquisition of Grammatical Morphology in 
Children With Cognitive Impairments

Most children who are nonspeaking also have cognitive impairments 
(Beukelman, 1988; Blockberger & Kamp, 1990). Cerebral palsy, one of the 
most common concomitant medical diagnoses, is caused by damage to the
brain before, during, or shortly after birth, and is associated with a downward shift of the overall distribution of IQ scores (Cruickshank, Hallahan, & Bice, 1976). It has been suggested that there is a hierarchy of vulnerability for language functions, with morphology and syntax being more likely to be impaired than the more robust area of lexical development (Bishop & Edmundson, 1987). One therefore might argue that children with cognitive impairments would be more apt to have difficulty with grammatical morphology compared to lexical semantics, regardless of whether they were able to speak. Although the evidence is mixed, there is some indication that children with cognitive impairments are indeed at risk for impaired grammatical morphology (Ratner, 1989).

Miller, Chapman, and MacKenzie (1981) made two highly pertinent observations, based on their review of the language and cognitive profiles of 42 children with developmental disabilities. First, there is considerable variability within the group of children with cognitive impairments; this is not a homogeneous population. Second, there is a much stronger likelihood of language problems in children with cognitive impairments than in the general population, if language impairment is defined as a gap between the level of language development and level of nonverbal cognitive development. Only 36% of the children in this study had language comprehension and production levels commensurate with nonverbal cognitive level. Delayed language production relative to cognitive level was seen in 24% of these children, and 17% had delays in both language production and comprehension, again relative to nonverbal cognitive level. These results indicate that language impairments are not uncommon in children with
cognitive impairments, and different language processes can show different degrees of impairment.

When delays in the acquisition of grammatical morphology are noted in children with cognitive impairments, researchers have found that acquisition proceeds along a typical developmental sequence although at a slower pace. For example, Tager-Flusberg et al. (1990) followed six children with Down Syndrome and six high-functioning children with autism in a 2-year longitudinal study. With the exception of one child with autism who suffered a dramatic recession in language and other developmental areas, children in both groups acquired specific grammatical structures in the same general order as typical children do.

The information above alerts us to a potential confound in the study of the acquisition of grammatical morphology by children who are unable to speak: Children with cognitive impairments may be more likely to have impaired grammatical morphology, and many children who are nonspeaking are also cognitively impaired.

Summary of Previous Research

In typical children, productive mastery of grammatical morphemes is acquired gradually, with adultlike usage of many grammatical morphemes attained by age 4 years. Perceptual salience appears to affect order of acquisition, presumably by influencing whether or not a grammatical morpheme is noticed in the input. The child's conceptual development also determines rate and order of acquisition, as does homonymity and semantic and syntactic complexity of the grammatical
form, which presumably affect the difficulty of determining the rules
governing use once the morpheme has been noticed. There is some
variability in the order of acquisition of grammatical morphemes within
typical children. Child-intrinsic factors (e.g., learning style) and
environmental factors (e.g., characteristics of the parental input) have been
suggested as factors contributing to this variability. Some studies of typical
children have compared comprehension of grammatical morphemes to
production data. These have revealed differences related to task demands
and the strategies with which children approach these two types of tasks.

Acquisition of grammatical morphology (or any other aspect of language
for that matter) has not been well studied in children who are unable to
speak. The ability to speak is certainly not necessary for language
acquisition, including acquisition of grammatical morphology. However,
there is some evidence to suggest that individuals who are nonspeaking
with at least grossly normal cognitive abilities are at risk for language
acquisition problems in general, and perhaps for problems in acquiring
grammatical morphology in particular. This evidence is consistent with
my hypothesis that language production opportunities are important
language learning tasks, especially facilitating the acquisition of
grammatical morphology. Some limited evidence from hearing children of
deaf parents who also acquire language through comprehension tasks
(e.g., television watching) also supports this hypothesis.

The impact of the provision of production opportunities via an AAC system
on speech development has been commented on extensively in descriptive
studies, and either no effect or a positive effect is almost always noted.
There has also been speculation that the provision of AAC has a positive effect on language acquisition at the phonological and lexical levels, and this is usually presumed to be related to characteristics of the AAC output which provide feedback to the child. The impact of production opportunities on the acquisition of grammatical morphemes has not been studied in this population.

Children with cognitive impairments may be at greater risk for language impairments, including difficulties with grammatical morphology. This is important, because most children who are nonspeaking also have cognitive impairments. In light of this information, the problem statement presented at the end of the previous chapter will now be revised.

Revised Statement of the Problem

Recall that at the end of the first chapter the problem to be addressed in this study was described as follows: Do children who are unable to speak exhibit more difficulty in the acquisition of grammatical morphemes than would be predicted by their level of acquisition of content vocabulary?

In the first chapter I gave a rationale for why children who are nonspeaking are predicted to have difficulty in the acquisition of grammatical morphology. Early language comprehension experiences are more likely to push acquisition of content vocabulary -- lexical items that tend to be more perceptually salient and carry a much higher information load. In contrast, grammatical morphemes are generally characterized by
low perceptual salience and low information load. In the early stages of language acquisition, production experiences are likely to contribute more to the learning process for grammatical morphemes and language comprehension experiences less so.

Children with cognitive impairments are at greater risk for language impairments, and many children who are nonspeaking also have cognitive impairments. Presumably one could argue that any identified impairment in grammatical morphology found in a group of nonspeaking children is related to cognitive impairments rather than to the inability to speak. However, children who are nonspeaking are predicted to experience difficulty in the acquisition of grammatical morphemes because they are learning language primarily through comprehension experiences and because they usually have limited to no opportunities to produce grammatical morphemes via their AAC systems. If this line of reasoning is valid, children who are nonspeaking should have proportionately more difficulty with the acquisition of grammatical morphology than speaking children with similar cognitive impairments. Therefore, to the question posed above, another question will now be added:

If children who are nonspeaking do have difficulty in acquiring grammatical morphology, is this difficulty more pronounced than what is seen in speaking children with similarly delayed language and/or cognitive development?
CHAPTER 3
METHOD

Do children who are nonspeaking show particular difficulty in the acquisition of grammatical morphology, as my consideration of the nature of language production and comprehension tasks led me to predict? I addressed this question by gathering information on the acquisition of grammatical morphology from a group of children who are nonspeaking. Information was collected via three measures: a comprehension task, a grammaticality judgment task, and -- for those children who were literate -- a structured output task.

The performance of the nonspeaking children on these three measures was compared to that of two groups of speaking children. The first comparison group were typical children matched to the nonspeaking children on a measure of content vocabulary comprehension. The hypothesis was that the children who were nonspeaking would show more difficulty on all three measures of acquisition of grammatical morphology than the typical children who had a similar level of knowledge of content vocabulary. The second comparison group was a group of speaking children who were similar to the nonspeaking group in chronological age and in delay in acquisition of content vocabulary (the "atypical speaking group"). I included this group in order to comment on whether any differences seen between the nonspeaking group and the typical group could be attributed
solely to developmental delays in the nonspeaking group, rather than to the fact that they were unable to speak. My prediction was that due to a lack of language production opportunities, children who are nonspeaking would have difficulty in the acquisition of grammatical morphology. Therefore, the nonspeaking children were also predicted to perform more poorly on measures of acquisition of grammatical morphology than speaking children who were within the same chronological age range as the nonspeaking group and who had similarly delayed content vocabulary levels.

This chapter will begin with the rationales for selection of the three specific grammatical morphemes and for the three tasks. This will be followed by a detailed description of the participants and procedures.

Rationale for the Grammatical Morphemes Selected

As discussed in the introduction, grammatical morphemes do carry meaning (see appendix B for further discussion), and one can conceive of comprehension experiences that would draw attention to grammatical morphemes and the rules governing their use. Some knowledge of grammatical morphemes by the nonspeaking children would therefore be expected, but in order to increase the likelihood that a delay would be detected grammatical morphemes that were most likely to be affected were selected. Three grammatical morphemes, past tense -ed, possessive 's, and third person regular -s were selected for study on the basis that they were likely to show the greatest impact from lack of production opportunities.
These grammatical morphemes were chosen by applying four criteria to Brown’s (1973) list of 14 grammatical morphemes:

1. Grammatical morphemes with relatively low perceptual saliency were selected, as the negative impact is presumed to be partly because children who are unable to speak will not have had their attention drawn to grammatical morphemes by the production task. Presumably this will be more detrimental for morphemes that are already more likely to be overlooked because they are perceptually less salient.

2. Grammatical morphemes that are regular versus irregular forms were selected, because irregular forms of grammatical morphemes (such as irregular past tense forms) may be learned more as individual lexical items, rather than as a grammatical class (Marcus et al., 1992; Pinker, 1984).

3. Grammatical morphemes that are of relatively low frequency (compared to other grammatical morphemes) were selected. The rationale for this criterion is that the negative impact is presumed to be partly because the child cannot control opportunities for learning, and this would affect the acquisition of lower frequency morphemes more since they would be less likely to occur in good learning contexts by chance alone.

4. Grammatical morphemes that are mastered relatively later were selected. The tasks used to probe acquisition of grammatical morphemes, and particularly the grammaticality judgment task, are usually not understood by children under 4 years of age, and so this was the lower age
limit of children in this study. To avoid ceiling effects, grammatical morphemes that may not be completely mastered by age 4 years were chosen.

Applying the first two criteria to Brown's list of much-studied grammatical morphemes, those that are irregular forms, syllabic, and/or stressed were eliminated, leaving the usually unstressed and nonsyllabic plural -s, possessive 's, past regular -ed, third person regular -s, contractible copula, and contractible auxiliary verbs. Applying the third criterion, from this subset three grammatical morphemes; possessive 's (The boy's hat...) past regular -ed (Yesterday he worked) and third person regular -s (The dog barks), appear less frequently in parental input. This was defined as having a frequency ranking of >7 in all three sets of parents studied by Brown (1973), where 1 was the most frequently heard grammatical morpheme, and 14 was the least frequently heard.

The fourth criterion was that the morphemes should not be completely mastered by age 4 years. There is some information about comprehension of these three grammatical morphemes. Regarding past tense, on the Test of Auditory Comprehension of Language (Carrow, 1973) 60% of the children pass items probing comprehension of past tense at age 3 to 3 1/2 years, but the 90% criterion is not achieved until over 7 years. Similarly, Rider (1979) found that 4-year-olds scored with 60% accuracy on items assessing past tense, but the 90% accuracy level was not reached by 5-year-olds, the oldest age group in his study. Comprehension of possessive 's is probed on the Miller-Yoder Test of Grammatical Comprehension (Miller & Yoder, 1984). Sixty percent of children pass items probing comprehension of possessive 's
at age 7, and 90% at age 8. However, Rider found comprehension of possessive 's to occur earlier with 3-year-olds in his study achieving 90% correct responses on items assessing this morpheme. Regarding third person regular -s, 4-year-olds did not show comprehension of this grammatical morpheme in the previously discussed study by Keeney & Wolfe (1972).

Information is also available about productive mastery of these three grammatical morphemes. According to Miller (1981) in spontaneous productive language possessive 's is mastered and past tense -ed first appears in Brown's Stage III (predicted c.a. 2;7 - 2;11), and a period of over-regularization is often seen with the latter morpheme. Third person regular -s is mastered somewhat later, typically in Brown's Stage V (predicted c.a. 3;7 - 3;10). By this stage, past tense -ed is mastered as well. On a structured productive language test Rider found that 4-year-olds achieved 90% accuracy in production of possessive 's. Three-year-olds achieved 60% accuracy in production of -ed, and 90% accuracy for production of this morpheme was not achieved by the 5-year-olds, the oldest group in his study.

Rationale for Task Selection

Once the grammatical morphemes were selected, the next methodological challenge concerned how to measure their acquisition. In this study, acquisition was defined as knowledge of the meaning conveyed by the grammatical morphemes and of the rules governing their use. Evidence of
acquisition was sought from three sources: a grammaticality judgment task, a multiple choice sentence comprehension task, and -- for those children who were literate -- a structured output task with written productions elicited via a cloze procedure. Because each of these measures is an imperfect indicator of the underlying construct in question, multiple measures were employed and converging evidence was sought. The advantages and drawbacks of each of these measures is discussed below.

**Production Data.**

Usually evidence for appropriate use in spontaneous productions is employed to build the case for granting that the child has "acquired" a grammatical morpheme or some other aspect of language. These data are relatively easy to collect for speaking children, and does not require the child to do anything out of the ordinary. However, spontaneous production data can be problematic even when studying typically developing children. Obligatory contexts for inclusion of grammatical morphemes may not occur in spontaneous speech, although this can be partially overcome, for example by designing a task which uses a cloze procedure to introduce obligatory contexts. In spontaneous language output it is sometimes difficult to distinguish self-constricted phrases from formulaic phrases, and there is also the question of what percentage of inclusion in obligatory contexts (e.g. 50%, 60%, 90%) is sufficient to credit the child with acquisition of a linguistic element. Furthermore, full adultlike acquisition implies not only mastery of the rules governing use of the grammatical morpheme, but also an awareness of its meaning, and although these two aspects of mastery appear to be highly correlated, they are not necessarily the same thing.
For children who are nonspeaking, the use of language production as a measure of acquisition is fraught with problems. There is no spoken language output, and output from the AAC system does not necessarily provide a reliable window of underlying language competence, since characteristics of the AAC system place limits on the amount of output and even what output is possible. There is also the strong possibility, suggested by evidence from spoken versus augmentative communication device output of typical speaking children, that the visual-graphic representational system could introduce modality-specific or symbol system-specific influences, which may mask the child's underlying language competence (Morford & Sutton, 1995; Smith, 1996; Soto, 1996). For example, if a child is trying to express the notion "The girl is sitting on the chair" and the graphic symbol that represents "sit" on the AAC system is a stick figure sitting on a chair, the child might assume that the information "sitting on a chair" can be conveyed by selection of that single graphic symbol.

When a nonspeaking individual acquires written literacy skills, it becomes possible to analyze orthographic output, and this provides a more reasonable source of productive data relevant to the child's acquisition of the language spoken in the community. Analysis of written output elicited via a cloze procedure (where the child is required to complete a sentence or phrase) was selected as one measure of acquisition of grammatical morphemes in this study. However there are several caveats to this data, which contributed to the decision to employ other measures of acquisition as well. In typical children, acquisition of written literacy at around age 7
occurs later than productive mastery of most grammatical morphemes. If acquisition of grammatical morphology was only slightly delayed in children who are nonspeaking, this problem may have resolved before they learned to produce orthographic output. Furthermore, because of physical impairments, which often affect both speed and accuracy of movements, there may be substantial differences in physical effort and demands on memory and attention for the nonspeaking child compared to the demands of that same task when performed by a typical able-bodied child. The impact of these differences can be minimized but not eliminated by using the structured cloze procedure to elicit only the target linguistic element. Finally, analysis of written language output suffers from the same limitation that analysis of spoken language output measures does: These measures can capture use, but they do not capture the child's understanding of the meaning of the linguistic units in question. To counter these potential confounds, and to ensure that data could be collected from children within the developmental period where acquisition of the grammatical morphemes would be expected to occur, two other sources of data were also used.

**Grammaticality Judgments**

Grammaticality judgment tasks are often used to tap linguistic knowledge and provide another method to measure acquisition of grammatical morphology. This type of task also has its drawbacks and limitations. Making a grammaticality judgment involves considering the well-formedness of the sentence independent of the truth value or plausibility, and this requires a certain amount of metalinguistic sophistication. Young children find grammaticality judgment tasks quite challenging and are
easily pulled off-task by semantic or world knowledge factors (deVilliers & deVilliers, 1974). As a result, this measure may underestimate acquisition of grammatical morphology, particularly for the younger children. Alternatively, it is conceivable that correct grammaticality judgments could be made based on partial or incorrect rule learning. For example, a child could have a rule that every declarative sentence contains only one -s, attached to either subject or verb. This rule would lead the child to correctly judge the grammaticality of *The boy eats, The boys eat, *The boy eat, and *The boys eats, and the child's knowledge of the rules governing the use of grammatical morphology would be overestimated. Finally, although grammaticality judgments tap that aspect of acquisition involved in obeying the grammatical rules for usage, this is not identical with acquisition of an understanding of the meanings conveyed by the presence or absence of that morpheme. Nevertheless, because grammaticality judgment tasks involve minimal motor demands, this type of task had particular appeal, given that participants in the study included individuals with severe physical impairments.

Comprehension Data

In a traditional comprehension probe the child is asked to indicate a picture or object that goes with a word, phrase or sentence, or to follow directions involving the manipulation of objects. A task requiring object manipulation was not possible here, given that many children who are nonspeaking also have significant motor impairments, but it was possible to design a task involving picture selection, where comprehension of the grammatical morpheme was necessary for selection of the correct picture.
Comprehension measures are notorious for variation in results depending on task design factors (Savage-Rumbaugh et al., 1993), and it is not known if these factors affect typical children and nonspeaking children in the same way. For example, children with severe speech and physical impairments have qualitative and quantitative differences in their exposure to picture books in the preschool years (Light & Kelford Smith, 1993). This may affect their performance on tasks involving picture interpretation.

Perhaps because typical children have more experience with story-book reading, they are more familiar with the story-book convention of pictures depicting on-going or uncompleted actions being paired with text where that action is presented in past tense. As a result, typical children may be more likely to select a picture of an ongoing action as being an acceptable depiction of a past tense sentence.

Testing effects are also of particular concern in the comprehension task, as the design of the task may lead the child to acquire the knowledge under investigation during the experimental probe. By stripping away situational and semantic cues, and leaving the one grammatical contrast and situational contrast, the child’s attention may be drawn to these contrasts by the task, and the child may be encouraged to seek to discover how these distinctions map on to each other. As Karmiloff-Smith (1986) points out, the child may do this based on strategies generated on the spot by general problem-solving procedures. Differences in performance between groups could be related to general problem-solving or hypothesis-generating abilities, rather than to differences in the acquisition of grammatical morphology per se.
In summary, all three types of tasks discussed above -- comprehension tasks, grammaticality judgment tasks, and production tasks -- can be seen to have drawbacks and potential pitfalls. Performance on any of these tasks will obviously be influenced by many factors and not solely by the child's knowledge of grammatical morphology. Therefore, the decision was made to use all three types of tasks, and to look for converging evidence of difficulties with grammatical morphology. Although problems with any one task might logically be ascribed to other factors, if consistent differences between the experimental groups are apparent on all three tasks, it becomes most probable that the results are related to acquisition of grammatical morphology, which is a factor in all three tasks.

These three tasks are complementary, both in terms of counter-balancing potential methodological confounds, and also in terms of the type of knowledge about grammatical morphology that they tap. Fatigue effects related to motor impairment may impact performance on the structured written output task, but are less likely to impact performance on the comprehension task and are highly unlikely to be significant in the grammaticality judgement task, which has minimal motor demands. The structured written output task can only be given to the older children who have acquired written literacy skills, and the metalinguistic demands of the grammaticality judgement task means that this task is suspect when administered to young children, but the comprehension task can be more confidently given to very young children. The picture interpretation skills required by the comprehension task are not required by the other two tasks. Although chance selections of the correct responses are a factor for the grammaticality judgement task and the comprehension task, this is not a
large concern in the structured output task. The comprehension task probes knowledge of the meaning of the grammatical morphemes, whereas the grammaticality judgement task focuses on syntactic rules governing the obligatory use of the grammatical morphemes, and the structured output task involves awareness of both semantic content and syntactic function.

Having provided a rationale for the three grammatical morphemes I selected, and for the three tasks used to probe acquisition of these grammatical morphemes, I will now describe the participants and experimental tasks and procedures in detail.

Participants

There were three groups of participants: the "nonspeaking" group, the "matched typical speaking" group, and the "atypical speaking" group. Comparison of the nonspeaking group to the matched typical group allowed me to explore whether children who are nonspeaking have more difficulty with grammatical morphology than one would predict based on information from typically developing children at the same mastery level for content vocabulary. Comparison of the nonspeaking children to the atypical speaking group, that is, speaking children who had delays in comprehension of content vocabulary, allowed me to determine whether any observed problems in the nonspeaking group would be seen in any group of children where most of them had language delays, regardless of
whether they were nonspeaking or not. Descriptive information comparing these three groups is given in Table 1 below.

No participant in any groups had any known active illness or hearing loss, and all passed a "contrastive pairs" screening test, described below, which established their ability to detect the presence or absence of word-final /s,z,t,d/. For all participants, English was the primary language.

In some cases, another language was also spoken in the home. In the nonspeaking group, French was spoken in two families, Italian in one family, and Tagalog in one family. In all four of these homes English was usually spoken to the nonspeaking child, and the child was reported to understand English better than the other language. In the atypical speaking group, Punjabi was spoken in one family, Portuguese in one family, and Hungarian in one family. In the Punjabi- and Portuguese-speaking families, the atypical speaking children spoke both English and the other language, but English was their preferred and better language. In the family where Hungarian was occasionally spoken, the atypical speaking child was described as understanding a little Hungarian but speaking only English. In the matched typical group, French was spoken in one family, and French and Danish were spoken in one family. In both cases English was the language spoken by the child, and the most common language spoken in the home.

**Nonspeaking Group**

Children with very severe speech impairments, all of whom were functionally nonspeaking, were recruited through speech-language
Table 1: Descriptive Information Comparing Nonspeaking vs. Matched Typical vs. Atypical Speaking Groups

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Chronological Age</th>
<th>PPVT Age Equiv.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonspeaking group (n=20)</td>
<td>11 boys 9 girls</td>
<td>Mean = 9;3</td>
<td>Mean = 6;1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range = 5;8 - 17;1</td>
<td>Range = 4;0 - 8;11</td>
</tr>
<tr>
<td>Matched typical group (n=20)</td>
<td>6 boys 14 girls</td>
<td>Mean = 5;9</td>
<td>Mean = 6;2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range = 4;1-8;7</td>
<td>Range = 4;1 - 8;10</td>
</tr>
<tr>
<td>Atypical speaking group (n=15)</td>
<td>9 boys 6 girls</td>
<td>Mean = 9;4</td>
<td>Mean = 6;2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Range = 7;6 - 15;5</td>
<td>Range = 4;6 - 8;6</td>
</tr>
</tbody>
</table>
pathologists in schools and rehabilitation centres in British Columbia, Alberta, and Washington State. Speech-language pathologists were contacted and asked to nominate participants who fulfilled these criteria: the child has no more than 10 words that are intelligible to strangers, there is no known hearing loss, English is the primary language of the home, and the child recently obtained or would be likely to obtain an age-equivalent score of between 4;0 and 8;11 on the *Peabody Picture Vocabulary Test - Revised* (PPVT) (Dunn, 1981), a test of comprehension of content vocabulary.\(^3\)

Twenty-six children were nominated by their speech-language pathologists as possible candidates for inclusion in the study. Two of these children failed the minimal pairs screening task described below, and four of the children failed to obtain the minimum age equivalent score on the PPVT. The remaining twenty children fulfilled all of the criteria listed above, and also passed the minimal pairs screening test, which will be described below.

The PPVT was chosen as the tool to delineate the language comprehension level criterion because it is a well known, standardized measure of language comprehension which assesses content vocabulary and does not assess grammatical morphemes. The PPVT is moderately correlated with intelligence measures (Dunn, 1981). It is easy to administer with alternate response formats suitable for individuals with motor impairments and appears to be reliable and valid when alternate formats are used (Wagner, \(^3\) It should be noted that many individuals who are nonspeaking also have severe cognitive impairments and so did not meet this last criterion for inclusion in the study.)
1994; Bristow & Fristoe, 1987). The lower limit of age equivalent 4;0 was specified because pilot testing had revealed that children under this chronological age were unable to make grammaticality judgments, one of the experimental tasks. The upper limit of age equivalent 8;11 was specified because pilot testing had revealed that typical children above this chronological age performed at or near ceiling levels on all three of the experimental tasks. This range of language comprehension age equivalents from 4;0 to 8;11 also represented an attempt to capture the expected evidence of gradual but delayed acquisition of grammatical morphology in the nonspeaking children.

"Nonspeaking" was operationally defined as having no more than 10 words intelligible to strangers, as reported by the parent or speech-language pathologist. Table 2 gives information on the multiple formal and informal communication systems used by these 20 children. More specific descriptions of the children and their communication methods are included in appendices C (children in the nonspeaking group who are literate) and D (children in the nonspeaking group who are preliterate).

Eleven of these children were boys, and 9 were girls. Mean chronological age was 9;3 (range: 5;8 to 17;1), and mean PPVT age equivalent score was 6;1. Medical diagnoses were varied, with cerebral palsy being the most common diagnosis. The children's primary medical diagnoses are listed in Table 3. As would be expected, many of these children had significant motor impairments, and as a result modifications to procedures were sometimes necessary. These modifications are mentioned in the description of tasks.
Table 2
Communication methods used by Children in the Nonspeaking Group:

<table>
<thead>
<tr>
<th>Communication Method</th>
<th>Number of children:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to face communication:</td>
<td></td>
</tr>
<tr>
<td>voice output communication aid</td>
<td>15</td>
</tr>
<tr>
<td>communication book(s) or board(s)</td>
<td>7</td>
</tr>
<tr>
<td>manual signs</td>
<td>6</td>
</tr>
<tr>
<td>gestures/pantomime</td>
<td>4</td>
</tr>
<tr>
<td>vocalizations/word approximations</td>
<td>5</td>
</tr>
<tr>
<td>Written communication:</td>
<td></td>
</tr>
<tr>
<td>computer, standard keyboard</td>
<td>2</td>
</tr>
<tr>
<td>computer, expanded keyboard</td>
<td>3</td>
</tr>
<tr>
<td>computer, alternate access</td>
<td>2</td>
</tr>
<tr>
<td>alphabet board and scribe</td>
<td>1</td>
</tr>
<tr>
<td>traditional pen and paper</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: The total is more than the 20 children in the study because many children used more than one method to communicate.
### Table 3
Medical diagnoses of children in Nonspeaking Group

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of children</th>
</tr>
</thead>
<tbody>
<tr>
<td>cerebral palsy</td>
<td>12</td>
</tr>
<tr>
<td>developmental delay or no diagnosis</td>
<td>5</td>
</tr>
<tr>
<td>Joubert syndrome</td>
<td>1</td>
</tr>
<tr>
<td>Spina bifida</td>
<td>1</td>
</tr>
<tr>
<td>Brain injury post meningo-encephalitis at c.a. 13 months</td>
<td>1</td>
</tr>
</tbody>
</table>
below, and are also delineated in detail in Appendix E. Fourteen of the children in the nonspeaking group were nonambulatory.

Information on the children's literacy level was gathered through interview of the parent and/or speech-language pathologist. Children who were described as being able to independently produce (write or type) a phrase or short sentence were designated as literate for the purposes of this study, and were given the structured output task described below. Children who were reportedly unable to independently produce a phrase or short sentence were designated as preliterate for the purposes of this study, and were not given the structured output task.

**Matched Typical Group**

This group of 20 children was selected from a larger group of 47 children; (10 each at ages 4, 5, 6, and 7 years, and 7 children who were 8-year-olds), all of whom had completed a *PPVT* and the experimental tasks described below. The 8-year-olds were recruited through one school in a middle-class suburban neighbourhood. The remaining children were recruited through word-of-mouth from among friends and acquaintances, and were from middle and upper middle-class suburban neighbourhoods. All of these children were reported by their parents to have no history of speech or language delays. From within the group of 47 typical children, one child was identified with the same *PPVT* age equivalent score (+/- 3 months) as each child in the nonspeaking group. The *PPVT* age equivalent score was selected as the matching variable. As noted above, the *PPVT* measures comprehension of content vocabulary and is reliable and valid when administered in alternate formats. Matching each nonspeaking child to a
typical speaking child by *PPVT* age equivalent allowed me to address the question of whether children who are nonspeaking have more difficulty with acquisition of grammatical morphology than would be expected given their level of acquisition of content vocabulary.

In the larger group of typical children from which the matched typical children were drawn, T tests were conducted with an alpha level of .05 to check for gender differences. There was no significant effect of gender on the comprehension task (*t*(45) = -1.45), grammaticality judgment task (*t*(45) = -1.66) and structured output task (*t*(21) = .067) in the larger group therefore there was no attempt to match for gender when selecting the matched typical children. Six of the matched typical children were boys and 14 were girls. The mean chronological age was 5;9 (range: 4;1- 8;7).

**Atypical Speaking Group**

This group consisted of 15 children with delayed language development, recruited through speech-language pathologists and psychologists from a provincial diagnostic centre and from two suburban school districts. Initially, the speech-language pathologists and psychologists were asked to nominate individuals who spoke English as a first language, had no known hearing loss, and who matched a nonspeaking child in both chronological age (+/- 3 months) and *PPVT* age equivalent (+/-3 months). These criteria proved to be very difficult to fulfill, so the criteria for inclusion were modified to include any child between the ages of 5;8 and 17;1 who had delayed language, and who had recently achieved or would be likely to achieve *PPVT* age equivalent scores between 4;0 and 8;11. The criterion of
chronological age range 5;8 months to 17;1 was selected because this is the age range of participants in the nonspeaking group.

T tests were conducted to check for differences between the atypical speaking group and the nonspeaking group on mean chronological age and mean PPVT age equivalent score. With an alpha level of .05 there were no significant differences between these groups on chronological age (t(33) = -.055) or PPVT age equivalent score (t(33) = .414).

In the atypical speaking group, 9 of these children were boys and 6 were girls. The children ranged in age from 7;6 to 15;5, with a mean chronological age of 9;4. The mean PPVT age equivalent was 5;11. Table 4 describes the diagnoses of the children in this group. For 9 of these children, information on diagnosis was gained from psychology and speech-language pathology reports of the provincial diagnostic centre. The other 6 children were recruited through the two school districts. I did not have access to their confidential school files, so information on diagnosis for these children was obtained by parent interview.

Experimental Tasks

One screening task and three experimental tasks were devised:

Contrastive Pairs Screening Task

The purpose of this task was to rule out hearing or perceptual impairment as a cause for subsequent difficulty on the experimental tasks which followed. Stimuli for this task consisted of pairs of pictures depicting words
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of children</th>
</tr>
</thead>
<tbody>
<tr>
<td>developmental delay or no diagnosis</td>
<td>4</td>
</tr>
<tr>
<td>language/learning disorder</td>
<td>4</td>
</tr>
<tr>
<td>attention deficit disorder</td>
<td>2</td>
</tr>
<tr>
<td>mild-moderate mental handicap</td>
<td>2</td>
</tr>
<tr>
<td>pervasive developmental delay</td>
<td>1</td>
</tr>
<tr>
<td>fragile x syndrome</td>
<td>1</td>
</tr>
<tr>
<td>metatrophic dwarfism</td>
<td>1</td>
</tr>
</tbody>
</table>
which minimally contrast phonemes /s,z,t,d/ in word final position where these phonemes are not grammatical morphemes (e.g. "bee" vs. "bead", "hoe" vs. "hose"). Children were presented with pairs of pictures and the examiner, while preventing the child from seeing her lips, asked the child to point to a picture. Each phoneme contrast was tested four times. The child was required to point to the correct picture in at least 13 of 16 trials, with no more than 1 error per phoneme contrast. Some children with physical impairments were asked to look toward a picture rather than pointing to it. Appendix F gives a complete list of the minimal pairs used in this task, and the exact instructions given to the children. As mentioned above, two nonspeaking children originally nominated as candidates for this study by their speech-language pathologists failed the screening task and were therefore not included in the study. One child who was a potential candidate for the matched typical group also failed the screening test and was not included in the study.

Grammaticality Judgment Task
Stimuli for the grammaticality judgment task consisted of 24 sentences. For each of the three grammatical morphemes there were 4 sentences that included correct grammatical use of the morpheme and 4 ungrammatical sentences with the morpheme omitted or used in conflict with other information in the sentence (e.g. "Tomorrow they walked...""). Sentences were presented in a pseudorandom order, with sentences probing the same morpheme never more than twice in a row, and no more than three consecutive grammatical or ungrammatical utterances. See appendix G for a complete list of these sentences.
A procedure developed by Stromswold (1990) for eliciting grammaticality judgments by young children was used. A dog puppet who is "just learning to talk" was introduced, and the child was asked to assist by listening to him practise saying some sentences. Two containers, one containing dog biscuits and one containing rocks, were set in front of the child. If what the dog puppet said sounded "okay," the child was instructed to give the dog a dog biscuit. If the dog "got mixed up or made a mistake," the child was told to give the dog a rock. To familiarize children with this procedure each child was asked to judge practise sentences (some grammatical, and some with omitted or incorrectly ordered words) until 3 consecutive correct judgments were made or until 10 practise sentences were judged, whichever came first. The exact wording of these instructions is given in appendix G.

When required, the task was adapted for children with significant motor impairment as follows: the containers of rocks and dog bones were placed so that the child could see their contents, the child was asked to select by gesture or eye gaze the appropriate container, then the experimenter manually assisted the child in "feeding" the selected item to the dog puppet. This adaptation was required by 6 children.

Grammatical Morpheme Comprehension Task
Stimuli for the grammatical morphology comprehension task consisted of 18 sets of three pictures. Pictures were realistic coloured drawings, 4" by 6" in size. In each set of three pictures, two of the pictures depicted scenes which differed in their description by the presence or absence of one of the three grammatical morphemes; e.g. "The baby pig is dirty" versus "The
baby's pig is dirty" (possessive 's), "The sheep jump over the fence" versus "The sheep jumps over the fence" (third person present -s), or "Mom said 'You push her" versus "Mom said 'You pushed her." (past tense -ed). The third picture in each triad differed in some semantic critical feature(s) from the target sentence. For example, the three pictures for the item "The deer drinks from the stream" were a) a picture of one deer drinking from a stream, b) a picture of two deer drinking from a stream, and c) a picture of a deer jumping over a stream. This latter selection differed from the target sentence because it depicted jumping rather than drinking. Six sets of pictures probing comprehension of each grammatical morpheme were constructed, each set being paired with a target sentence. For three sets the grammatical morpheme was present in the target sentence, and for three sets the grammatical morpheme was not present. These sets of pictures were pseudorandomly ordered; with the same morpheme never tested more than two consecutive times, and the same relative location (i.e., left picture, middle picture, right picture) correct on no more than three consecutive trials. Appendix H lists the target sentences and briefly describes the sets of three pictures used for each item. A tape recording of an adult female reading each target sentence slowly and with neutral emphasis and intonation contour was also prepared.

During the training phase, children were told that they would hear sentences on a tape recorder, and that their task was to find the picture that went with the sentence. A set of three pictures were presented, and the child was told to point to the picture described. The examiner then read a sentence describing one of the pictures. If the child selected the wrong picture during the training phase, the examiner repeated the sentence and
pointed out the correct picture. The examiner proceeded to present practise items until the child had successfully selected the correct picture three consecutive times, or until ten practise sentences and sets of pictures had been given (whichever came first).

Then the testing phase began. The examiner told the child that he/she would now hear someone on the tape recorder say "Ready," then speak the next sentence. Sets of pictures were then presented to the child, and the tape recording of the target sentences was played. The tape was paused between each sentence to allow the child to choose a picture, after which the examiner would present the next set of pictures and play the next sentence.

If required, this task was adapted for children with significant gross motor impairment as follows: The child was asked to indicate how she signals yes and no. The examiner played the sentence on the tape recorder, then pointed to each picture in turn, beginning on the child's left, and saying "Tell me when I get to the right one." The examiner pointed and paused for approximately one second on each picture, asking in a neutral tone of voice, "Is this it?" If the child indicated "no" or did not respond in 1 second, the examiner pointed to the next picture. The child indicated "yes" or "no" in their customary manner. Seven children required this procedural adaptation. In addition, one child responded by shining her head-mounted light pointer on her selection, rather than pointing with her hand.

Structured Output Task
A short story was prepared with accompanying illustrations. Within the text of the story were a total of 20 missing words, indicated by the first letter
(or letters if the word began with a consonant cluster) of the word, followed by an underlined blank (____) approximately 2 cm. in length. The first two missing words were practise items. Each subsequent missing word represented an obligatory context for past tense -ed, possessive 's, or third person regular -s. There were six contexts for each morpheme. (See Appendix I for the full text of this story.) This story was presented on standard letter size paper in 24 point type, Palatino font.

The child was told that he or she was going to help the examiner write a story, that the examiner had started it, and that it would the child's job to fill in the missing parts. The first page of the story was then presented, and the examiner read it aloud, pausing at the first missing word. The child was instructed to print or type the missing word, using whatever was his or her typical method of producing written output. For 5 of the 8 children in the nonspeaking literate group, written output was produced through use of their AAC system. The remaining 3 nonspeaking literate children and all of the literate children in the control groups wrote the missing words using the conventional pen and paper method. On the first two practise items the examiner provided as much assistance as was necessary so that the child achieved success. The examiner then proceeded through the story, pausing at each "missing" word and instructing the child to fill in the blank. On test items, no assistance was provided with these exceptions: If the child paused before starting to produce the word and indicated uncertainty about what should come next, the examiner assisted the child by rereading the context or pointing to a cue in the picture.
Procedure

Children were seen in a quiet room with a comfortable table in their homes or in a testing room at a pediatric facility, whichever was most convenient for them. The children were first given the contrastive pairs screening task, described above, the purpose of which was to rule out difficulty in hearing the grammatical morphemes as a possible reason for poor performance on the subsequent experimental tasks. If the child passed the pretest, the PPVT (Form M) was administered and scored as described in the manual. (If the PPVT had been administered within the last three months, the previously obtained score was used, and this step was omitted.) Next the grammaticality judgment task, then the sentence comprehension task were administered as described above. In addition, children whose parent or speech-language pathologist had responded positively to the question "Can your child independently write or type a brief phrase or sentence?" were given the structured written output task, also described above. A total of 8/20 children in the nonspeaking group, 6/20 children in the matched typical group, and 7/15 children in the atypical speaking group were given the structured written output task.

The entire battery took approximately 45 - 60 minutes to administer to children who were able-bodied, and was completed in one session. Some of the children in the nonspeaking group were unable to point to pictures with their finger or to write or print their responses for the structured output task, due to physical impairments. For these children, response formats were adapted, and if the battery took significantly more than an hour, testing was discontinued and another session was scheduled. Five
children required two sessions to complete the test battery. One child required three sessions. Appendix E provides details on all procedural adaptations that were made for the children with severe physical impairments.
The first set of analyses reported below tested the prediction that nonspeaking children would have more difficulty in the acquisition of grammatical morphology than would be predicted by their comprehension level for content vocabulary. The second set of analyses tested the prediction that nonspeaking children would exhibit more difficulty in the acquisition of grammatical morphology than a group of speaking children who also had delays in content vocabulary acquisition similar to the nonspeaking group. These analyses are presented in turn.

Nonspeaking Children Versus Matched Typical Children

The first set of analyses compared performance of the nonspeaking group to that of the typical group, matched on content vocabulary comprehension level as measured by the PPVT. The prediction was that the nonspeaking children would have more difficulty in the acquisition of grammatical morphology relative to their acquisition of content vocabulary, because the latter is highlighted in early comprehension experiences whereas acquisition of the former is largely pushed by production experiences. Therefore, children in the nonspeaking group were expected to perform
more poorly on the three tasks assessing acquisition of grammatical morphology than children in the matched typical group.

Comprehension Task
As predicted, children in the nonspeaking group achieved lower scores (Mean = 9.3, SD = 2.25) than children in the matched typical group (Mean = 11.55, SD = 1.96) on the comprehension task. During administration of this task the typical speaking children with higher content vocabulary scores were noted to differ in their responses on items assessing third person regular -s. To explore this phenomenon statistically, subjects in both groups were dichotomized into those with low content vocabulary comprehension levels (PPVT age equivalent scores of less than 6 years) and those with high content vocabulary comprehension levels (PPVT age equivalent scores of 6 years and above). This yielded four subgroups with 10 children per cell as shown in Table 5 below. Table 6 shows the mean scores and standard deviations for these groups on the comprehension task, and Figure 1 presents these results graphically.

A 2 (group) x 2 (content vocabulary level) x 3 (grammatical morphemes) mixed model ANOVA was conducted. For this and subsequent analyses, the alpha level was set at .05. The main effect for group was significant, $F(1, 36) = 11.27, p = .002$, as was the interaction between grammatical morpheme and group, $F(2, 72) = 4.38, p = .016$. No other significant effects were found.

As inspection of Table 6 reveals, with the exception of items assessing third person regular -s, the matched typical group did better than the
Table 5

Mean C.A. for Typical vs. Nonspeaking Group.
High vs. Low Content Vocabulary Comprehension Levels

<table>
<thead>
<tr>
<th></th>
<th>Nonspeaking Group</th>
<th>Matched Typical Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low content vocab. level</td>
<td>n = 10</td>
<td>n = 10</td>
</tr>
<tr>
<td></td>
<td>Mean C.A. = 7;10</td>
<td>Mean C.A. = 4;9</td>
</tr>
<tr>
<td>High content vocab. level</td>
<td>n = 10</td>
<td>n = 10</td>
</tr>
<tr>
<td></td>
<td>Mean C.A. = 10;9</td>
<td>Mean C.A. = 6;9</td>
</tr>
<tr>
<td>Content Vocab. Comp. Level</td>
<td>Nonspeaking Group</td>
<td>Matched Typical Group</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td></td>
<td>low (n=10)</td>
<td>high (n=10)</td>
</tr>
<tr>
<td>past tense -ed</td>
<td>$M = 3.0$</td>
<td>$M = 3.2$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.16$</td>
<td>$SD = 1.03$</td>
</tr>
<tr>
<td>possessive 's</td>
<td>$M = 2.8$</td>
<td>$M = 3.2$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.03$</td>
<td>$SD = 1.23$</td>
</tr>
<tr>
<td>3rd person regular -s</td>
<td>$M = 3.0$</td>
<td>$M = 3.4$</td>
</tr>
<tr>
<td></td>
<td>$SD = .94$</td>
<td>$SD = 1.27$</td>
</tr>
<tr>
<td>Total score (max = 18)</td>
<td>$M = 8.8$</td>
<td>$M = 9.8$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.93$</td>
<td>$SD = 2.53$</td>
</tr>
</tbody>
</table>
Figure 1: Comprehension task results: Nonspeaking vs. matched typical groups, low vs. high content vocabulary levels, for 3 grammatical morphemes: past tense -ed, possessive 's, and third person regular -s.
nonspeaking group, and in each group children with a higher content vocabulary comprehension level did better than children with a lower content vocabulary level, although this latter result did not reach statistical significance.

On items evaluating comprehension of third person regular -s the pattern of results was quite different. Children in the matched typical group with higher content vocabulary comprehension levels had a lower mean score than either the typical children with lower content vocabulary comprehension levels or the children in the nonspeaking group. This interaction did not reach statistical significance.

Simple effects analysis of the significant group X grammatical morpheme interaction revealed that there was a significant difference between the groups for past tense -ed, $F(1, 106) = 13.05, p < .05$, and for possessive 's, $F(1, 106) = 7.91, p < .05$. There was no significant difference between the groups for third person regular -s. Table 7 presents the mean scores of the nonspeaking versus the matched typical group for each morpheme.

Remarks offered by the children in the typical group during this task suggested an explanation for their poor performance on items assessing comprehension of third person regular -s. It appeared that typical children often based their responses on their interpretation of information in the initial noun phrase, rather than in the verb, and that specifically they were looking for the presence or absence of a plural -s marker in that noun phrase. Children offered comments such as "It's not this one, because you
Table 7:
Mean Score for Three Grammatical Morphemes on Comprehension Task:
Nonspeaking Group vs. Matched Typical Group

<table>
<thead>
<tr>
<th></th>
<th>past tense -ed</th>
<th>possessive 's</th>
<th>3rd person reg. -s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonspeaking group</td>
<td>3.1</td>
<td>3.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Matched typical</td>
<td>4.4</td>
<td>4.0</td>
<td>3.15</td>
</tr>
</tbody>
</table>
didn't say sheeps" and (indignantly) "Hey but you can say one sheep or two sheep, so this one's not fair!"

The impression that typical children were adopting the strategy of looking for a plural marker in the initial noun phrase was supported by a post hoc analysis of responses to the third person regular -s items. Recall the format for this task: Three pictures were presented, two of which differed in their description by the presence or absence of the target grammatical morpheme; the child listened to a target sentence and selected the picture that went with the sentence; the grammatical morpheme was included in the target sentence on half of the items. If children based their responses to the third person regular -s items on the presence or absence of a plural marker in the initial noun phrase, (the "look for a plural marker" strategy), they would be correct for the three items where the third person regular -s was included (i.e., they would select the correct picture for "The sheep eats the grass"), but incorrect on the three items where the third person regular -s was excluded (i.e. they would select the incorrect picture for "The sheep jump over the fence.").

Children's responses to the third person regular items were reanalysed to determine the extent to which they appeared to be adopting the "look for a plural marker" strategy described above. Responses consistent with the strategy were scored 1, and responses inconsistent with this strategy were scored 0. The resulting total score is labeled the "plural marker strategy score." Children receiving a plural marker strategy score of 6 would have responded to all 6 items probing third person regular on the basis of the absence of a plural marker in the noun phrase, thus they would have been
correct on three items such as "The sheep eats the grass," but would have incorrectly interpreted three items such as "The sheep jump over the fence" as referring to a single subject.

Table 8 presents the results of this analysis, giving the mean plural marker strategy score for the nonspeaking and matched typical high and low content vocabulary groups. A 2 (group) X 2 (vocabulary level) factorial ANOVA was completed on this data, and there was a significant effect for group, $F(1, 36) = 11.23, p = .002$. No other significant effects were found. Children in the matched typical group were more likely to respond to items assessing third person regular -s in a manner consistent with the "look for a plural marker" strategy, that is: they searched the initial noun phrase for a plural -s marker, and as there was no such marker, they selected the picture depicting a single subject. This finding was confirmed by subject-wise analysis of responses to the third person regular items. Seven children in the typical group received plural marker strategy scores of 5/6 or better, but none of the children in the nonspeaking group received a plural marker strategy score of 5/6 or better.

The observation that many typical children appeared to have adopted a "look for the plural marker" strategy would explain the performance of typical children in the low vocabulary group on the third person regular -s morpheme items, but it does not explain why typical children in the high vocabulary group did even more poorly than typical children in the low vocabulary group. Comments spontaneously offered by two children in the high content vocabulary typical group suggest that unlike most of their peers, they were in fact responding on the basis of the presence or absence
<table>
<thead>
<tr>
<th>Content Vocab. Comp.</th>
<th>Nonspeaking Group</th>
<th>Matched Typical Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low (n=10)</td>
<td>high (n=10)</td>
</tr>
<tr>
<td>Plural Marker</td>
<td>$M = 2.4$</td>
<td>$M = 2.8$</td>
</tr>
<tr>
<td>Strategy Score</td>
<td>$SD = 1.17$</td>
<td>$SD = 1.03$</td>
</tr>
</tbody>
</table>
of the third person regular -s morpheme. However, these children had formed a hypothesis about the interpretation of this grammatical morpheme which was leading them to make consistent errors. One child, when asked to find the picture for "The sheep eats the grass", said "Eats, eats... You said eats, so that means there's more than one." Another child carefully repeated back the verb in the target sentence before selecting the incorrect picture on all 6/6 items. These two children appeared to have been confusing the meaning of the plural -s with that of the third person regular -s, and their pattern of consistent errors pulled down the mean scores for this morpheme in the typical, high content vocabulary level group.

Children in the nonspeaking group, of course, cannot offer the interesting spontaneous comments that give clues as to the strategies they adopted in this task. However some general observations can be made. The items on this task were such that usually one of the three pictures could be eliminated as a possible choice on the basis of the semantics of the content words in the sentence stimuli. For example, on the item where the sentence stimulus was "The sheep eats the grass," the children selected from a picture of one sheep eating grass, a picture of two sheep eating grass, or a picture of two sheep jumping over the fence. This last picture could be eliminated on the basis of not matching the semantic information in the verb eat. In fact, this appears to be the strategy most often adopted by children in the nonspeaking group: the semantically incorrect selection was chosen by the nonspeaking children only 7% of the time. They selected the correct picture 53% of the time, and 40% of the time they selected the incorrect picture that matched the semantic information in the target sentence was selected.
A subject-wise analysis of the results of the comprehension task was also conducted to confirm that trends in the individual children's scores were accurately reflected in trends in the group data. For each grammatical morpheme, the scores of each subject were evaluated in relation to the probability of achieving that score by chance alone. Recall that there are 6 items probing comprehension of each grammatical morpheme. Given a multinomial distribution of three choices, the probability of obtaining a result of 5/6 or better for any one grammatical morpheme is approximately .02. Only 6 children in the nonspeaking group achieved 5/6 or better on one grammatical morpheme, whereas 15 children in the typical speaking group achieved this result on one or more grammatical morpheme. Table 9 compares the numbers of children in the two groups who achieved significantly better-than-chance scores for each grammatical morpheme, given an alpha level of .05. This subject-wise analysis confirms the trends seen in the group data: More typical children than nonspeaking children appeared to have mastered past tense -ed and possessive 's. The results for third person regular -s were quite different, with the same number of typical children and nonspeaking children mastering this grammatical morpheme, and no typical children with high content vocabulary levels demonstrating mastery of third person regular on this test.

**Grammaticality Judgment Task**

As predicted, the nonspeaking group achieved lower scores (Mean = 11.8, SD = 2.44) than the typical speaking group (Mean = 14.7, SD = 4.18) on the
Table 9
Number of Children Achieving 5/6 or Better* on Comprehension Test Items for Three Grammatical Morphemes: Nonspeaking vs. Matched Typical Groups

<table>
<thead>
<tr>
<th>Content Vocab. Comp.</th>
<th>Nonspeaking Group</th>
<th>Matched Typical Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low (n = 10)</td>
<td>high (n = 10)</td>
</tr>
<tr>
<td>past tense -ed</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>possessive 's</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3rd person regular -s</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

*p = .02.
grammaticality judgment task. Again, preliminary analysis of the data indicated an apparent interaction involving content vocabulary level, so subjects were dichotomized as described above into those with low content vocabulary comprehension levels and those with high content vocabulary comprehension levels. Table 10 shows the mean scores and standard deviations for these groups on the grammaticality judgment task. Figure 2 presents this information graphically.

A 2 (group) X 2 (content vocabulary level) X 3 (grammatical morphemes) mixed model ANOVA was conducted. Significant main effects were found for group, $F(1, 36) = 10.56$, $p = .002$, and for content vocabulary level $F(1, 36) = 4.531$, $p = .04$, and the interaction between group and content vocabulary level was also significant $F(1,36) = 15.38$, $p = .0004$. No other significant effects were found.

Main effects were subsumed in the interaction effect. Simple effects analysis of the group X content vocabulary level interaction indicated that there was a significant difference between the nonspeaking and matched typical groups at the high content vocabulary level only, $F(1, 36) = 77.11$, $p = <.05$. Children in the high content vocabulary typical group performed better than the children in the high content vocabulary nonspeaking group. For children with low content vocabulary comprehension levels there was no significant difference between the nonspeaking and matched typical groups.

Recall that in this task children were asked to indicate whether or not sentences "sounded okay." Comments by children in the typical group
Table 10:
Grammaticality Judgment Task Results:
Typical versus Nonspeaking Group,
High vs. Low Content Vocabulary Comprehension Levels

<table>
<thead>
<tr>
<th>Content Vocab. Comp. Level</th>
<th>Nonspeaking Group</th>
<th>Matched Typical Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low (n=10)</td>
<td>high (n=10)</td>
</tr>
<tr>
<td>past tense -ed</td>
<td>$M = 3.6$</td>
<td>$M = 3.2$</td>
</tr>
<tr>
<td></td>
<td>$SD = .97$</td>
<td>$SD = 1.03$</td>
</tr>
<tr>
<td>possessive 's</td>
<td>$M = 4.3$</td>
<td>$M = 4.0$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.34$</td>
<td>$SD = .82$</td>
</tr>
<tr>
<td>3rd person regular -s</td>
<td>$M = 4.7$</td>
<td>$M = 3.8$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.42$</td>
<td>$SD = 1.48$</td>
</tr>
<tr>
<td>Total score (max = 24)</td>
<td>$M = 12.6$</td>
<td>$M = 11$</td>
</tr>
<tr>
<td></td>
<td>$SD = 2.32$</td>
<td>$SD = 2.4$</td>
</tr>
</tbody>
</table>
Figure 2: Grammaticality judgment task results: Nonspeaking vs. matched typical groups, low vs. high content vocabulary levels, for 3 grammatical morphemes: past tense -ed, possessive 's, and third person regular -s.
suggested that typical children in the lower content vocabulary comprehension level group were unable to maintain the task set of making judgments based on the grammaticality of the sentence, and often reverted to answering based on their world knowledge about the truth value of the statement. For example, many children judged that the sentence "The horses eat the carrots" was not okay. Several typical speaking children in the low content vocabulary level group spontaneously commented that "Horses don't eat carrots. They eat grass" (or "hay," or "horsefood").

A subject-wise analysis was also carried out on this data, to confirm that trends identified in the group data held true for individual subjects. In the subject-wise analysis, the scores of each subject for each grammatical morpheme were evaluated in relation to the probability of achieving that score by chance alone. Recall that there are 8 items probing ability to make grammaticality judgments for each grammatical morpheme. Given a binomial distribution of two choices (judged to be grammatical or judged to be ungrammatical), the probability of obtaining a result of 7/8 or better for any one grammatical morpheme is .035. Only 1 child in the nonspeaking group achieved 7/8 on one grammatical morpheme, whereas 8 children in the typical speaking group achieved this result on one or more grammatical morpheme(s). Table 11 compares the numbers of children in the two groups who achieved significantly better-than-chance scores for each grammatical morpheme on the grammaticality judgment task, given an alpha level of .05, and confirms that patterns revealed in the group analysis were also obtained in the subject-wise analysis.
Table 11
Number of Children Achieving 7/8 or Better* on Grammaticality Judgment Test Items for Three Grammatical Morphemes: Nonspeaking versus Matched Typical Groups

<table>
<thead>
<tr>
<th>Content Vocabulary</th>
<th>Nonspeaking Group</th>
<th>Matched Typical Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>low (n=10)</td>
<td>high (n=10)</td>
</tr>
<tr>
<td>past tense -ed</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>possessive 's</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3rd person regular -s</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* p = .035.
Structured Output Task

Recall that the structured output task was given to children whose parents and/or speech-language pathologists answered affirmatively to the question "Can this child independently write or type a brief phrase or sentence?"

Eight children in the nonspeaking group and six children in the typical group were reported to be able to do so, and were therefore given this task. Information on the chronological ages and PPVT age equivalents of these 14 children is summarized in Table 12. Because of the small numbers of children completing this task inferential statistics were not computed, but descriptive information of the results will be presented. Recall that on this task each child had a total of 18 opportunities to include grammatical morphemes in obligatory contexts in written or typed output, which was elicited via a cloze procedure. The mean score for children in the typical group on this task was 12.5 (SD = 6.86).

The performance of the eight children in the nonspeaking group who were reported to produce text independently stands in striking contrast to that of the children in the typical group. In the nonspeaking group only one child included a grammatical morpheme in 4/18 opportunities, one child included a grammatical morpheme in 3/18 opportunities, and one child included a grammatical morpheme once. The remaining five children never included a grammatical morpheme in their written responses. The

---

4 The typical group included one youngster who despite parental report to the contrary, appeared to be able to spell only a few memorized words and whose responses consisted of seemingly randomly generated strings of letters. This child received credit for only one correct response, and her performance obviously depressed the group mean. Although it appears clear that she should not be considered literate, her results are nevertheless included in order to be conservative in guarding against Type I error.
Table 12
Chronological Age and Peabody Picture Vocabulary Test Results for Children in Nonspeaking Group and in Matched Typical Group Who Were Given the Structured Output Task

<table>
<thead>
<tr>
<th></th>
<th>Nonspeaking Group (n=8)</th>
<th>Typical Group (n=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronological Age</td>
<td>$M = 11;3$</td>
<td>$M = 7;5$</td>
</tr>
<tr>
<td></td>
<td>(SD = 40.41)</td>
<td>(SD = 12.11)</td>
</tr>
<tr>
<td>PPVT age equivalent</td>
<td>$M = 7;2$</td>
<td>$M = 7;10$</td>
</tr>
<tr>
<td></td>
<td>(SD = 14.04)</td>
<td>(SD = 10.52)</td>
</tr>
<tr>
<td>PPVT standard score</td>
<td>$M = 71.5$</td>
<td>$M = 104.5$</td>
</tr>
<tr>
<td></td>
<td>$SD = 8.69$</td>
<td>$SD = 7.12$</td>
</tr>
<tr>
<td></td>
<td>(2 children below norms)</td>
<td></td>
</tr>
</tbody>
</table>
mean score for children in the nonspeaking group on this task was 1 (SD = 1.6).

Errors were analyzed to determine if those committed by children in the nonspeaking group were due specifically to difficulties with the grammatical morpheme. Of the 136 errors made by the nonspeaking children, the vast majority (109, or 80%) consisted of the target root word, but without the grammatical morpheme (i.e., play instead of played; Kate instead of Kate's, etc.). The remaining errors consisted of indecipherable words, words that were neither semantically plausible nor grammatically acceptable (e.g., "This teddy bear always will a big blue hat"), or words that were semantically plausible, but grammatically incorrect (e.g., "She lie on the couch", when the target was looked). There were only three instances where the child was unable to supply any word at all.

Table 13 compares the response types of children in the nonspeaking group to those of children in the typical group. In both groups, omission of the grammatical morpheme is a common error. The striking difference lies in the frequency with which this error occurred. Overall, the children in the nonspeaking group produced the root word but omitted the grammatical morpheme 76% of the time, whereas children in the typical group did this only 13% of the time.

Summary of Results: Nonspeaking vs. Matched Typical Groups
On a task probing comprehension of grammatical morphemes, with the exception of items assessing comprehension of third person regular -s, the children who were nonspeaking performed more poorly than typical
Table 13
Comparison of Response Types on Structured Output Task:
Typical versus Nonspeaking Group

<table>
<thead>
<tr>
<th>Response type:</th>
<th>Typical Group (108 responses)</th>
<th>Nonspeaking Group (144 responses)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>% of total responses</td>
</tr>
<tr>
<td>correct grammatical morpheme</td>
<td>75</td>
<td>69%</td>
</tr>
<tr>
<td>omission of grammatical morpheme</td>
<td>14</td>
<td>13%</td>
</tr>
<tr>
<td>substitution of incorrect grammatical morpheme</td>
<td>2*</td>
<td>2%</td>
</tr>
<tr>
<td>semantically plausible, no grammatical morpheme</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>semantically implausible, no grammatical morpheme</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>Indecipherable</td>
<td>17**</td>
<td>16%</td>
</tr>
<tr>
<td>No response/Don't know</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* In both cases this was substitution of past tense when the target was third person regular

** These were all attributable to the one youngster who appeared to be unable to spell.
children matched by comprehension level for content vocabulary. Post hoc analyses suggested that the anomalous results for the third person regular form can be attributed to two phenomena: many typical children appeared to attend to the noun phrase for information regarding number, and were apparently unaware that nouns such as sheep and deer do not take an overt plural marker. These children tended to interpret all of the target sentences assessing this grammatical morpheme as singular. Other typical children appeared to be confused due to the homonymity of this grammatical morpheme with the plural -s and thus made consistent errors in interpretation of this morpheme. Post hoc analysis of the responses to the third person regular -s items by the nonspeaking group suggested they were eliminating the picture that did not match the target sentence semantically, then arbitrarily selecting between the remaining two pictures.

The impression that children in the nonspeaking group had greater difficulty with grammatical morphology was further supported by results of a grammaticality judgment task. Children with lower vocabulary comprehension levels in both the nonspeaking and the typical matched group had difficulty with this task, but typical children with higher content vocabulary levels showed increased awareness of the rules governing the use of grammatical morphemes, as evidenced by their performance on this task. No significant improvement was seen in the nonspeaking group, who generally performed at chance levels on this task.

Finally, striking differences in the use of grammatical morphology in a structured output task were observed between literate children in the
nonspeaking group versus literate children in the typical group. Children in the nonspeaking group usually omitted grammatical morphemes in text output, whereas children in the typical group usually included them.

Nonspeaking Children Versus Atypical Speaking Children

The results summarized above indicate that children who are nonspeaking have more difficulty in the acquisition of grammatical morphology than one would expect, given their knowledge of content vocabulary as measured by the PPVT. However, these results do not tell us if this difficulty is peculiarly characteristic of children who are nonspeaking, or whether any group of children with language delays as evidenced by depressed performance on the PPVT would also show this profile on these tasks.

To explore this question, a group of speaking children with delayed language development was assembled, and the performance of this "atypical speaking" group was compared to that of the nonspeaking group described above. As the difficulties exhibited by the nonspeaking children were hypothesized to be related to lack of productive language experiences, it was predicted that the atypical speaking group would do better on the three experimental tasks than the nonspeaking group.

The distribution of the PPVT age equivalent scores of the subjects in the atypical speaking group was such that it was not possible to dichotomize the two groups into similarly sized high and low content vocabulary level groups as was done in the comparisons between the nonspeaking and
atypical speaking groups. Therefore, in the analyses described below, comparisons will be made between the nonspeaking and atypical groups as a whole.

**Comprehension Task**

The prediction was that children in the atypical speaking group would do better on the comprehension task than children in the nonspeaking group. Table 14 compares the results of the nonspeaking group compared to those of the atypical speaking group. This table gives mean scores and standard deviations on each grammatical morpheme and shows that, as predicted, the nonspeaking group consistently achieved lower scores than the atypical speaking group.

A 2 (group) x 3 (grammatical morpheme) mixed model ANOVA was used to analyze these results. The main effect for group was found to be significant, \( F (1,33) = 4.75, p = .037 \), and there were no other significant effects.

Subject-wise analysis of the results of the comprehension task was completed to confirm that trends in the individual subjects' scores were accurately reflected in trends in the group data. For each grammatical morpheme, the scores of each subject were evaluated in relation to the probability of achieving that score by chance alone. Recall that only 6 of the 20 children (30%) in the nonspeaking group achieved 5/6 or better on items assessing any one grammatical morpheme. In the atypical speaking group 7 of the 15 children (47%) achieved this result for one or more grammatical morpheme. Table 15 compares the numbers and percentages
Table 14
Grammatical Morpheme Comprehension Task: Atypical Speaking versus Nonspeaking Group.

<table>
<thead>
<tr>
<th></th>
<th>Nonspeaking Group</th>
<th>Atypical Speaking Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=20)</td>
<td>(n=15)</td>
</tr>
<tr>
<td>past tense -ed</td>
<td>$M = 3.1$</td>
<td>$M = 4.0$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.07$</td>
<td>$SD = .85$</td>
</tr>
<tr>
<td>possessive 's</td>
<td>$M = 3.0$</td>
<td>$M = 3.53$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.12$</td>
<td>$SD = 1.13$</td>
</tr>
<tr>
<td>3rd person regular -s</td>
<td>$M = 3.2$</td>
<td>$M = 3.47$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.11$</td>
<td>$SD = 1.19$</td>
</tr>
<tr>
<td>Total score</td>
<td>$M = 9.3$</td>
<td>$M = 11$</td>
</tr>
<tr>
<td></td>
<td>$SD = 2.25$</td>
<td>$SD = 2.33$</td>
</tr>
</tbody>
</table>
of children who achieved significantly better-than-chance scores for each grammatical morpheme, given an alpha level of .05. For ease of comparison, information about children in the matched typical group is also presented in this table. As predicted, for all three grammatical morphemes a higher percentage of children in the atypical speaking group than in the nonspeaking group achieved 5/6 or better. Children in the atypical speaking group did not do as well as children in the matched typical group, however: There was a smaller percentage of children in the atypical speaking group than in the matched typical group who achieved the criterion for past tense -ed and possessive -s.

**Grammaticality Judgment Task**

The prediction was that children in the atypical speaking group would do better than children in the nonspeaking group on the grammaticality judgment task. Table 16 compares the results of the nonspeaking group to those of the atypical speaking group on this task, giving mean scores and standard deviations for each grammatical morpheme. Once again, as predicted, children in the atypical speaking group did better than the children in the nonspeaking group on each grammatical morpheme.

A 2 (group) x 3 (grammatical morpheme) mixed model ANOVA was used to analyze these results. The main effect for group was found to be significant, $F_{(1,33)} = 7.843$, $p = .008$, and the effect for grammatical morpheme was also found to be significant, $F_{(2,66)} = 3.67$, $p = .03$. There was no significant interaction effect. Children in the atypical speaking group performed significantly better on the grammaticality judgment task. The grammatical morpheme effect was further explored using the Tukey
Table 15
Children Achieving 5/6 or Better* on Comprehension Test Items for Three Grammatical Morphemes: Nonspeaking vs. Atypical Speaking vs. Matched Typical Groups

<table>
<thead>
<tr>
<th></th>
<th>Nonspeaking Group (n=20)</th>
<th>Atypical Speaking Group (n = 15)</th>
<th>Matched Typical Group (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>past tense -ed</td>
<td>1 (5%)</td>
<td>5 (30%)</td>
<td>11 (55%)</td>
</tr>
<tr>
<td>possessive 's</td>
<td>2 (10%)</td>
<td>3 (20%)</td>
<td>6 (30%)</td>
</tr>
<tr>
<td>3rd person regular -s</td>
<td>3 (15%)</td>
<td>3 (20%)</td>
<td>3 (15%)</td>
</tr>
</tbody>
</table>

*p = .02.
Table 16
Grammaticality Judgment Task:
Atypical Speaking versus Nonspeaking Group.

<table>
<thead>
<tr>
<th></th>
<th>Nonspeaking Group (n=20)</th>
<th>Atypical Speaking Group (n=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>past tense -ed</td>
<td>$M = 3.4$</td>
<td>$M = 4.4$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.0$</td>
<td>$SD = 1.18$</td>
</tr>
<tr>
<td>possessive 's</td>
<td>$M = 4.15$</td>
<td>$M = 4.8$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.09$</td>
<td>$SD = 1.15$</td>
</tr>
<tr>
<td>3rd person regular -s</td>
<td>$M = 4.25$</td>
<td>$M = 4.73$</td>
</tr>
<tr>
<td></td>
<td>$SD = 1.48$</td>
<td>$SD = .96$</td>
</tr>
<tr>
<td>Total score</td>
<td>$M = 11.8$</td>
<td>$M = 13.93$</td>
</tr>
<tr>
<td></td>
<td>$SD = 2.44$</td>
<td>$SD = 1.9$</td>
</tr>
</tbody>
</table>
procedure with alpha = .05. This analysis indicated that there was a significant difference between -ed and -s, and between -ed and 's (HSD = .49). Scores on past tense -ed items were, overall, lower than scores on possessive 's and third person regular -s items.

Subject-wise analysis of the results of the grammaticality judgment task was completed to confirm that trends in the individual subjects' scores were accurately reflected in trends in the group data. For each grammatical morpheme, the scores of each subject were evaluated in relation to the probability of achieving that score by chance alone. Recall that only one child in the nonspeaking group achieved 7/8 or better on items assessing any one grammatical morpheme. In the atypical speaking group two of the 15 children achieved this result. Clearly, the grammaticality judgment task was extremely difficult for both the atypical speaking children and the nonspeaking children. Table 17 compares the numbers and percentages of children who achieved significantly better-than-chance scores for each grammatical morpheme, given an alpha level of .05. For ease of comparison, information about the matched typical children is also presented in this table. The matched typical group did much better than the other two groups on this task.

**Structured Output Task**

A total of seven children in the atypical speaking group were reported to be able to independently write or type a short phrase or sentence, and were therefore given the structured output task. Of these seven, three children were described as having a language learning disorder, two children were
Table 17
Children Achieving 7/8 or Better* on Grammaticality Judgment Task Items for Three Grammatical Morphemes: Nonspeaking vs. Atypical Speaking Group vs. Matched Typical Group

<table>
<thead>
<tr>
<th></th>
<th>Nonspeaking Group (n=20)</th>
<th>Atypical Speaking Group (n = 15)</th>
<th>Matched Typical Group (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>past tense -ed</td>
<td>-</td>
<td>-</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>possessive 's</td>
<td>1 (5%)</td>
<td>1 (7%)</td>
<td>4 (20%)</td>
</tr>
<tr>
<td>3rd person regular -s</td>
<td>-</td>
<td>1 (7%)</td>
<td>3 (15%)</td>
</tr>
</tbody>
</table>

*p = .03.
described as developmentally delayed, one child had fragile x syndrome, and one child had metatrophic dwarfism. These children were, on average, 10 months younger than children completing the structured output task in the nonspeaking group. Table 18 compares the chronological ages and PPVT results of the literate atypical speaking children to the literate nonspeaking children.

Because of the small numbers of children descriptive information only will be presented. Recall that in the nonspeaking group the mean score on this task was 1 (SD = 1.6), the highest score was 4/18 and five of the eight children scored 0/18. In the atypical speaking group a mean of 7.86 grammatical morphemes were included (SD = 5.5). The data were bimodally distributed: Three of the children in the atypical speaking group (two children with language disorders and one child with developmental delay) included 4 or fewer grammatical morphemes. The remaining four children included 9 or more morphemes.

Children in the atypical speaking group were more likely than either the nonspeaking group or the typical group to produce the correct root with the incorrect grammatical morpheme. In all cases this involved substituting a past tense form when the target grammatical morpheme was 3rd person regular -s (e.g., substituting "This teddy bear always wore a blue hat" instead of "This teddy bear always wears a blue hat"). Children in the atypical group did this in 7.14% of their responses (42.86% of the third person regular probes), whereas children in the typical group did this in only 1.85% of their responses (11.12% of the third person regular probes), and nonspeaking children never made this error.
Table 18
Chronological Age and Peabody Picture Vocabulary Test Results for Children in Nonspeaking Group and in Atypical Speaking Group Completing the Structured Output Task

<table>
<thead>
<tr>
<th></th>
<th>Nonspeaking Group (n=8)</th>
<th>Atypical Speaking Group (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chronological Age</strong></td>
<td>$M = 11;3$</td>
<td>$M = 10;5$</td>
</tr>
<tr>
<td></td>
<td>$SD = 40.41$</td>
<td>$SD = 31.04$</td>
</tr>
<tr>
<td><strong>PPVT age equivalent</strong></td>
<td>$M = 7;2$</td>
<td>$M = 6;9$</td>
</tr>
<tr>
<td></td>
<td>$SD = 14.04$</td>
<td>$SD = 13.34$</td>
</tr>
<tr>
<td><strong>PPVT standard score</strong></td>
<td>$M = 71.5$</td>
<td>$M = 72.17$</td>
</tr>
<tr>
<td></td>
<td>$SD = 8.69$</td>
<td>$SD = 14.02$</td>
</tr>
<tr>
<td></td>
<td>(2 children below norms)</td>
<td>(1 child below norms)</td>
</tr>
</tbody>
</table>
Table 19  
Comparison of Response Types Between Nonspeaking, Atypical Speaking, and Typical Groups on Structured Output Task

<table>
<thead>
<tr>
<th>Response type</th>
<th>Nonspeaking Group (144 responses)</th>
<th>Atypical Speaking Group (126 responses)</th>
<th>Typical Group (108 responses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>correct grammatical morpheme</td>
<td>8 6%</td>
<td>58 46%</td>
<td>75 69%</td>
</tr>
<tr>
<td>omission of grammatical morpheme</td>
<td>109 76%</td>
<td>49 39%</td>
<td>14 13%</td>
</tr>
<tr>
<td>substitution of incorrect grammatical morpheme</td>
<td>0 --</td>
<td>9* 7%</td>
<td>2* 2%</td>
</tr>
<tr>
<td>semantically plausible, no grammatical morpheme</td>
<td>4 3%</td>
<td>1 &lt;1%</td>
<td>0 --</td>
</tr>
<tr>
<td>semantically implausible, no grammatical morpheme</td>
<td>5 3%</td>
<td>7 6%</td>
<td>0 --</td>
</tr>
<tr>
<td>Indecipherable response</td>
<td>15 10%</td>
<td>2 2%</td>
<td>17** 16%</td>
</tr>
<tr>
<td>No response/Don't know</td>
<td>3 2%</td>
<td>0 --</td>
<td>0 --</td>
</tr>
</tbody>
</table>

* In every case, this was substitution of past tense for 3rd person regular.
** These were all attributable to one youngster who appeared to be unable to spell.
Summary of Results: Nonspeaking vs. Atypical Speaking Groups
As predicted, the atypical speaking group performed better than the nonspeaking group on all three tasks measuring acquisition of grammatical morphology. On the language comprehension task a significant group difference was found, with the nonspeaking group performing more poorly than the atypical speaking group. Both groups struggled with the grammaticality judgment task, but again there was a significant group difference with the nonspeaking group performing more poorly. There was also a significant effect for grammatical morpheme on this task. On the structured output task, three of the seven literate children in the atypical group performed similarly to the children in the nonspeaking group, including 4 or fewer grammatical morphemes in 18 opportunities. However, four of the seven children included 9 or more grammatical morphemes, performing similarly to children in the typical group.

Summary of Main Results by Research Question

The first research question was: Do children who are nonspeaking exhibit more difficulty in the acquisition of grammatical morphology than would be predicted by their knowledge of content vocabulary? To answer this question, the performance of a group on nonspeaking children was compared to that of a group of speaking children, matched to the nonspeaking group on a measure of content vocabulary. The results from
three different tasks probing acquisition of grammatical morphology quite clearly suggest that nonspeaking children do have more difficulty.

On the comprehension task the nonspeaking group performed more poorly on two of the three grammatical morphemes tested. The anomalous result for items assessing the third person regular -s grammatical morpheme is explained by the fact that many of the children in the typical group responded on the basis of the absence of a plural marker in the noun phrase, and some of the children in the typical group had an erroneous hypothesis about the meaning of this grammatical morpheme. In contrast, children in the nonspeaking group largely ignored the grammatical morpheme when selecting their responses.

The grammaticality judgment task was very difficult for the typical children with low content vocabulary levels, but those with higher content vocabulary levels performed significantly better than children in the nonspeaking group, all of whom generally responded at chance level. Performance on the structured output task was also markedly different between the two groups. Children in the nonspeaking group tended to omit grammatical morphemes in their output, and children in the typical group tended to include them.

It is my contention that the difficulty with grammatical morphology is related specifically to the impact of an inability to speak. However, a potential counterargument would be that the difficulties observed in the nonspeaking group would have been seen in any group that was composed predominantly of children with low PPVT scores relative to same-age
peers, regardless of whether or not they were able to speak. The second research question, included to allow response to that potential counterargument, was: If children who are nonspeaking do have difficulty in the acquisition of grammatical morphology, is this difficulty more pronounced than that seen in speaking children with similarly delayed levels of content vocabulary?

To answer this question a group of speaking children was assembled with a similar mean content vocabulary level and chronological age to that of the nonspeaking group. Performance of this atypical speaking group was compared to that of the nonspeaking group on the three tasks. The atypical speaking group performed significantly better than the nonspeaking group on both the comprehension task and the grammaticality judgment task, although the latter was clearly very difficult for both groups. On the structured output task three of seven atypical speaking children performed similarly to the children in the nonspeaking group, but four of the seven children performed similarly to the children in the typical group. Taken together, these results suggest that particular difficulty with grammatical morphology is not an inevitable sequela of low content vocabulary comprehension levels. Thus it is highly unlikely that the difficulties with grammatical morphology evidenced by the nonspeaking group could be attributed solely to the presence of general language or cognitive delays.
The seeds for this dissertation topic were planted when, in the course of my clinical practise, I met two young children who had lost the ability to speak at about the time they entered school. I was struck by the quality and grammaticality of their written output, so unlike the written output of other nonspeaking children I had known. This observation led me to consider the role of these children's early experiences as speakers in their acquisition of grammatical morphology. I reasoned that children who are unable to speak are deprived of important motivational sources that push acquisition of grammatical morphology -- i.e., the image of self as a speaker, the struggle to convey subtle meaning distinctions, and the desire to sound like their language models. Furthermore, by virtue of being unable to speak, children's intentional and unintentional influences on the language input of others are decreased, and overt practise of grammatical morphemes in the process of being acquired is not possible. For all of these reasons, I predicted that children who were nonspeaking would have difficulty in acquiring grammatical morphology, a prediction that this dissertation explored and confirmed.

I found that, compared to a group of typically developing children with the same comprehension level for content vocabulary, a group of children who are nonspeaking showed difficulty in two different measures of acquisition of grammatical morphology, a comprehension task and a grammaticality judgment
task. Furthermore, those children in the nonspeaking group who were able to produce written output were much more likely to omit grammatical morphemes in a structured written output task than the literate children in the typical group. To rule out the possibility that these results would be seen in any group of children with low content vocabulary comprehension levels regardless of their ability to speak, a group of "atypical speaking" children were also given the three experimental tasks. Although as a group the atypical speaking youngsters did not do as well as children in the typical group, their performance on all three tasks was superior to that of children in the nonspeaking group. The atypical speaking group included some children with specific language impairments, a population known to have difficulty in the acquisition of grammatical morphology (Johnston & Schery, 1976), so it is not unexpected that they would perform more poorly than the typical group. That the nonspeaking group had more difficulty than the atypical speaking group, despite the fact that the latter included children with specific language impairments, is particularly persuasive evidence for the argument that the difficulty in acquiring grammatical morphology was related to the inability to speak.

Reconciling the results of this study with the literature, the two previous studies whose results are most clearly at odds with these results are the work of Bishop et al. (1990) and Stromswold (1994). Bishop et al. failed to find significant differences on a measure of comprehension of grammatical forms and structures between anarthric and dysarthric groups and controls matched for level of physical disability; and Stromswold presented a case study of one nonspeaking child with impressive knowledge of grammatical morphology. These two studies will be considered in turn.
Two potentially important differences between my study and that of Bishop et al. were identified in chapter 2. These are the language level of the participants and the measure of acquisition of grammar. In Bishop's study, the mean age equivalent on a content vocabulary measure similar to the PPVT ranged from 8;0 to 10;1 for the various groups. In contrast, the mean PPVT age equivalent for participants in my study was 6;1 for the nonspeaking group, and 6;2 for the matched typical group and the atypical speaking group. Furthermore, participants in Bishop's study were, on average, almost five years older than the participants in my study. Bishop's subjects were therefore chronologically older and had a higher content language comprehension level. It would be interesting to see if the differences I found in my study would be replicated in a study with older participants and/or participants with even higher content vocabulary levels. However, given that even the older nonspeaking participants in my study exhibited difficulties with grammatical morphology, I suspect that the important difference between the studies lies in the measure of acquisition of grammar.

Bishop employed the Test of Reception of Grammar (TROG), a measure of comprehension of grammatical forms and structures that requires the individual to select pictures in response to phrases or sentences of increasing grammatical complexity. Other aspects of language are assessed in addition to grammatical morphology, including derivational inflections and adjectives. There is no reason to expect that children who are unable to speak would have more difficulty with adjectival forms. English derivational morphemes are similar to English inflectional morphemes in that they tend to have low perceptual salience, but because they carry a greater information load than grammatical morphemes, children who are unable to speak may be more likely to acquire these morphemes as a result of attempts to comprehend. Only 4 of the 80 items on this test appear to
specifically tap comprehension of bound inflectional morphemes. In contrast, my study looked at the acquisition of three grammatical morphemes, all of which were bound morphemes.

The grammatical morphemes examined in my study were all bound morphemes because I specifically selected morphemes that were acquired relatively later and that had low perceptual salience. The rationale for this decision was as follows: Since I was predicting a delay rather than an absence of knowledge of grammatical morphology, and since the experimental procedures (especially the grammaticality judgment task) were appropriate only for children of four years and above, I wanted to examine grammatical morphemes most likely to still show delays at this relatively late (for grammatical morphemes) period in the developmental sequence. Since perceptual salience is one of the factors that influences how difficult a grammatical morpheme is to acquire, grammatical morphemes that are acquired later are also likely to have low perceptual salience. Also, morphemes with low perceptual salience were considered to be more likely to be overlooked in the comprehension situation. Therefore low perceptual salience and relatively late acquisition were two of the criteria used when selecting which grammatical morphemes to study.

The other study whose results stand in direct contradiction to this work is the case study by Stromswold (1994). She reported on one 4-year-old nonspeaking child who demonstrated very impressive knowledge of many aspects of language, including the ability to make grammaticality judgments for subject-verb agreement. Stromswold was primarily interested in contributing to the debate on the role of negative evidence in language acquisition, concluding that the existence of this child "suggests that negative evidence is not necessary for
normal language development and, hence, that the ability to learn language is innate." Based on the results of my research and my clinical experience I believe that this child is quite unusual.

There are many ways of framing questions about the relationship between two factors in development. For example, one can ask: "Does anyone with factor x show normal y?" or, alternatively, "Is there a difference in y between those with factor x and those without?". The former is the type of question that Stromswold asked in her case study, and the latter is the type of question I asked in my research. If the question is: Does any person with a very severe speech impairment show acquisition of any grammatical morphemes, the answer is most certainly "yes." In addition to the child described by Stromswold, there are rare but well-known examples of adults who, though unable to speak, exhibited excellent productive control of language once they were given a means of producing written output, (e.g., Creech, 1984; Fourcin, 1975; Williams, 1984). These individuals prove that alternate routes to grammatical acquisition are possible. In my study as well, there was evidence that some children in the nonspeaking group had developed some awareness of grammatical morphology. This was seen in their performance on the comprehension task in particular, and also in the occasional inclusion of grammatical morphemes on the structured output task. This evidence of grammatical morphology acquisition is not contradictory to the arguments made in this dissertation, because I am not arguing that production is necessary for the acquisition of grammatical morphology. Rather I am arguing that certain kinds of production opportunities, specifically, those that require the child to attend to and make decisions about the selection of grammatical morphemes, facilitate acquisition of grammatical morphemes.
Candidate Explanations for the Results

Lack of Productive Control of Grammatical Morphology

The explanation I have offered for these results is that the lack of productive control of grammatical morphology impedes the acquisition of grammatical morphology in children who are nonspeaking. There are, as I have discussed, a number of likely reasons why language production experiences are important for the acquisition of grammatical morphology. An inability to speak or more accurately, the lack of productive control of grammatical morphology, has consequences that affect the language learning process on several different levels.

A lack of productive control of grammatical morphology affects the child's motivation to attend to a grammatical form: If the form is unexpressible, the child is not as motivated to decide what exactly it is and whether and how it is used. Once the grammatical morpheme is noticed and is being subjected to analysis by the child, a lack of productive control affects the quantity and quality of the language learning opportunities in which the child can participate. The child is unable to actively test hypotheses about the rules governing the use of a grammatical morpheme by controlling its introduction into communicative exchanges. Nor can the child overtly reauditorize and practise a form in the process of being acquired. A lack of productive control also impacts on the quality of the language input addressed to the child. There are informative cues in both the content and form of speaking children's utterances that cause caregivers to modify their input in ways that have been shown to facilitate language development in general and grammatical morphology in particular. These cues are severely diminished for caregivers of children who are unable to speak. This
study does not attempt to specify which of these consequences of lack of productive control is the most important in terms of the impact on acquisition of grammatical morphology. I assume that all of these consequences have a cumulative effect.

There are a number of alternate explanations for why the nonspeaking children in this study did poorly on the three tasks designed to tap acquisition of grammatical morphology. These explanations will be now be considered.

**By-product of Cognitive or Language Impairment**

The control group with the same mean chronological age and *PPVT* age equivalent scores was included to determine if any observed difficulty in acquisition in grammatical morphology in the nonspeaking group is more than would be predicted in any group with intellectual and/or language delays. The *PPVT* is a measure of comprehension of content vocabulary, not a measure of intellectual level, although there is a moderate correlation between the two. Matching on this variable made it unlikely that the observed group differences were related solely to intellectual or general language delays, but it does not rule out this explanation altogether. Serious consideration was given to trying to assemble a control group matched to the nonspeaking group by some measure of nonverbal intelligence. This avenue was ultimately abandoned because of the difficulties in finding a good measure of nonverbal intelligence that could be administered to children in this age range, some of whom had very severe physical impairments, and some of whom had severe cognitive impairments.

The *PPVT* has been shown to overestimate mental age in children with mild mental retardation, according to Fazio and Johnston (1993), who propose that the
knowledge of objects and events captured by this test is more influenced by experience. Perhaps matching by PPVT resulted in overall lower mental ages in the nonspeaking group compared to the typical group, and this accounted for the differences observed between these two groups. However, this would not explain the differences found between the atypical speaking group and the nonspeaking group where the mean chronological age and the mean PPVT age equivalent were the same. If the PPVT age equivalent overestimated mental age in the nonspeaking group, it would also have also overestimated mental age in the atypical speaking group.

It is possible that the group differences were due to the coincidental presence in the nonspeaking group of some sort of specific cognitive impairment such as impaired ability to test hypotheses. However, there is no reason to suspect that the nonspeaking group would be more likely to have such an impairment than the atypical speaking group.

**Fatigue Effects Related to Motor Impairment**

Probably the most likely alternate explanation is related to the number and severity of physical impairments in the nonspeaking group compared to the atypical speaking group. Some (but not all) of the nonspeaking group had significant gross motor impairments. Some of the children in the atypical speaking group also had motor impairments, although these were not as numerous or severe. The children with significant physical impairments likely had to expend proportionately more of their available cognitive and attentional resources on managing the motor demands of the experimental tasks. This could have resulted in greater fatigue and fewer internal resources to devote to the cognitive and linguistic demands of the experimental tasks. Every care was taken
to monitor the level of fatigue and physical discomfort of subjects with physical impairments, but this could still have been a factor.

Reduced Opportunities for Language Learning

It could also be argued that significantly different language learning experiences were afforded children in the nonspeaking group because of their physical impairment, rather than because of the fact that they were unable to speak, and this could have resulted in the observed group differences. Children with severe physical impairments often have health problems that necessitate hospital stays and school absences. Daily care activities such as eating, toiletting, getting dressed and undressed take more time, and this leaves less time for other types of learning activities including less instructional time in school (Koppenhaver & Yoder, 1993). Could these sorts of differences in language learning opportunities have accounted for the differences between the two groups? One would think that factors such as school absences and less instructional time would be more likely to affect content vocabulary knowledge than knowledge of grammatical morphology, since grammatical morphemes are relatively frequent and pervasive, whereas exposure to specific content vocabulary might be more tied to certain specific situations or experiences. Nevertheless the performance of a control group of atypical speaking individuals with similar levels of physical impairment would have been illuminating.

Hearing or Auditory Processing Problems

Impaired hearing in the nonspeaking group is an unlikely explanation, given that all participants were reported to have normal hearing, and all passed a contrastive pairs screening task indicating the ability to detect word final /s,z,t,d/. It is possible that children in the nonspeaking group had impaired acoustical
and/or phonological processing that accounted for their difficulties with grammatical morphology but did not affect performance on the contrastive pairs screening test. Difficulties with perceptual stimuli involving rapid acoustic events have been proposed as an explanation for impaired grammatical morphology in children with specific language impairments (SLI) (Tallal & Stark, 1981). Leonard (1992) notes that children with SLI are more successful in mastering the same phonetic forms in nonmorphonemic contexts (e.g., the /t/ in "wrist" vs in "kissed") and suggests that in the latter case the morphological complexity plus the perceptual demands overtax the limited resources of the child with SLI. By the same logic, it is possible that either a limited attentional capacity and/or perceptual deficit could be undetected by the contrastive pairs screening task since this did not require decoding of morphologically complex words, but could account for difficulties in the experimental tasks that did require decoding of morphologically complex words in sentences. However, there appears to be no reason to suspect that children in the nonspeaking group would be more likely to have these sorts of impairments than children in the atypical speaking group. In fact, given that the atypical speaking group included several children with SLI, one would think that the opposite would be more probable.

In summary, although one could conceive of a number of alternate explanations for why the nonspeaking children in this study did poorly on the three tasks designed to tap acquisition of grammatical morphology, the most likely explanation is that the observed difficulties are due to the consequences of lack of productive control of the grammatical morphology.
Limitations

There are several limitations to this work that must be acknowledged. Children in the nonspeaking group were not randomly selected from the population of children who are nonspeaking, and they differ in systematic ways from that population as a whole. Most obviously, these children were all able to obtain an age-equivalent score of at least 4;0 on the PPVT. These children overrepresent the more cognitively able end of the spectrum of individuals who are unable to speak. It is likely that the finding of difficulty with grammatical morphology is not clinically relevant for the AAC user with very limited cognitive abilities who is learning to use a simple AAC system to give communicative signals rather than as a vehicle for linguistic expression.

The grammatical morphemes assessed in this study were all bound inflectional morphemes. It would be interesting to repeat my study but with grammatical morphemes with relatively higher perceptual salience, such as pronouns or uncontracted auxiliary verbs. If the group differences disappear when grammatical morphemes with greater perceptual salience are probed, this would suggest that perceptual salience is the important variable in predicting which grammatical morphemes are likely to be problematic for individuals who are nonspeaking. Such a finding would have obvious implications for intervention. It would also suggest that the reasons the less perceptually salient morphemes are impacted have to do with the role that the production task plays in directing attention to a grammatical morpheme, and not the role it plays in allowing for experimentation and practice. If the child's inability to produce and experiment with a grammatical morpheme is important (i.e., during the period after a grammatical morpheme has been noticed but before it has been mastered), we
would expect acquisition of the relatively more salient grammatical morphemes to be affected by lack of production opportunities as well. Another way to determine if the important variable is perceptual salience would be to look at acquisition of grammatical morphology in nonspeaking individuals from another linguistic community such as Italian, where grammatical morphology is reported to be more saliently expressed.

Several methodological modifications would have allowed me to rule out alternative explanations for my results even more definitively. A more refined phonological discrimination screening task, including more items assessing consonant cluster discrimination, would have been stronger evidence against a perceptual deficit since often the addition of a grammatical morpheme results in a consonant cluster. A control group matched to the nonspeaking group by a measure of nonverbal intelligence would have added more weight to the argument that the differences seen are not due to differences in cognitive abilities. Similarly, a control group with more children with severe physical impairments would have added more weight to the argument that the differences seen are not due to different life experiences related to physical impairments. Also, as indicated above, it would have been informative to extend the PPVT age-equivalent range upwards to allow for a more direct comparison between my results and those of Bishop et al. (1990), and to determine if the difficulties with grammatical morphology appeared to resolve over time.

Implications for Theories of Spoken Language Development

This research is not a test of nativist versus interactionist theory, but I believe that it sits more comfortably in the interactionist camp. Currently popular views of
language acquisition suggest that "(a)s far as grammar learning goes, the child must be a naturalist, passively observing the speech of others, rather than an experimentalist, manipulating stimuli and recording the results" (Pinker, 1994, p. 281). Evidence that children who are unable to speak exhibit difficulty in the acquisition of grammatical morphology challenges this view. This outcome argues against a characterization of language acquisition as a relatively passive triggering process, suggesting that although production may not be necessary for language acquisition, it is important, contrary to the claims of Lenneberg (1962), Pinker (1994), and others. Although this study does not indicate which specific consequence(s) of being nonspeaking has a negative impact on acquisition of grammatical morphology, several factors have been suggested.

The circumstances of the child who is unable to speak provide fruitful ground for examining the relationship between language experiences and language acquisition. Specifically, these children provide a rare opportunity to determine what role production experiences play, since the potential for language production will depend almost entirely on the AAC system. Furthermore, the linguistic abilities of children who are unable to speak illuminates the extent to which various aspects of language can be acquired through comprehension experiences.

Some researchers in normal child language development may be surprised at the results of this study, given studies that suggest that in comprehension tasks, typical children can attend to grammatical morphology (and word order and argument structure) in order to make educated guesses about a word's meaning (e.g., Behrend, Harris & Cartwright, 1995) or part of speech (e.g., Brown, 1958; Taylor & Gelman, 1988). These studies are part of a very active line of research in
normal child language development that is exploring how children use what they know about syntax to narrow down the field of possible meanings of a word -- so-called "syntactic bootstrapping" (Gleitman, 1990). I will now consider whether findings from this line of research are incompatible with my assertions that comprehension experiences alone are not optimal for acquisition of grammatical morphology and that production experiences are important. I believe that these results are not incompatible. Several studies that have employed comprehension tasks and have found sensitivity to grammatical morphology will be discussed in more detail in order to illustrate the points supporting this claim.

The previously cited study by Gerken and McIntosh (1993) showed that 21- to 28-month-old children who are producing two-word combinations are affected when a grammatical morpheme is misused, as they had more difficulty in responding to "Find was dog for me" versus "Find the dog for me." This suggests that children at this age recognize when something sounds not quite right. The Naigles et al. study described by Hirsh-Pasek and Golinkoff (1993) and previously summarized in chapter 2 suggested that children were aware of the contribution that the grammatical morpheme with made to the meaning of the sentence. That study showed 26- to 30-month-old children responding differently to "Big Bird is turning with Cookie Monster" versus "Big Bird is turning Cookie Monster". Based on these studies and others we can conclude that after having about a year's experience as language producers, typical children can exhibit some sensitivity to grammatical morphemes, and after about year's experience in attempting to produce word combinations, children appear to show comprehension of a grammatical morpheme, at least within the context of these experimental probes. However, these studies do not indicate how the children came to acquire this knowledge about grammatical morphology, more
specifically, the relative role that comprehension experiences and production attempts have played in getting the child to this point in the language acquisition process. Furthermore, although the experimental procedures used in these studies are comprehension tasks, this does not tell us if children usually attend to grammatical morphemes in early comprehension experiences.

It is possible that the experimental design of these studies push children to attend to grammatical morphology and to form hypotheses about their significance. By way of example, consider the "Big Bird is turning with Cookie Monster" scenario from the Naigles et al. study. In this study, the child is seated in front of two video screens, one showing Big Bird turning Cookie Monster, and one showing the two characters turning together. The child knows "Big Bird," "Cookie Monster," and "turning." The child hears a sentence "Big Bird is turning with Cookie Monster". There are no nonlinguistic cues such as direction of the speaker's gaze that he can consult to help him determine which screen to look at. Nor can he choose to look at one screen over the other based on "Big Bird", "Cookie Monster", or "turning", since both screens match this semantic information. Possibly, the child then searches his representation of the input for further cues, notices phonetic material (with) that he has never particularly analyzed before, and proceeds to hypothesize about its meaning. In other words, this study may represent the rare sort of comprehension task that would push the child to attend to and analyze the grammatical morpheme. If the child has ever noticed with before, or can recall having heard this phonetic string in any other context ("Come with Mommy," for example), he may be more likely to guess correctly about the meaning of this grammatical morpheme. But if the child had never previously noticed with, and could not recall having heard this word in any other context, he could just as easily form an incorrect hypothesis about its meaning.
The results of the experiment then would be that children would respond as if they have a hypothesis about the meaning of *with*, that some children would be consistently wrong, but more children would be consistently right. It would be interesting to know if some individual children did respond in a manner consistent with having formed an incorrect hypothesis about the meaning of *with* during this experiment.

Evidence that the children can be led by the experimental design to acquire linguistic material of interest is found in Behrend (1995). Recall that Behrend, Harris and Cartwright (1995) found that children appear to use the indirect partial correlation between the meaning of past tense -*ed* and result verbs, and present progressive -*ing* and action verbs, to guide their hypotheses about the meaning of nonsense verbs presented with one ending or the other. In a discussion of this line of experimentation, Behrend noted that he got the predicted result only when he used a within-subjects design that exposed children to both grammatical morphemes, but not when he used a between-subjects design. This suggests to me that rather than the experimental task uncovering a strategy that children use to guess the meaning of unknown verbs, it was actually the experimental task that led children to form the hypothesis about the relationship between the grammatical morpheme and the verb meaning.

The research cited above and similar studies demonstrate that very young children can, in the process of trying to comprehend language input, attend to and form hypotheses about grammatical morphemes. My research with children who are unable to speak suggests that if children do attend to and form hypotheses about grammatical morphemes within a comprehension task, it is probably because of what they have learned or are attempting to learn within the
task of language production. We should be cautious about assuming that very young children routinely attend to grammatical morphemes while engaged in the comprehension process in typical real life situations.

Researchers have devised some sensitive and inventive procedures to study children's understanding of language, such as the preferential looking paradigm described above. We can be fairly confident in saying that these procedures show us what children can figure out about language input. Given the possibility of testing effects we should be less confident in saying that these procedures show us what children usually have figured out at any given age, and given how different the experimental paradigms often are from children's real life experiences, we should be especially cautious about assuming that children have acquired their knowledge by the same processes that we tap into to determine what they know. In other words we need to distinguish between what children know, how we determine what children know, and how they have come to acquire this knowledge.

Implications for AAC Theory

The situation of the AAC user has been described as having to master at least two different communication codes (Light, 1989). The child must master the linguistic code(s) of the family and community in order to decode language input. In addition the child must learn how to use the AAC symbol system to encode output, and this involves learning the meaning of individual graphic symbols as well as any rules for their combination. A theoretical model of AAC must address the nature of the relationship between these codes.
The often unstated assumption is that both the AAC user and their communication partner formulate their message in the spoken language of the environment, but the AAC user then encodes the spoken language into the modality of the AAC system. In this view, the relationship between the input via spoken language and the output via the AAC system is analogous to the relationship between spoken language and language expressed in traditional orthography, morse code, or finger spelling, that is, that of a primary versus derived form of the same language (von Tetzchner et al., 1996).

One implication of adopting the primary form-derived form model is the assumption that language forms and structures evident in the output code are also present in the child's internal representation of the input code. However, a situation that clearly does not fit the primary form-derived form model is described by Romski and Sevcik (1993, 1996) in their longitudinal study of AAC symbol learning by youths with moderate or severe mental retardation and severe communication impairments. As part of this study, teachers and parents were taught to model use of the AAC system while speaking to the youths. Over the course of the study, some youths learned to comprehend the meaning of graphic symbols and to use them communicatively, despite the fact that they apparently had not acquired comprehension of the spoken word equivalent. For these youths, the AAC system functioned as both an input and an output form.

Romski and Sevcik's work indicates that the presence of a linguistic form or structure encoded in output via the AAC system does not necessarily signal the presence of that form or structure in the child's internal representation of the input language of the family or community. The converse is also true: The
absence of a linguistic form or structure in the output code of the AAC system does not necessarily signal the absence of that form or structure in the child's internal representation of the input language. Studies of speaking individuals who have been taught to communicate via AAC systems have revealed what appear to be modality-specific and/or symbol system-specific influences that result in characteristic patterns in output via the AAC system.

An example of such as study is that of Smith (1996a), who presented evidence to suggest that the pictographic nature of graphic symbols, such as Picture Communication Symbols (PCS) may lead children to use them as "global messages." Five typical speaking children were introduced to a puppet with whom they had to communicate by pointing to PCS symbols on a communication board, and over a ten-week period children were taught to communicate with the puppet using the PCS symbols in the context of games and pretend play activities. Smith then systematically assessed their comprehension of the spoken words and the graphic symbols, and their ability to describe pictures using spoken language and using PCS symbols. Among many interesting results, Smith noted that the children often produced single-word utterances in PCS while giving structurally complete spoken descriptions. For example, one child was asked to describe a picture of a girl sitting on a chair. Despite the fact that the symbols for GIRL, SIT, ON, and CHAIR were available and known to the child, and despite the fact that his spoken language description of the picture included all of these meaning elements, the child selected the PCS symbol SIT (a stick figure sitting on a chair) to describe the picture, apparently assuming that the symbol expressed all the necessary critical elements. Thus, even when it appears that the AAC system would allow for more complex constructions than what the individual is
producing, one cannot assume an underlying linguistic deficit by equating graphic symbol output to spoken language output.

Soto and Toro-Zambrana (1995) also provided evidence of the influence of the AAC symbol system (in this case Blissymbolics) on the formal properties of AAC output. In their study of Spanish Blissymbol-using adults they found that question forms followed Blissymbol patterns of word order rather than Spanish patterns. There was also evidence of an influence in the opposite direction -- that is, the influence of the formal properties of Spanish on the use of the Blissymbols. One individual consistently substituted the Blissymbol for the Spanish verb *ser* (to be) to convey the impersonal pronoun *se*, which is common in Spanish but was not represented on his AAC system.

Observations such as these have led to a questioning of the adequacy of the primary form-derived form model of the relationship between the language of the community and the AAC system output code: It looks like the relationship is just not that simple. Other possibilities that have been suggested as analogies for this relationship include bilingual situation of two linguistic codes (von Tetzchner, Grove, Loncke, Barnett, Woll, & Clibbens, 1996) or that of a formal language and a pidgin (Mills, 1994). Do children creolize AAC codes, going beyond that which is modelled in the AAC input? Should we be analyzing AAC output as a separate linguistic code, looking for modality-determined or modality-influenced substantiations of linguistic characteristics? Grove and her colleagues (Grove, 1996; Grove, Dockrell, & Woll, 1996) have attempted to do the latter in studies of the signed output of children with intellectual impairments who have been exposed to key word signing. They have identified patterns that suggest that these individuals creatively employ modality-specific characteristics such as changes
in hand shape, location of sign, and orientation of sign to convey meaning distinctions. These patterns are similar to characteristics seen in the undeniably linguistic systems of American Sign Language and British Sign Language. However, Grove et al. have concluded that although there is evidence of both creativity and contrastiveness in the sign output of these individuals, there is not enough evidence of arbitrary categorical features to grant this output linguistic status.

Whether or not the child's representation for the AAC output code is distinct from that of the input language, and whether or not it is linguistic, it is clear that these two codes can and do influence each other. We cannot assume language deficits on the basis of evidence from AAC output, but nor can we assume that telegraphic output via an AAC system is solely the result of modality or system effects, and bears no relation to the individual's underlying competence in the spoken language of the wider linguistic community. There appear to be complex bidirectional interactions between the AAC users' knowledge of the language of their environment, characteristics of that spoken language, and characteristics of the AAC systems. Where my work fits in is that it shows that characteristics of the AAC system (i.e., no productive control of grammatical morphology), influence the child's acquisition of the linguistic code of the community. This is the product of the AAC system's influence on the child's language learning opportunities. A comprehensive theoretical model of AAC will need to not only capture the nature of the individual's mental representation of input codes and output codes, it will need to capture the interactions and the influences these codes have on each other within a developmental context.
Clinical Versus Statistical Significance

Up to this point, I have described and discussed my results in terms of statistical significance. I would now like to make a distinction between statistical significance and clinical significance, and discuss my results in relation to the latter. The clinical significance of a statistically reliable group difference is determined by several factors. Bishop (1993) points out that even given a reliable group difference, if the size of the effect is small it would probably not be considered clinically significant. She proposes that clinical significance should be defined by whether or not performance falls "within accepted normal limits." Effect size is certainly one component of clinical significance, but I believe that two other components are also important. These are the time frame (i.e., the length of time that a difficulty persists) and its functional impact. An effect that is short-term and spontaneously resolves without any special intervention is unlikely to be regarded as clinically significant. Furthermore, even an effect that is clearly not "within normal limits" can be considered of no clinical interest if that difference has no noticeable present or future effect on the individual's daily functioning. For example, some 3-year-olds go through a period of quite dramatic and noticeable dysfluency. This is not usually deemed to be clinically significant unless it either persists longer than a few months or has the functional impact of causing considerable distress to the child or parents.

I will now examine my results in light of these three components of clinical significance: effect size, persistence of the difficulty, and impact on daily functioning. Looking first at effect size, on the comprehension task the mean score of the nonspeaking children fell more than one standard deviation below the mean for children in the typical group: This was true both for children with low
content vocabulary comprehension levels and children with high content vocabulary comprehension levels. In the grammaticality judgment task, there was no difference between the typical and nonspeaking groups for children with low content vocabulary levels, but this is likely because the metalinguistic task demands were too onerous for the youngest children. For children with high content vocabulary comprehension levels, the mean performance of the nonspeaking children fell almost two standard deviations below the mean for the typical group. The group difference on the output task was most striking of all. Children who were nonspeaking almost never included grammatical morphemes in this task in stark contrast to children in the typical group, who almost always did. The effect size on all three measures of acquisition of grammatical morphology is large enough, in my opinion, to support the claim for clinical significance.

The second factor to be considered when attributing clinical significance to a finding is the time frame, i.e., the persistence of the identified difficulty with grammatical morphology experienced by nonspeaking children. I have been discussing the difficulties that children who are nonspeaking have with grammatical morphology in terms of a delay, acknowledging that alternate routes to acquisition of grammatical morphology are clearly possible. There is certainly evidence that some individuals who are nonspeaking do develop very good control over grammatical morphology, so does this mean that this problem is short-term and will usually resolve on its own? Although this appears to happen in some cases, two observations suggest that persistent difficulties are more the norm. The previously described study by Kelford Smith et. al (1989) examining the written output of adolescent and young adult AAC users suggests that most literate AAC users continue to struggle with grammatical morphology, as
evidenced by errors in spontaneous written output. Also, participants in my study were as old as 17;1, and these older participants still showed difficulties in the acquisition of grammatical morphology. Therefore, it is concluded that, without intervention, difficulties in the acquisition of grammatical morphology tend to persist at least into adolescence and young adulthood.

The final component of clinical significance has to do with the impact of the difference on daily functioning. How important is it that individuals who are nonspeaking should have a good grasp of the grammatical morphology of their linguistic community? As I have suggested above, comprehension of grammatical morphology becomes increasingly important as the children leave the preschool years and the language addressed to them becomes more complex and decontextualized. Even earlier than this, a failure to attend to and appreciate grammatical morphemes may impede the acquisition of content vocabulary, given that typical children appear to use what they know about grammatical morphology to help form hypotheses about word meanings. Furthermore, difficulties in the use of grammatical morphology in written output will have an impact on both the clarity and the acceptability of written communication. The importance of good written communication skills both for academic success and ultimately for gainful employment cannot be underestimated (Light & McNaughton, 1993).

As McNaughton (1990) has pointed out, "It is of primary importance that, as a field, we strive for continuing growth that is relevant and purposeful, in order that the same process can be experienced by the individuals for whom our field developed" (p. 3). The effect size, persistence, and probable functional impact of
the difficulties with grammatical morphology that nonspeaking individuals experience all suggest that this is a relevant, clinically significant finding.

Clinical Implications

Given that this work was initiated by a clinical observation, it seems fitting that it should end with a discussion of clinical implications. The first clinical implication that can be drawn from this work concerns the need for careful assessment of the acquisition of grammatical morphology in children who are nonspeaking. Although an ideal clinical work-up of the child who is nonspeaking would include evaluation of all aspects of language (Beukelman & Mirenda, 1992; Roth & Cassatt-James, 1989), often this does not occur. Too often, the only information known about a child's understanding of language is that which can be gained by observations of the child in daily activities and familiar environments. There is much valuable information to be gained from such ecological observations and analyses, but it is not a good way to find out about what a child who is nonspeaking knows about grammatical morphology. Formal language tests can provide some information, but their administration to children with physical impairments can be very time-consuming, and the test adaptations that are often required make the application of the test norms highly suspect. Furthermore, the information gained in formal test administration is usually not detailed enough to aid in the selection of specific intervention targets (Miller & Paul, 1995). Because of these factors, and because the time demands for selecting, setting up, and learning to use an AAC system are extensive, often only a minimal amount of formal testing is conducted. Given current assessment
practices, difficulties with grammatical morphology in a child who is nonspeaking are therefore highly likely be overlooked. 

Because we now know that the acquisition of grammatical morphology is an area of probable difficulty for children who are nonspeaking, clinicians would be advised to routinely take the time to assess and monitor this area of language development more thoroughly. Informal test procedures such as the tasks used in this study could be employed for this purpose. Although these tasks are not standardized, the performance of children who are nonspeaking can be compared against norms for typically developing children.

This study also has implications for intervention with children who are nonspeaking, suggesting that perhaps we should be putting more emphasis on the design and prescription of AAC systems that give children productive control over grammatical morphology. However, as I indicated in the introduction, there are good reasons why grammatical morphemes are not often incorporated into AAC systems. Clinicians tend to select morphemes with higher information content given the vocabulary restrictions imposed by the AAC system. Furthermore the timing demands of face-to-face communication are such that systems that require the child to select separately each individual morpheme are too time-consuming and hence ineffective as communication tools in many situations. Obviously, AAC systems should continue to incorporate prestored phrases to enhance speed and effectiveness of communication, and clinicians

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5 In the course of gathering potential matched controls for this study I administered these tasks to 47 typically developing children between the ages of 4;0 and 8;11. Most 6- and 7-year-olds and all except one 8-year-old passed at least 5/6 items on the comprehension test probing past tense -ed and possessive 's. Most 7- and 8-year-olds could make at least 7/8 correct grammaticality judgments on the items probing past tense -ed and possessive 's.
should recognize that construction and production of multimorpheme utterances on a morpheme-by-morpheme basis will be too slow for most naturally occurring communication interactions. Therefore, for the acquisition of grammatical morphology to be enhanced by the prescription of an AAC system that allows for productive control over grammatical morphemes, provision of the system would probably need to be coupled with the provision of structured controlled opportunities for productive manipulation and construction of utterances incorporating these aspects of language.

Of course, it does not necessarily follow that because production opportunities push acquisition of grammatical morphology, the production task provides the only situation in which acquisition of these grammatical morphemes would be facilitated. For example, situations (rare in natural language environment of the preschooler) where comprehension of input depends crucially on the grammatical morpheme would also be predicted to be facilitative. These situations could be created and manipulated by a clinician within a therapy session. Furthermore, some procedures used in interventions with speaking children, such as focused stimulation and modeling (Johnston, 1985), could also be incorporated into interventions with children who are nonspeaking. If these intervention strategies are found to be effective with children who are nonspeaking, it may not be necessary to sacrifice speed or informativeness of a child's AAC system by including grammatical morphemes. A logical next research step would be the exploration of the efficacy of these various intervention strategies.
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Appendix A:

AAC Symbol Systems Which Allow for
Productive Control of Grammatical Morphology

Two types of AAC symbol systems which, when employed in an AAC system, do potentially give the user partial control over grammatical morphology are Blissymbols™ and Semantic Compaction™ systems. Individual lexical representations in Blissymbolics are composed of sublexical meaning elements which are combined using systematic rules. These include some symbol elements for semantic concepts, such as PAST, which are highly correlated with syntactic concepts such as past tense. Blissymbol users whose symbol sets include those sublexical symbols could use them as pseudo-grammatical morphemes.

Semantic compaction systems (i.e. Minspeak™), where words and phrases are stored under icon sequences, can be set up to give the user control over grammatical morphology. For example, one Minspeak Application Program⁶, IEP+™ (Bruno, 1990) has all present tense verbs stored under sequences of icons that end with the [PRESENT] icon, which is a picture of a gift-wrapped present. All present progressive verbs are stored under icon sequences ending with the [-ING] icon, which is a picture of a young couple with a prominently displayed diamond ring. All past tense verbs are stored under icon sequences ending with the [PAST] icon, which is a picture of

---

⁶ Minspeak Application Programs, or MAPS, are used with voice output communication aids manufactured by Prentke Romich. They consist of software with a starter set of vocabulary to be loaded into the device, an overlay of a set of icons which is placed on the keyboard of the device, materials explaining the rationales for selecting the icon sequences, and suggestions for teaching the system and for expanding and customizing the vocabulary.
tombstone. Examples of how specific words are stored in this program are given in Table 20.

This particular Minspeak Application Program was aimed at elementary school-aged children, who would be taught to learn to use the associations and homonymity cues to help remember the icon sequences. Children who could not appreciate these cues would need to learn the icon sequences by rote.

Neither Minspeak nor Blissymbolic approaches to vocabulary representation appear to be widely used in British Columbia, Alberta, or Washington State. None of the children nominated by their speech-language pathologists as potential participants in this study had productive control of grammatical morphology using either of these approaches, despite the fact that the recruitment materials did not specify that they be excluded. In British Columbia it is my impression that these systems are not prescribed in part to the extensiveness of the instruction required before the AAC user and those that are supporting the AAC user achieve operational competence.
Table 20

Examples of icon sequences for vocabulary in IEP+™

<table>
<thead>
<tr>
<th>To make the device say....</th>
<th>Press these icons:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ask</td>
<td>[LADLE] + [PRESENT]</td>
</tr>
<tr>
<td>asking</td>
<td>[LADLE] + [COUPLE WITH RING]</td>
</tr>
<tr>
<td>asked</td>
<td>[LADLE] + [TOMBSTONE]</td>
</tr>
<tr>
<td>call</td>
<td>[PHONE] + [PRESENT]</td>
</tr>
<tr>
<td>calling</td>
<td>[PHONE] + [COUPLE WITH RING]</td>
</tr>
<tr>
<td>called</td>
<td>[PHONE] + [TOMBSTONE]</td>
</tr>
<tr>
<td>learn</td>
<td>[SCHOOL] + [PRESENT]</td>
</tr>
<tr>
<td>learning</td>
<td>[SCHOOL] + [COUPLE WITH RING]</td>
</tr>
<tr>
<td>learned</td>
<td>[SCHOOL] + [TOMBSTONE]</td>
</tr>
<tr>
<td>eat</td>
<td>[HOT DOG] + [PRESENT]</td>
</tr>
<tr>
<td>eating</td>
<td>[HOT DOG] + [COUPLE WITH RING]</td>
</tr>
<tr>
<td>ate</td>
<td>[HOT DOG] + [TOMBSTONE]</td>
</tr>
</tbody>
</table>

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Appendix B: What is Involved in Mastery of Three English Grammatical Morphemes

In order to master fully a grammatical morpheme, the child must understand both the syntactic rules and relationships governing its use (as per Cowper, 1992) and the semantic information carried by the presence or absence of that morpheme. These factors are discussed below for three English grammatical morphemes: possessive 's, past tense -ed, and 3rd person regular -s.

Possessive 's:

Semantic Information:
- Indicates an owner or possessor-possession relationship between the referent of the first noun and the referent of the second noun.
- Absence of 's marker on two consecutive nouns indicates that the first describes the second noun, e.g., "the baby cat", "the giant castle", "the boy dentist"
- This semantic information is usually also highly predictable from world knowledge and context (e.g., highly unlikely that a baby cat and the baby's cat would both be present, or would both be probable referents)

Syntactic Information:
- Overt marker of Genetive Case of NP

Regular past -ed

Semantic Information:
- Presence of -ed indicates that the action or state happened in the past
- Absence of -ed and any other suffix (or in other words a verb that is uninflected) indicates a habitual action (They jog in the park) or ongoing state (I like baroque music), and a subject that is not third person singular. The latter information is usually redundant to semantic information in the subject NP.
- If the reference of the inflected verb is to a past event, and the child knows something of the meaning of the root verb, situational context will likely cue the child that this is a past event, especially as parents are more likely to talk to the young child about the immediate past rather than the distant past. The suffix will be a redundant and less perceptually salient cue.
• If the reference of the uninflected verb is to an ongoing state, and the child knows something of the meaning of the root verb, the semantic knowledge combined with situational cues and world knowledge will likely cue the child to this information.

**Syntactic Information:**
- overt marker of [+ tense] INFL. Attaches to first and only one verb in IP, i.e.
  
  He walked to the store.
  Did (do +ed) he walk to the store?
  *Did he walked to the store?

**3rd person regular -s**

**Semantic Information:**
- Differentiates a habitual action from a presently occurring action, which would be indicated by the present progressive form (e.g., "He walks the dog" versus "He is walking the dog")

- Indicates that the subject is third person singular; this information is almost always redundant to semantic information in the subject NP.

**Syntactic Information:**
Overt marker of number and tense agreement between NP and I' in IP
Appendix C:

Description of Literate Participants in Nonspeaking Group

<table>
<thead>
<tr>
<th>Gender</th>
<th>C.A.</th>
<th>Diagnoses</th>
<th>Communication System(s)</th>
<th>Written literacy level</th>
<th>PPVT Age Equivalent (AE)</th>
<th>Standard Score (SS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>female 7;11</td>
<td>cerebral palsy</td>
<td>Alphabet board; points with foot. Mac with intellikeys</td>
<td>Independently outputs brief phrases</td>
<td>AE=5;4</td>
<td>SS=67</td>
</tr>
<tr>
<td>JA</td>
<td>male 8;2</td>
<td>undiagnosed</td>
<td>Gestures, vocalizations, communication book with Picture Communication Symbols (PCS) &amp; printed words</td>
<td>Independently prints sentences if words are from sight word vocabulary</td>
<td>AE=6;6</td>
<td>SS=76</td>
</tr>
<tr>
<td>JG</td>
<td>female 9;3</td>
<td>Joubert's Syndrome</td>
<td>Dynavox with Dynasym, manual signs (conventional and ideosyncratic), a few word approximations intelligible only to familiar partners in context</td>
<td>Can type sentences slowly but independently. Usually facilitated by elbow stabilization.</td>
<td>AE=7;2</td>
<td>SS=78</td>
</tr>
<tr>
<td>EE</td>
<td>female 9;8</td>
<td>cerebral palsy</td>
<td>Mac with Unicorn Board, alphabet array</td>
<td>Can type sentences independently, but usually facilitated</td>
<td>AE=6;4</td>
<td>SS=65</td>
</tr>
<tr>
<td>BM</td>
<td>male 10;10</td>
<td>undiagnosed</td>
<td>Gestures/pantomime. &lt;20 manual signs. Message Mate with printed words used in limited situations</td>
<td>Independently prints sentences</td>
<td>AE=8;7</td>
<td>SS=83</td>
</tr>
<tr>
<td>DB</td>
<td>male 11;9</td>
<td>cerebral palsy</td>
<td>Mac with intellikeys and QUERTY array for written output. Macaw with PCS for face-to-face communication.</td>
<td>Independently outputs brief phrases</td>
<td>AE=7;0</td>
<td>SS=61</td>
</tr>
<tr>
<td>AK</td>
<td>female 15;7</td>
<td>cerebral palsy</td>
<td>Real Voice accessed via block-row-column scanning controlled by a single head switch. Abbreviated letter codes.</td>
<td>Outputs brief sentences slowly but independently; strongly prefers to use sentences prestored under abbreviated letter codes</td>
<td>AE=8;11</td>
<td>SS=below norms</td>
</tr>
<tr>
<td>SR</td>
<td>male</td>
<td>17;1</td>
<td>cerebral palsy</td>
<td>Liberator with custom vocabulary of prestored phrases, via head switch, block/row/column scan</td>
<td>Independently outputs brief phrases</td>
<td>AE=7;2 SS=below norms</td>
</tr>
</tbody>
</table>
Appendix D

Description of Preliterate Participants in Nonspeaking Group

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>C.A.</th>
<th>Medical Diagnoses</th>
<th>Communication System(s)</th>
<th>Written literacy level</th>
<th>PPVT Age Equivalent (AE) Standard Score (SS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CJ</td>
<td>male</td>
<td>5;8</td>
<td>developmental delay; developmental apraxia</td>
<td>50-100 signs, gestures, vocalizations</td>
<td></td>
<td>AE=5-1 SS=92</td>
</tr>
<tr>
<td>RS</td>
<td>female</td>
<td>6;4</td>
<td>cerebral palsy</td>
<td>Mac power book &amp; Speaking Dynamically (SD), hand switch, inverse row-column scan, with PCS &amp; some printed words</td>
<td>Small sight word vocabulary</td>
<td>AE=4;1 SS=69</td>
</tr>
<tr>
<td>CF</td>
<td>male</td>
<td>6;5</td>
<td>cerebral palsy</td>
<td>Dynavox with Dynasyms, controlled by single switch</td>
<td>Can spell name &amp; a few other familiar words</td>
<td>AE=5-2 SS=86</td>
</tr>
<tr>
<td>MY</td>
<td>female</td>
<td>6;5</td>
<td>cerebral palsy</td>
<td>Mac power book &amp; SD, communication book, with PCS and some printed words; word approximations intelligible only to familiar partners in context</td>
<td>Spells simple words on alphabet array. Just beginning to write simple sentences independently on computer</td>
<td>AE=6-8 SS=104</td>
</tr>
<tr>
<td>HG</td>
<td>female</td>
<td>7;2</td>
<td>cerebral palsy</td>
<td>Dynavox with Dynasyms, row-column scan; Etran with PCS, signals yes/no by turning head</td>
<td></td>
<td>AE=5;3 SS=77</td>
</tr>
<tr>
<td>DN</td>
<td>female</td>
<td>7;6</td>
<td>post meningoencephalitis at c.a. 13 mos.</td>
<td>Real Voice/ Eval Pac &amp; communication book, both with PCS, accessed via head-mounted light</td>
<td>Recognizes name &amp; most letters of alphabet</td>
<td>AE=6;6 SS=87</td>
</tr>
<tr>
<td>TB</td>
<td>male</td>
<td>7;11</td>
<td>spina bifida</td>
<td>Dynavox with Dynasyms, alphabet array, &amp; some words</td>
<td>Sight word vocabulary</td>
<td>AE=5-6 SS=69</td>
</tr>
<tr>
<td>Name</td>
<td>Gender</td>
<td>Age</td>
<td>Diagnosis</td>
<td>Communication Methods</td>
<td>Functionality</td>
<td>Scores</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>-----</td>
<td>-----------</td>
<td>-----------------------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>RF</td>
<td>female</td>
<td>8;1</td>
<td>cerebral palsy</td>
<td>Manual signs, gestures, &lt;10 intelligible word approximations</td>
<td></td>
<td>AE=4-0, SS=42</td>
</tr>
<tr>
<td>KC</td>
<td>male</td>
<td>8;8</td>
<td>cerebral palsy</td>
<td>Picture books with PCS and Mac computer at school</td>
<td>Can spell first letters of words</td>
<td>AE=5-6, SS=60</td>
</tr>
<tr>
<td>SC</td>
<td>male</td>
<td>9;11</td>
<td>developmental delay; paracentric inversion involving long arm of chromosome 15</td>
<td>Touch Talker (custom vocabulary, 1 symbol = 1 message) with PCS, manual signs, head nods, vocalizations</td>
<td>Recognizes name; can spell name with help</td>
<td>AE=4;4, SS=below norms</td>
</tr>
<tr>
<td>DA</td>
<td>male</td>
<td>10;5</td>
<td>developmental delay; developmental apraxia of speech</td>
<td>About 50 conventional signs, several ideosyncratic signs; various static displays with PCS symbols at school, word approximations</td>
<td></td>
<td>AE=4;5, SS=below norms</td>
</tr>
<tr>
<td>WM</td>
<td>female</td>
<td>11;4</td>
<td>cerebral palsy</td>
<td>Mac power book &amp;SD with PCS, 2 switch directed scan</td>
<td></td>
<td>AE=8;10, SS=81</td>
</tr>
</tbody>
</table>
Appendix E

Procedural Adaptations for Nonspeaking Children with Significant Motor Impairments

<table>
<thead>
<tr>
<th>Child</th>
<th># of Sessions</th>
<th>Minimal pairs screening task</th>
<th>PPVT</th>
<th>Grammaticality judgement task</th>
<th>Sentence comp. task</th>
<th>Structured output task</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC</td>
<td>indicated with foot</td>
<td>partner-assisted scan¹</td>
<td></td>
<td>pointed to letters on alphabet board with foot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JG</td>
<td>3</td>
<td></td>
<td></td>
<td>used IBM-compatible PC with standard keyboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE</td>
<td></td>
<td></td>
<td></td>
<td>used Macintosh computer with Intellikeys expanded keyboard and keyguard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DB</td>
<td></td>
<td></td>
<td></td>
<td>used Macintosh computer with Intellikeys expanded keyboard and keyguard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AK</td>
<td>2</td>
<td>eye gaze to select picture²</td>
<td>partner-assisted scan¹</td>
<td>looked right to indicate &quot;yes, okay&quot;, and left to indicate &quot;no, sounds mixed up&quot;³</td>
<td>partner-assisted scan¹</td>
<td>used Real Voice/Eval Pac &amp; block-row-column scan, single head switch</td>
</tr>
<tr>
<td>SR</td>
<td>2</td>
<td>eye gaze to select picture²</td>
<td>partner-assisted scan¹</td>
<td></td>
<td>partner-assisted scan¹</td>
<td>used LightTalker in spell mode, row-column scan, single head switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>eye gaze to select picture(^2)</td>
<td>partner-assisted scan(^1)</td>
<td>looked right to indicate &quot;yes, okay&quot;, and left to indicate &quot;no, sounds mixed up&quot;(^3)</td>
<td>partner-assisted scan(^1)</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>----------------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
<td></td>
</tr>
<tr>
<td>RS</td>
<td></td>
<td>eye gaze to select picture(^2)</td>
<td>partner-assisted scan(^1)</td>
<td>looked right to indicate &quot;yes, okay&quot;, and left to indicate &quot;no, sounds mixed up&quot;(^3)</td>
<td>partner-assisted scan(^1)</td>
<td></td>
</tr>
<tr>
<td>CF</td>
<td></td>
<td>eye gaze to select picture(^2)</td>
<td>partner-assisted scan(^1)</td>
<td>looked right to indicate &quot;yes, okay&quot;, and left to indicate &quot;no, sounds mixed up&quot;(^3)</td>
<td>partner-assisted scan(^1)</td>
<td></td>
</tr>
<tr>
<td>HG</td>
<td>2</td>
<td>eye gaze to select picture(^2)</td>
<td>eye-gaze to select picture - choices arrayed on 4 corners of Etran</td>
<td>looked right to indicate &quot;yes, okay&quot;, and left to indicate &quot;no, sounds mixed up&quot;(^3)</td>
<td>partner-assisted scan(^1)</td>
<td></td>
</tr>
<tr>
<td>DN</td>
<td>2</td>
<td>used head-mounted light</td>
<td>partner-assisted scan(^1)</td>
<td>looked right to indicate &quot;yes, okay&quot;, and left to indicate &quot;no, sounds mixed up&quot;(^3)</td>
<td>head-mounted light</td>
<td></td>
</tr>
<tr>
<td>WM</td>
<td>2</td>
<td>eye gaze to select pictures(^2)</td>
<td>partner-assisted scan(^1)</td>
<td>looked right to indicate &quot;yes, okay&quot;, and left to indicate &quot;no, sounds mixed up&quot;(^3)</td>
<td>partner-assisted scan(^1)</td>
<td></td>
</tr>
</tbody>
</table>

1 Partner-assisted scan: The examiner pointed to each picture in the array, then said the target word or sentence, Then the examiner again pointed to each picture in turn and asked "Is this it?", pausing for about 1 second on each picture. When the child indicated "yes" this picture was recorded as the child's selection.

2 The two pictures were placed on the table approximately 12" apart. Instead of being instructed to "Point to x" the child was instructed to "Look at x".

3 The container of dog biscuits were placed to the child's right, and a contain of rocks to the child's left. The child was told "You get to decide what Otto (the dog puppet) gets. If his sentence sounds okay, we'll give him a dog biscuit. If he gets mixed up or makes a mistake we'll give him a rock". After the child indicated by looking which item the dog puppet should get, the examiner assisted the child to "feed" the dog puppet using a hand-over-hand full manual prompt.
Appendix F: Contrastive Pairs Pretest

In order to rule out hearing or auditory perceptual problems, each participant's ability to identify pictures of minimal pairs was assessed. Four pairs of pictures illustrated words which differed only by presence or absence of word final /d,t,s/ or /z/, and four additional pairs of pictures illustrated words where these same phonemes contrasted with another phoneme in word final position. All participants correctly identified at least 13/16 pictures, and made no more than 1 error per phoneme. The minimal pair contrasts used were:

/d/
bee/bead
mad/map

/t/
"C"/seat
boat/bone

/z/
hoe/hose
peas/peek

/s/
pant/pants
kiss/kick
Appendix G: Grammaticality Judgement Task

Instructions: Participants were introduced to a dog puppet named Otto. They were told "Otto is learning how to talk, and you are going to be his teacher. He's going to practise his sentences. You listen. If it sounds okay, you give Otto a bone. But if he gets mixed up or makes a mistake, you give him a rock. That way he'll know how he's doing."

Training items: These training items were administered until 3 consecutive correct judgements were made, or until all ten training items had been administered.

- The farmer fed his cows.
- *The boy juice.
- *The little walked.
- Oscar was really grouchy.
- *Big Bird happy is.
- *Laughing Bert loudly was.
- Ernie is painting a picture.
- The dog barked.
- *The combed girl hair her.
- My friend has a ball.

Test items: The presentation of these 24 sentences was pseudo-randomly ordered. The same morpheme was probed no more than twice in a row, and no more than 3 consecutive grammatical or ungrammatical utterances were presented. Half of these items involved detection of the presence or absence of syllabic /iz/ or /id/. Half involved detection of the presence or absence of /s,z,t,v/ or /d/

Probes for 3rd person regular -s:
1. *Bert like ice cream.
2. *The man scratch the dog.
3. *The cows eats the grass.
5. Cookie Monster likes cookies.
6. The kitty catches mice.
7. The horses eat the carrots.
8. Hockey players wear helmets.

Probes for past tense -ed:
9. *Yesterday the monkey climb a tree.
10. *A few minutes ago my friends pat the dog.
11. *Tomorrow they chopped the wood
12. *Now the baby only crawls, but next year he walked.
13. Yesterday the goat climbed the hill.
14. A long time ago my parents planted a tree.
15. Last week they walked the dog.
16. Now the girl walks, but last year she only crawled..

Probes for possessive -s:
17. *I like my aunt new car.
18. *The farmer barn was painted red.
19. *Janice coat was very warm
20. *We saw our grandma house.
21. I like my cat's soft fur.
22. The sailor's boat was very big.
23. Ross's boots were too small.
24. They found their mommy's keys.

Presentation order: Sentence number 3, 15, 6, 7, 10, 1, 18, 14, 21, 4, 24, 16, 19, 5, 12, 17, 2, 22, 9, 23, 20, 13, 8, 11.
Appendix H: Morpheme Comprehension Task

Instructions: Participants were told "You are going to hear some sentences on a tape recorder. Look at the pictures, and show me the picture that goes with the sentence. The sentences will be like this..." (Training items were presented until three correct responses were obtained, or until all ten training items had been presented.) Next participants were told "I'm going to turn on the tape recorder now. You will hear someone say 'ready', then you'll hear the first sentence."

Training items: Subjects were shown sets of three pictures, and asked to show the picture that goes with the sentence. Training item sentences were spoken by the researcher.

The dog is running.
David said "This is my ball."
The cat is sleeping on the chair.
This is a big house.
The boys are reading books.
The boy is swimming.
Meghan said "This is my car."
The cat is walking on the fence.
This is a big mug.
The boys are riding bicycles.

Test items: Sets of 3 pictures assessing comprehension of one of these grammatical morphemes: 3rd person regular -s, past tense -ed, and possessive 's were constructed. Six sets were constructed for each morpheme, each set consisting of a picture that would be described by a sentence including the morpheme, a picture that would be described by a sentence without the morpheme, and a picture that would be described by a semantically related sentence. The total of 18 test sets were ordered pseudo-randomly, so that the same morpheme was never tested more than two consecutive times, and the same location (lefthand, middle, or righthand picture) was never correct more than three consecutive times.

The target sentences were recorded and played back to the children on a Realistic Ctr-68 cassette recorder. Target sentences were read in a monotone with roughly even stress on each syllable. The target sentences and descriptions of the pictures for each morpheme are described below.

I. 3rd person regular -s, items:

1. Target: The sheep eats the grass.
   Pictures: 
   √One sheep eating grass
Two sheep eating grass
Two sheep jumping fence

2. Target: The fish splashes in the river.
Pictures:
Two fish splashing in a river
One fish on a plate.
√One fish splashing in a river

3. Target: The moose watch the bunny.
Pictures:
One moose looking at a bunny
√Two moose looking at a bunny
Two moose in the zoo

4. Target: The sheep jump over the fence.
Pictures:
Two sheep eating.
One sheep jumping over the fence.
√Two sheep jumping over the fence.

5. Target: The deer drinks from the stream.
Pictures:
Several deer drinking from the stream
One deer jumping over the stream
√One deer drinking from the stream

Pictures:
√Two fish eating
Fish on a plate
One fish eating

II. Possessive 's items:

7. Target: The baby's pig is dirty.
Pictures:
√Baby with dirty stuffed pig
Baby with dirty shirt.
Dirty baby pig with mother pig.

8. Target: The cat's mug has milk in it.
Pictures:
Sleeping cat
√Cartoon cat holding up a mug of milk.
Mug with picture of a cat on it
9. Target: The girl's bear has a yellow hat.
   Pictures:
   Boy holding a boy bear with yellow hat
   Girl bear with yellow hat
   √Girl holding a boy bear with yellow hat

10. Target: The baby duck is in the water.
    Pictures:
    Baby in bathtub with an "adult"-looking toy duck.
    Baby in bathtub, no duck
    √Baby duck in water with an "adult" duck

11. Target: The bunny hat is pink.
    Pictures:
    √Girl wearing pink "bunny hat" with long ears
    Bunny wearing pink bonnet-type hat
    Girl wearing pink sweater

12. Target: Jenny took the boy bear.
    Pictures:
    Girl taking girl bear from a boy
    √Girl taking boy bear off a shelf also containing a girl bear.
    Boy taking car off a shelf containing a boy bear

III. Past tense -ed Items:

13. Target: John said "I painted the picture."
    Pictures:
    √Boy holding up a completed picture
    Boy painting a picture
    Boy reading book

14. Target: Sarah said "The puppy messed up the room"
    Pictures:
    Child in tidy room with puppy
    Puppy pulling at a table cloth while child watches
    √Child in messy room pointing to puppy

15. Target: Mom said "You pushed her."
    Pictures:
    Mother looking at one child while pointing to another child on a
    swing
    √Mother and child standing; other child on floor crying
    Two children building blocks, mother watching

16. Target: The teacher said "You paint this."
    Pictures:
    Teacher giving boy a book.
Teacher pointing to picture on wall, boy with dripping paint brush in his hand
Teacher giving boy with paints a blank piece of paper

17. Target: Sarah said "The puppies play with this toy"
Pictures:
  Two girls with puppies at their feet, one with a look of displeasure holding up a chewed up teddy bear
  Two girls, one pointing to two puppies playing with a toy.
  Two girls patting puppies

18. Target: Grandma said "You pull it."
Pictures:
  Tired grandma pointing to wagon she is pulling, child watching.
  Grandma watching child with teddy bear.
  Grandma watching child pull a wagon.
Appendix I: Structured Output Task

This task was administered to any child whose parent, teacher, or speech-language pathologist responded affirmatively to the question "Can the child independent write or type a short phrase or sentence?".

Instructions: The child was told "Now we're going to do a story together. I'm going to read you this story that has missing words, and I want you to fill in the missing words for me."

The child was then shown the story below, printed out on 8.5 x 11' paper, in 24 point type, Palatino font. (The dashed lines below mark page breaks in the version shown to the participants). The child was also simultaneously shown a set of 4 pictures which illustrated the story. The story was read to the child, including the first sound(s) of the "missing" words. The researcher paused at each missing word, and encouraged the child to complete the missing word. If the child looked confused or asked for assistance, the researcher cued the child for the semantic content of the missing word by either re-reading a previous section of the story, or by pointing to an element in one of the illustrations.

The first two target words were practise items. Additional assistance was provided on these items if necessary. The remaining target words are in contexts which obligate the inclusion of a grammatical morpheme. There are 6 obligatory contexts each for past tense -ed, possessive 's, and 3rd person regular -s.

The child was asked to complete the missing words using whatever method was their customary method of producing written output.

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Story about Kate

This is a story about a little g____ named Kate.

Once upon a t____ there was a little girl named Kate.

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Here is Kate.
And here are all her hats.
These hats all belong to Kate.
They are all K____ hats.

Here are some other things that belong to Kate.
Here are her teddy bears.
Kate says "Every day I like to do the same thing - wake up, eat breakfast, play with my teddy bears."

I like to put hats on their heads."

Yesterday, Kate woke up. She ate breakfast. Then she pl_____ with her teddy bears.

All her teddy bears wear hats.
This teddy bear is her favourite.
This teddy bear always w_____ a big blue hat."

Kate put her teddy bears on the couch in the living room.
This chair belongs to her mom.
Kate put her favourite teddy bear on her m_____ chair.

Suddenly, Kate noticed that her teddy bear didn't have his hat. So she went to find it.

Mrs. Pete came to have coffee with mom.
Mom said "I'll get us some coffee. Go sit in the living room, and I'll be with you in a minute."

Mrs. Pete went to sit in the living room.
She wanted to sit on the couch, but it was full of bears.
She l_____ on the chair, but there was a teddy bear on the chair too!
There was no place for her to sit.

Mrs Pete said to mom "Whose teddy bears are these?"

Mom said, "These teddy bears are K_____.
Every day she pl_____ with these teddy bears
Every day she p_____ hats on their heads.
But she shouldn't leave them all over the living room!"
Mom said "I'll call Kate and tell her to move these bears."

Mom went to the door and c_____ Kate.

"Kate" she said. "Come move these teddy bears.

Mom said "We wish to sit down. I wish to sit down, and Mrs Pete ____ to sit down.."  

Kate came when she heard her mom call.

Kate said "I was looking for a hat.

Mom said "Whose hat were you looking for?"
Kate said "My teddy b_____ hat. But I can't find it.

Mom said "Did you look in your room?"
Kate said "Yes, I l_____ in my room, but it wasn't there."

Suddenly, mom said "Oh Kate,"
"I think I found it!"
I'll lift you up
so you can peek out the window!"

Mom l_____ Kate up,
And Kate p_____ out the window.

There was her puppy with a hat!

Kate said "That hat doesn't belong to my teddy bear.
That hat belongs to a lady.
That's a l_____ hat
"Oh no!" said Mrs Pete. "That's my hat!"
Everybody ran outside.
Kate took Mrs P____ hat away from the puppy and gave it back to her.

Kate said. "Well, I like hats, and
I guess my puppy l____ hats too.
But I don't think that Mrs Pete l____ puppies!

THE END