

# Thinking with and without Language

## *What Is Necessary and Sufficient for School-Based Learning?*

---

C. Tane Akamatsu

---

*Biology makes psychology possible; consciousness, sociality, and technology make it actual. (Ratner 1991, 17)*

IN THIS CHAPTER I raise issues that concern how deaf children learn and examine assertions in the literature about the relationship between cognition, language, and school-based learning. In particular, I explore the role of language in an overall conception of intelligence and the utility of this verbal intelligence in educational pursuits, particularly in literacy acquisition.

Cognition is the foundation for higher-level learning. Human biological, neurological, and sociocultural factors support or hinder cognition. Thus, children's levels of cognitive development, as well as their cognitive potential, may constrain their learning. How this cognitive potential and level of development are determined has become a contentious issue in the field of deaf education. We have seen the pendulum swing from "deaf as deficient" (Pintner and Patterson 1917), through "deaf as concrete" (Myklebust 1964), to "deaf as the same as hearing" (Furth 1966, 1973). Others have since explored the emotional, cognitive, and psycholinguistic development of deaf children to determine exactly how they are the same as—or different from—hearing children (e.g., Levine 1981; Marschark and Clark 1993; Martin 1991). The work presented here raises the possibility of "deaf as potentially the same but . . ." or "deafness as a preventable form of intellectual and educational delay."

By and large, the work in cognition and cognitive development in deaf children has either explicitly or implicitly drawn on the work of Jean Piaget, followed by the work of Hans Furth and his colleagues. Work on cognitive processes has often been in the human information-processing school and

---

The author is grateful to Adele Churchill, Anne Miller, Irene Nizzero, and Phyllis Vazquez for their many hours of discussions, data collection, and coding, and also to Carol Musselman for making the data set available to me. Steven Hardy-Braz, Connie Mayer, and Carol Musselman, in addition to two anonymous reviewers, provided helpful comments on earlier drafts of this chapter. Any errors of fact or interpretation are, of course, my own.

its offshoots. Both these traditions have yielded much information, but have suffered from being too grounded within the individual—without consideration for how the individual has arrived at a particular level of cognition. In contrast, Bruner and Sherwood (1981, 27) pointed out the potential of cultural influences:

While the *capacity* for intelligent behavior has deep biological roots . . . the exercise of that capacity depends upon man appropriating to himself tools and techniques that exist not within his genes but in his culture.

Ratner (1991) has more recently argued for the study of cognition in its societal context.

We must understand the socially mediated processes by which deaf children appropriate meaning from various contexts and become participating members of a society that uses various forms of meaning making, such as signing, print, and even speech (Akamatsu, Gavelek, and Bonkowski 1990; Bonkowski, Gavelek, and Akamatsu 1991; Trevarthen 1979; Vygotsky 1978, 1987; Wertsch 1985, 1991; Wood, Wood, Griffiths, and Howarth 1986).

Much of the impetus for changes in how society in general views deaf individuals has come from the work of linguists who not only provided evidence that naturally evolved signed languages were bona fide languages, but also forced changes in the very definition of such sacrosanct linguistic concepts as *language* and *phonology*. Societal changes helped deaf people participate more fully in U.S. society—that is, after the 1960s civil rights movement paved the way for rights of communicative access. These changes primed society to accept signing as an integral part of many deaf children's school curricula. In sharp contrast to the 1880 International Congress on Education of the Deaf, which passed a resolution effectively banning signing in schools and barring deaf individuals from teaching in many countries, today newly trained teachers of the deaf must typically be able to sign the national signed language and use both the signed and written forms of the national spoken language.<sup>1</sup>

Since sign language has been integrated into many programs for deaf students, it is now high time to look at the attendant verbal thought development and processes in deaf students. We are only now beginning to develop a body of research that explicitly goes beyond the nonverbal thought processes of deaf individuals and taps their verbal processes.

#### THE ROLE OF LANGUAGE IN AN OVERALL CONCEPTION OF INTELLIGENCE

Theoretical models of cognition that allow and, indeed, compel us to explore the realm of language and deaf education are those characterized as socio-cultural or cultural-historical (Vygotsky 1978). In a Vygotskian framework, learning is a transactional process with the child and a more knowledgeable

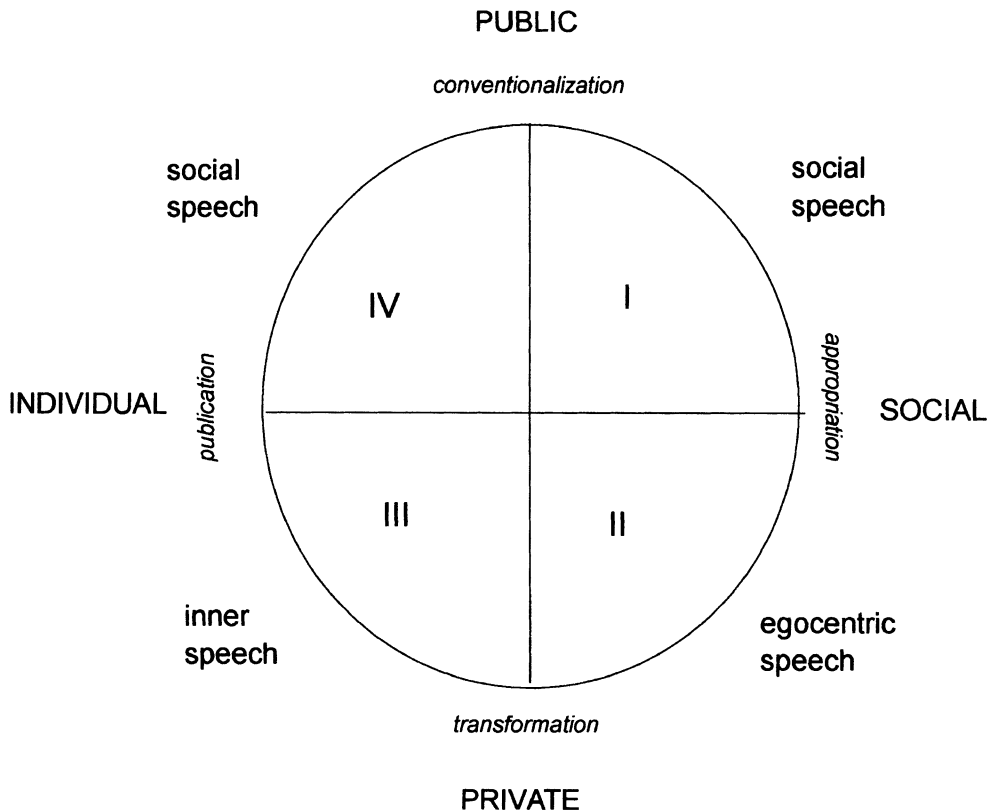


Figure 2.1. Language interaction domains in Vygotsky's space (adapted from Raphael and Hiebert 1995, by permission of the publisher).

"other" constructing knowledge together in an interactive partnership. Vygotsky believed that mastering semiotic systems, including language, transforms an individual's existing (i.e., natural) forms of mental functioning into higher psychological processes. From such a perspective, an individual's interactions with knowledgeable others—within the contexts of sign-mediated,<sup>2</sup> goal-oriented activity—bring higher-level cognitive and meta-cognitive strategies.

We may envision this transactional process using the following diagram, borrowed from Harre (1984) and Raphael and Hiebert (1995). Figure 2.1 shows two axes, one differentiating the public and the private domains of an individual's world, and the other differentiating social from individual language. That which is public is observable; that which is private is not observable. Social language has its origins in interactions with others; individual language is language generated within oneself. Quadrant 1 indicates social, public, observable linguistic interactions. These interactions are appropriated into quadrant 2, egocentric speech,<sup>3</sup> which is private and observable but not intended for social use. Quadrant 3 represents individual, idio-

syncratic inner speech. It is this inner speech that forms the basis for the cognitive tools necessary for thinking and literate thought. Quadrant 4 is individually generated public speech, including making public what was formerly private. This individual public speech eventually becomes conventionalized for use among multiple speakers, becoming the public, social speech of Quadrant 1. This is a recursive process, extending over time and across contexts.

From this perspective, language and cognition are intimately intertwined—language development drives cognitive development as much as cognitive development drives language development. A person's disposition to learn is inextricably bound to his or her problems of creative meaning. The challenge of mediating meaning and learning is especially acute in deaf children because of the difficulties of establishing the necessary inner speech in quadrants 2 and 3, regardless of the external language modality used to develop this inner speech (Akamatsu, Gavelek, and Bonkowski 1990; Bernstein and Finnegan 1983; Bonkowski, Gavelek, and Akamatsu 1991; Conrad 1979; Webster 1986). This situation can have serious cognitive repercussions that affect both language and literacy learning unless advocates intervene and give children access to a wide variety of social forms, genres, registers, and markers of language.<sup>4</sup> The literature for both deaf and hearing children (e.g., Curtiss 1977; Kaiser-Grodecka and Cieszynska 1991; Lane 1976; Taylor 1990) has provided evidence for the detrimental effects of a failure to develop inner speech during the critical language-learning years.

Despite the fact that signed language is often used successfully to ameliorate these effects, I argue that signed language, by itself, is not an academic panacea for late language-learning individuals. The fact that these individuals have missed the most crucial early language-learning years may have caused a permanent language delay that cannot be entirely made up through the use of sign language alone (Mayberry and Eichen 1991; Mayberry and Fischer 1989; Newport 1990). I argue that this language delay has cognitive consequences, which also cannot be circumvented.

In my practice, I find increasing numbers of students who enter school between the ages of six and ten with no formal education, no language, and no communication system at home. Many arrive in Canada as refugees and have, therefore, not had the opportunity to engage in formal schooling. After several years of participating in our educational system, they are able to communicate well enough for everyday needs, but their academic language (in either speech or sign) remains far from adequate for their academic needs.

## THE UTILITY OF LANGUAGE FOR THINKING AND LEARNING

Deaf parents are perceived to be in the ideal position to provide the intermental and interpersonal conditions for establishing inner speech and, thus, ignite this cognitive cycle. Indeed, deaf children of deaf parents are often

touted as the ideal model for natural language acquisition and subsequent educational achievement because of the rich, early, accessible language and emotional acceptance they provide (e.g., Gee and Mounty 1991; Marschark 1993; Supalla 1991; Vernon and Andrews 1990). However, there is now some evidence that simply having deaf parents may not be equally advantageous for all educational pursuits.

My colleagues at the Ontario Institute for Studies in Education and I have been examining the language and communication proficiency of deaf and hard of hearing teenagers, and comparing this proficiency to early indicators from their preschool years. We are examining the effects of intellectual structure, heredity, early communication, and hearing levels on later communication abilities. Our results, collected on a large sample of deaf children, stand in contradiction to more widely held beliefs. That is, we found that children whose parents are hearing—and in whose families a genetic component to deafness exists—perform better on standardized measures of intelligence than do children whose parents are deaf.

It is important to remember that access to school-based knowledge is also attained through literacy and access to the knowledge and thinking tools of the dominant culture. Hearing parents provide a link to the dominant culture through the use of the dominant spoken (and written and sometimes signed) language and through generally higher education, higher socioeconomic status, print-rich home environments that stress the value of reading, and occasionally, greater knowledge about deafness.<sup>5</sup> We suggest, therefore, that having genetic deafness and hearing parents can be advantageous to performance on standardized tests of intelligence precisely because such tests are standardized on school populations and their school-based knowledge.

We compared the language/communication proficiency of seventy deaf teens to their verbal IQ, as measured by a language/communication proficiency interview (LCPI) and the verbal subtests of the Wechsler Intelligence Scales for Children (WISC), third edition, or the Wechsler Adult Intelligence Scales (WAIS), revised edition, depending on the student's age. The LCPI was an adaptation of the Sign Communication Proficiency Interview described by Newell, Caccamise, Boardman, and Holcomb (1983). Each teen engaged in spontaneous conversation using a flexible but structured interview protocol. By interviewing all students in three different modalities and two languages (American Sign Language [ASL]: sign only; English: simultaneous speech and sign; and English: speech only), we were able to ascertain each student's strongest language and modality for face-to-face communication. To assess the student's ability to use language for thinking, we administered the WISC or WAIS test in the student's preferred mode of communication (Nizzero, Musselman, and MacKay-Soroka 1993).

The distribution of language proficiency scores among the teens showed that as many teens were proficient in spoken English ( $n = 13$ ) as in ASL

( $n = 14$ ), but only two were bilingually fluent in both (Akamatsu, Musselman, and Miller 1994). Not surprisingly, for all students, the highest score from the three interviews strongly related to verbal IQ, but not to performance IQ (Musselman, MacKay, Trehub, and Eagle 1997). In addition, some skills measured on the verbal IQ scales of the WISC/WAIS were predictive of literacy.

Both ASL and spoken English can be associated with equally high verbal IQ scores, but the teens' typical/average performance in these two languages was different. Teens who demonstrated high levels of language/communication proficiency, in either ASL or oral English, were able to use their language to think in ways similar to those of hearing people. However, the LCPI and verbal IQ scores of the majority of the teens suggest that they lack sufficient skill at using either ASL or English as effective learning tools. As a rule, students use ASL, as it is currently provided in the school systems, as an effective language for communication but not as an academic register, particularly for the kind of thinking that occurs through literacy.

#### IMPLICATIONS FOR EDUCATIONAL REFORM

The key question we must address concerning the role of natural sign language and signed forms of spoken language in any plans for educational reform is: *What kinds of language and what sort of communication milieu must we provide deaf children to facilitate their acquisition of literacy skills?* When designing an educational program for deaf children, consider carefully the following assertions with supporting arguments:

*ASSERTION 1: Natural sign language is both necessary and sufficient for the development of inner speech for communicative purposes as a deaf child's first language.*

We have argued that, in a Vygotskian framework, education is formative rather than merely facilitative in the cognitive development of the individual (Akamatsu and Stewart 1992; Bonkowski et al. 1991). Therefore, a deaf individual's full cognitive capabilities can emerge only as a result of instruction that uses an accessible language as a central component in the mediation of experience. To some extent, the total communication and bilingual education movements have succeeded in providing visually accessible language for the mediation of experience. But why have educational achievement levels not improved to a great extent?

The equivalence of deaf people's nonverbal intelligence with the general population has long been documented in the literature (Moore 1996). This equivalence supports arguments that deaf people should be able to succeed in school, if they receive proper access to instruction (e.g., Johnson, Liddell, and Erting 1989; Vernon and Andrews 1990).

The psycholinguistic basis of artificial sign systems remains obscure, but it is clear that natural signed languages have the advantage of capitalizing on a fully functional visual system, are easily used, have widely understood methods of communication, have been shown to be bona fide languages, and are highly effective media for communicating both concrete and abstract information. Therefore, natural sign language should be both necessary and sufficient for establishing the essential inner speech needed for complex psychological processes. Our data as well as recent studies (Cook and Harrison 1995; Jamieson 1995) suggest that, in fact, they are.

We still believe that having deaf parents is advantageous for early language development, particularly for signed language development, and we also believe that having a solid native language base will help in developing academic and higher-order thinking skills. And while certainly one would need a basic intelligence within or above normal limits to benefit from school-based programs, one also needs access to the written form of language for independent learning. Yet, adequate performance in literacy skills is very difficult for deaf children to acquire. Literacy in a specific language requires knowledge of that language, but further requires access to the lexicogrammatical structure of that language and perhaps even to sound/symbol relationships. Given that, to date, signed languages have no written form, deaf children must move from internal representations of a signed language to external representations of a spoken language they have never heard!

*ASSERTION 2: Natural sign language is not a sufficient basis for teaching literacy of a spoken language without the student's proven fluency in the spoken form or a signed system representing that spoken language.*

Mayer and Wells (1996) point out that in studies of second-language literacy acquisition, students had access to the target second language in both its spoken and written form, and/or access to the written forms of both the first and second language. Obviously, for most deaf students, the first route—fully accessible spoken language—is out of the question. Given that, to date, signed languages do not have a standardized written form that is taught to schoolchildren, they do not have this access route to their second language, either. Mayer and Wells refer to this as the “double discontinuity model.” Moreover, the students who seem to have high levels of literacy in English are those who somehow (from cued speech or signed English, for example) found an alternate way into the phonological or flow of the spoken component without necessarily being able to speak or hear (Lichtenstein 1983).

In their discussion of the linguistic interdependence model (Cummins 1989, 1991), Mayer and Wells (1996, 104) contend that, for a first language (L1) to provide a bridge to a second language (L2), the following assumptions must be met:

1. Both languages have a written as well as a spoken mode, and the former constitutes a systematic representation of the latter—that is, the two modes are representations of the same underlying linguistic code.
2. In both languages, the external spoken mode can provide a bridge between the mode of inner speech and that of written speech.
3. The learner has already achieved some degree of mastery of the written mode of his or her L1 before attempting to master the written mode of L2.
4. There are adequate opportunities for the learner to become a fluent speaker of L2.
5. In both languages, the written mode is used for a broad range of functions, at least some of which are relevant to the learner's purposes.

They argue that, since none of these assumptions are met in the case of deaf students, natural sign language alone cannot provide an adequate bridge to written forms of spoken language. Because of their linear mapping with the spoken language, however, it may well be the case that natural sign systems may provide that bridge.

*ASSERTION 3: Natural sign systems, because of their links to spoken language, are viable for use in teaching educational subjects, such as science, social studies, and mathematics.*

There is no doubt that sign language is capable of expressing the necessary conceptual complexities contained in these fields of study. Indeed, it might be argued that it is only through the use of sign language that most deaf children will be capable of exercising this level of thought. The difficulty arises when the children must begin to learn “independently” through the use of printed materials. In highly literate and technological societies, true participation demands the ability to read and write. Those who cannot recognize their “face-to-face” language in print are disempowered, regardless of their hearing status. This assertion begs the question of how technically lexical items should be represented, as well as the process for their mapping onto written and signed forms, fingerspelling and initialized signs. It also requires that adults be fluent in the academic register of both target languages.

In North America, ASL is not widely used in schools for instructional purposes. Moreover, there is no clear “school discourse” in this language, nor is there any written form of the language. Because this schooled register is not widely used, if at all, the students do not have practice in using that level of discourse to think, to learn, and to think about thinking, learning, and language. Even assuming that the “schooled” register of ASL does exist, there are relatively few teachers currently employed who are capable of using it. Written (and signed/spoken) English remains the language used across contexts.

Some evidence is coming to light that natural sign language, while being sufficient, is not necessary for the establishment of the inner speech code in



sign (e.g., Luetke-Stahlman 1988; Schick and Moeller 1992; Stewart, Akamatsu, and Becker 1995; Wodlinger-Cohen 1986). That is, sign systems designed to represent a spoken language on the hands can also provide sufficient linguistic information for establishing the inner speech (and consequently, a language) that would enable deaf children to engage in the higher cognitive functions that are generally present in literate people. Our data suggest an advantage for familial deafness, but not parental deafness. That is, genetic deafness confers an intellectual advantage as well as a link to the language as used by hearing people. Rather than pin hopes on the Deaf community's use of artificial sign systems based on spoken language for interpersonal communication (natural sign language does this perfectly well), we would suggest that natural sign systems, as suggested in this volume by Fischer (1998), can provide the same necessary and sufficient basis for the establishment of inner speech on which to base literacy.

English, as a language of instructional discourse, has a far longer history of use, a greater variety of genres, and a more clearly defined school register than does ASL. Importantly, it has a written form, which has allowed for a more uniform use of this discourse register across geographic contexts (from school to school, from province to province, even from country to country) and through time (e.g., Chaucer to Shakespeare to modern literature; Newton to Einstein to modern scientific writing).

*ASSERTION 4: Total communication continues to be a viable means of instruction, provided that the programs are bilingual in nature.*

In daily classroom practice, total communication as a program philosophy is often misinterpreted to mean simultaneous communication (i.e., spoken language with concurrent signing, but not using nonspeaking natural signed language). The current term in vogue to represent programs that include the use of natural signed language is "bilingual-bicultural." Yet, can natural signed languages not be considered as a part of a "total" or comprehensive communication arsenal? The call for bilingual programs for deaf children is reasonable—from both a theoretical and a practical standpoint—and implementable (e.g., Luetke-Stahlman 1983; Paul, Bernhardt, and Gramly 1992; Reagan 1985). However, empirical evidence supporting particular models of bilingual programs has yet to be collected.

Research into the nature of simultaneous communication has shown that much of what is represented linearly in speech can be represented spatially in natural sign systems without detracting from meaning (Fischer 1998; Maxwell and Bernstein 1985; Maxwell, Bernstein, and Maer 1991; Newell, Stinson, Castle, Mallery-Ruganis, and Holcomb 1990; Stewart, Akamatsu, and Bonkowski 1990). Musselman et al. (1997) note that the sensory channel overrides linguistic considerations when using simultaneous signing and speech. That is, the auditory signal is the primary channel for auditory/oral students and the visual signal for signing students.<sup>6</sup> "Good" simultaneous

communication must exploit spatial syntax to be visually accessible. It may also be able to exploit its linear relationship to speech to support development of the written form of language.

## CONCLUSIONS

We must give consideration to verbal thinking and the symbols that lead themselves to verbal mediation (sign, speech, print) in the overall picture of cognition of deaf individuals. Natural sign language is both necessary and sufficient for establishing inner speech in one's first language, if the adults are competent signers. However, natural sign language is necessary—but probably not sufficient—for establishing links to second-language literacy.

We must examine links to decontextualized and verbal thinking through the signed channel as a tool to accessing print. The roles of various sign languages and systems must be examined for their links to literacy learning. According to the literature on bilingual literacy acquisition, the initial access to second-language literacy occurs via the route of the spoken channel of the second language or through the print channel of the first language. Given that speech is completely or nearly inaccessible, and there are no standard written forms of signed languages, we must explore other avenues, such as visually appropriate signed forms of spoken languages (Mayer and Wells 1996).

I have argued that the fulfillment of a signed language mandate would require that the more knowledgeable others of the teaching/learning dyad be bilingually fluent in the academic registers of natural signed language, signed forms of the national language, and be academically literate. Rodda, Cumming, and Fewer (1993, 346) went further by suggesting that:

the introduction of [natural signed language] into classrooms for deaf students will fail because a change in the language of instruction will not assist deaf students *unless it is also accompanied by a change in instructional strategies*. . . . The use of [natural signed language] does not guarantee it will be possible to [use interactive communication to develop a sound first language] if the use of [such language] is coupled with poor teaching techniques. (emphasis theirs)

Classroom discourse research by Musselman and Hambleton (1990) and Wood et al. (1986) also support this contention.

To create a visual world context of the visual world for deaf children necessitates the use of some sociolinguistic practices that differ from those found in hearing dyads, described in Padden and Humphries (1988). The challenge for hearing parents and teachers of deaf children is (1) to learn to see in a new and different way, (2) to engage in a world where vision is primary for the development of language and cognition, and (3) to create the necessary conditions for establishing inner speech.

Theory in the absence of data is not helpful for the practical application of teaching. In the more than twenty years since Furth showed that deaf students are as intelligent as hearing students, expectations for deaf children may have been raised and face-to-face communication in the classroom may have improved, but no appreciable gain in literacy levels has been documented (Paul and Quigley 1994). However, theories can help drive research agendas into fruitful areas of investigation, and have done so.

## NOTES

1. For my purposes here, I will use American Sign Language (ASL) and English as examples of national signed language and national spoken language, respectively. The relationship between the signed and spoken languages of other countries may not necessarily parallel that found in the United States and Canada (including Langue des Signes Québécoise [LSQ] and French). Therefore, researchers and educators in each country will have to determine for themselves how the arguments presented here have relevance for their particular setting.

2. The term *sign* is used here to refer to semiotic system, rather than lexical unit of sign language.

3. I want to be very clear when I use the term *speech* in the context of deaf individuals, particularly signing deaf individuals. Following Vygotsky, such speech refers to language in action, regardless of modality. Thus, egocentric and inner speech refer to the idiosyncratic, verbal thought that individuals use for themselves. This verbal thought is not intended for interpersonal communicative use, but for intramental functions that require some kind of verbal representation. However, there is disagreement as to the form of this inner speech (e.g., Conrad 1979; Mayer and Wells 1996).

4. Cummins (1989) maintained that both the quality and quantity of exposure to a second language are important determiners of eventual acquisition of that language. This is also true for first-language acquisition.

5. This is particularly true of hearing parents who themselves have parents and/or members of their extended family who are deaf.

6. Productively, SimCom can be sign-driven or speech-driven, depending on various internal and external factors including student comprehension, teacher skill in both languages, and communication demands of the moment (Stewart et al. 1990).

## REFERENCES

- Akamatsu, C. T., J. Gavelek, and N. Bonkowski. 1990. Acquisition of word meaning in social contexts. Paper presented at the International Congress on the Education of the Deaf, 31 July–3 August, Rochester, N.Y.
- Akamatsu, C. T., C. Musselman, and A. Miller. 1994. Using a language/communication proficiency interview as a form of dynamic assessment. Paper presented at the American Educational Research Association annual conference, 4–8 April, New Orleans, La.
- Akamatsu, C. T., and D. Stewart. 1992. Socially constructing language use for cognitive empowerment in deaf children. *Curriculum and Teaching: International Review of Curriculum and Instruction* 7:1–12.

- Bernstein, M., and M. Finnegan. 1983. Internal speech and the deaf child. *American Annals of the Deaf* 128:483–89.
- Bonkowski, N., J. Gavelek, and C. T. Akamatsu. 1991. Education and the social construction of mind: Vygotskian perspectives on the cognitive development of deaf children. In *Advances in cognition, education, and deafness*, edited by D. Martin, 185–94. Washington, D.C.: Gallaudet University Press.
- Bruner, J., and V. Sherwood. 1981. Thought, language, and interaction in infancy. In *Social cognition: Perspectives on everyday understanding*, edited by J. Vorgas. New York: Academic Press.
- Conrad, R. 1979. *The deaf school child*. London: Harper and Row.
- Cook, J., and M. Harrison. 1995. Private sign and literacy development in preschoolers with hearing loss. *Sign Language Studies* 88:201–26.
- Cummins, J. 1989. A theoretical framework of bilingual special education. *Exceptional Children* 56:111–19.
- . 1991. Interdependence of first- and second-language proficiency in bilingual children. In *Language processing in bilingual children*, edited by E. Bialystok, 70–89. Cambridge: Cambridge University Press.
- Curtiss, S. 1977. *Genie: A psycholinguistic study of a modern-day wild child*. New York: Academic Press.
- Fischer, S. 1998. Critical periods for language acquisition: Consequences for deaf education. In *Issues unresolved: New perspectives on language and deaf education*, edited by A. Weisel, 9–26. Washington, D.C.: Gallaudet University Press.
- Furth, H. 1966. *Thinking without language: Implications of deafness*. New York: Free Press.
- . 1973. *Deafness and learning*. Belmont, Calif.: Wadsworth Publishing Company.
- Gee, J., and J. Mounty. 1991. Nativization, variability, and style shifting in the sign language development of deaf children of hearing parents. In *Theoretical issues in sign language research*, Vol. 2, edited by P. Siple and S. Fischer, 65–83. Chicago: University of Chicago Press.
- Harre, R. 1984. *Personal being: A theory for individual psychology*. Cambridge: Harvard University Press.
- Jamieson, J. 1995. Visible thought: Deaf children's use of signed and spoken private speech. *Sign Language Studies* 86:63–80.
- Johnson, R. E., S. Liddell, and C. J. Erting. 1989. *Unlocking the curriculum: Principles for achieving access in deaf education*. Working Paper 89–3. Washington, D.C.: Gallaudet Research Institute.
- Kaiser-Grodecka, I., and J. Cieszynska. 1991. The understanding of time by deaf pupils. In *Advances in cognition, education, and deafness*, edited by D. Martin, 201–4. Washington, D.C.: Gallaudet University Press.
- Lane, H. 1976. *The wild boy of Aveyron*. Cambridge: Harvard University Press.
- Levine, E. 1981. *The ecology of early deafness: Guides to fashioning environments and psychological assessments*. New York: Columbia University Press.
- Lichtenstein, E. 1983. *The relationships between reading processes and English skills of deaf students*. Rochester, N.Y.: National Technical Institute for the Deaf.
- Luetke-Stahlman, B. 1983. Using bilingual instructional models in teaching hearing-impaired students. *American Annals of the Deaf* 128:873–77.
- . 1988. SEE2 in the classroom: How well is English represented? In *Signing English in total communication: Exact or not?* edited by G. Gustason, 128–31. Los Alamitos, Calif.: Modern Signs Press.

- Marschark, M. 1993. *Psychological development of deaf education*. New York: Oxford University Press.
- Marschark, M., and M. D. Clark, eds. 1993. *Psychological perspectives on deafness*. Hillsdale, N.J.: Lawrence Erlbaum Associates.
- Martin, D., ed. 1991. *Advances in cognition, education, and deafness*. Washington, D.C.: Gallaudet University Press.
- Maxwell, M., and M. Bernstein. 1985. The synergy of sign and speech in simultaneous communication. *Applied Psycholinguistics* 6:63–82.
- Maxwell, M., M. Bernstein, and K. Maer. 1991. Bimodal language production. In *Theoretical issues in sign language research: Psychology*, Vol. 2, edited by P. Siple and S. Fischer, 171–90. Chicago: University of Chicago Press.
- Mayberry, R., and E. Eichen. 1991. The long-lasting advantage of learning sign language in childhood: Another look at the critical period for language acquisition. *Journal of Memory and Language* 30:486–512.
- Mayberry, R., and S. Fischer. 1989. Looking through phonological shape to lexical meaning: The bottleneck of nonnative sign language processing. *Memory and Cognition* 17:740–54.
- Mayer, C., and G. Wells. 1996. Can the linguistic interdependence theory support a bilingual-bicultural model of literacy education for the deaf? *Journal of Deaf Studies and Deaf Education* 1:93–107.
- Moores, D. 1996. *Educating the deaf: Psychological principles and practices*. 4th ed. Boston: Houghton Mifflin.
- Musselman, C., and D. Hambleton. 1990. Creating classroom conversations with deaf children. *The ACEHI Journal/La Revue ACEDA* 16:68–90.
- Musselman, C., S. MacKay, S. Trehub, and R. Eagle. 1997. Communicative competence and psychosocial development in deaf children and adolescents. In *Language, learning, and behavior disorders*, edited by J. H. Betichman, N.J. Cohen, M. M. Konstanterreas, and R. Tan-nock, 555–70. New York: Cambridge University Press.
- Myklebust, H. 1964. *The psychology of deafness*. New York: Grune and Stratton.
- Newell, W., F. Caccamise, K. Boardman, and B. R. Holcomb. 1983. Adaptation of the Language Proficiency Interview LPI for assessing sign communicative competence. *Sign Language Studies* 41:311–52.
- Newell, W., M. Stinson, D. Castle, D. Mallery-Ruganis, and B. Holcomb. 1990. Simultaneous communication: A description by deaf professionals working in an educational setting. *Sign Language Studies* 69:391–414.
- Newport, E. 1990. Maturation constraints on language learning. *Cognitive Science* 14:11–28.
- Nizzero, I., C. Musselman, and S. MacKay-Soroka. 1993. Verbal and nonverbal intelligence as predictors of academic achievement in deaf teenagers. Paper presented at the meeting of the Convention of American Instructors of the Deaf, June, Baltimore.
- Padden, C., and T. Humphries. 1988. *Deaf in America: Voices from a culture*. Cambridge: Harvard University Press.
- Paul, P., E. Bernhardt, and C. Gramly. 1992. Use of ASL in teaching reading and writing to deaf students: An interactive theoretical perspective. In *Bilingual considerations in the education of deaf students: ASL and English*, edited by Juanita Cebe, 75–97. Washington, D.C.: Gallaudet University.
- Paul, P., and S. Quigley. 1994. *Language and deafness*. 2d ed. San Diego: Singular Publishing Group.
- Pintner, R., and D. Patterson. 1917. A comparison of deaf and hearing children in visual memory span for digits. *Journal of Experimental Psychology* 2 (2):76–88.

- Raphael, T., and E. H. Hiebert. 1995. *Creating an integrated approach to literacy instruction*. Fort Worth, Tex.: Harcourt Brace College Publishers.
- Ratner, C. 1991. *Vygotsky's sociohistorical psychology and its contemporary applications*. New York: Plenum Press.
- Reagan, T. 1985. The deaf as a linguistic minority: Educational considerations. *Harvard Educational Review* 55:265–77.
- Rodda, M., C. Cumming, and D. Fewer. 1993. Memory, learning, and language: Implications for deaf education. In *Psychological perspectives on deafness*, edited by M. Marschark and M. D. Clark, 339–52. Hillsdale, N.J.: Erlbaum.
- Schick, B., and M. P. Moeller. 1992. What is learnable in manually coded English sign systems? *Applied Psycholinguistics* 13:313–40.
- Stewart, D., C. T. Akamatsu, and B. Becker. 1995. Aiming for consistency in the way teachers sign. *American Annals of the Deaf* 140:314–23.
- Stewart, D., C. T. Akamatsu, and N. Bonkowski. 1990. Synergy effects: Sign driven and speech driven simultaneous communication. In *SLR '87: Papers from the fourth international symposium on language research*, edited by W. Edmondson and F. Karlsson, 235–42. Hamburg: Signum Verlag Press.
- Supalla, S. 1991. Manually coded English: The modality question in signed language development. In *Theoretical issues in sign language research*, Vol. 2, edited by P. Siple and S. Fischer, 85–109. Chicago: University of Chicago Press.
- Taylor, N. J. 1990. Impact ASL. Paper presented at the International Congress on the Education of the Deaf, 31 July–3 August, Rochester, N.Y.
- Trevarthen, C. 1979. Communication and co-operation in early infancy: A description of primary intersubjectivity. In *Before speech*, edited by M. Bullowa, 321–47. Cambridge: Cambridge University Press.
- Vernon, M., and J. Andrews. 1990. *The psychology of deafness*. White Plains, N.Y.: Longman.
- Vygotsky, L. S. 1978. *Mind in society: The development of higher psychological processes*, edited by M. Cole, V. John-Steiner, S. Scribner, and E. Souberman. Cambridge: Harvard University Press.
- . 1987. *Thinking and speech*. Translated by N. Minick. New York: Plenum.
- Webster, A. 1986. *Deafness, development and literacy*. London: Methuen.
- Wertsch, J. 1985. *Vygotsky and the social formation of mind*. Cambridge: Harvard University Press.
- . 1991. *Voices of the mind: A sociocultural approach to mediated action*. Cambridge: Harvard University Press.
- Wodlinger-Cohen, R. 1986. The manual representation of speech by deaf children, their mothers, and their teachers. In *Theoretical issues in sign language research: Psychology*, Vol. 2, edited by P. Siple and S. Fischer, 149–69.
- Wood, D., H. Wood, A. Griffiths, and I. Howarth. 1986. *Teaching and talking with deaf children*. New York: Wiley.