

HANDBOOK OF APPLIED PSYCHOLINGUISTICS

edited by
SHELDON ROSENBERG



Psychology Press

**HANDBOOK OF
APPLIED PSYCHOLINGUISTICS**
Major Thrusts of
Research and Theory

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*THIS BOOK IS DEDICATED
TO MY FRIENDS AND TEACHERS
Eugene S. Gollin
and
James J. Jenkins*

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Preface

The chapters of this handbook contain critical integrative reviews of research and theory in the major areas of the field of applied psycholinguistics, the field in which applied problems of language and communicative functioning and development are approached from the standpoint of basic research and theory in psycholinguistics and related areas of cognitive psychology. The book was designed to meet the needs of researchers, practitioners and graduate students from such disciplines as education (including special education), language learning, linguistics, neurology, psychiatry, psychology, and speech and hearing for such reviews, although the state of research in an area and a desire to stress research and theory in substantive areas resulted in a decision not to include chapters on the measurement of linguistic maturity, language intervention, the language of the learning disabled child, language and environmental deprivation, language and mania, language and senile dementia, and the design of written and oral information and computer command language.

A chapter dealing exclusively with dialect and social class differences in language and communication had been planned but its prospective author withdrew from the project without warning at a time when it was impossible to replace him with another author. Language measurement and intervention are discussed briefly in Chapter 1 and there is a discussion of literature on language intervention in certain of the chapters. The reader is introduced to the field of applied psycholinguistics as a whole in Chapter 1, which also discusses its basic underpinnings and overviews the contents of the present volume.

The grouping of the various substantive chapters reflects my perception of the current organization of the field. Thus they appear under the headings Reading, Writing and Language Learning; Discourse Processes; Disorders of First-Language

Development; and Adult Language Disorders. The contributors, however, selected and organized the literature in their areas of expertise as they saw fit.

My experience with a graduate survey course in applied psycholinguistics gave birth to the idea for the present volume: there was available no single book that reflected the scope of the field (from problems of normal communicative development—e.g., reading and writing—to adult language disorders), its organization, and its deep commitment to basic research and theory. It is hoped that the present volume will serve as such a book and to bring professional researchers and practitioners in the many areas of applied psycholinguistics into contact with recent developments in and outside of their own immediate area. Also, contact with developments outside one's immediate concerns will, it is hoped, lead to the discovery of ways in which research and theory in one area of applied psycholinguistics (e.g., second-language learning) might suggest ways to advance the work in another area (e.g., language intervention). Finally, the perceptive reader will not miss noting in the pages of the present handbook, the many ways in which basic theoretical claims in psycholinguistics and related areas of cognitive psychology are put to the test in the arena of applied psycholinguistics.

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INTRODUCTION

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1 Applied Psycholinguistics: Introduction, Foundations and Overview

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Definitional Matters

The revolution in basic research and theory in psycholinguistics and related areas of cognitive psychology that began shortly after the publication of Chomsky's *Syntactic Structures* (1957)¹ has had a profound influence on conceptions of applied problems (e.g., language and communication disorders; the assessment of linguistic and communicative knowledge and performance capabilities; reading, writing, second-language learning, and learning from texts and lectures). As a result of this influence, we have witnessed changes in applied research and educational and clinical practices that reflect the view that applied problems should be approached from the standpoint of basic research and theory in psycholinguistics (developmental, experimental, and social) and related areas of cognitive psychology (perception, memory, problem solving, conceptual behavior; in other words, information processing generally).

For some years now, basic research and theory in psycholinguistics have been oriented mainly toward answering the following questions.

1. How are syntactic, semantic, phonological, lexical, and pragmatic linguistic units, structures, and operations represented and organized psychologically?

¹As a result of Chomsky's influence, psycholinguists, both basic and applied, were for a number of years primarily interested in characterizing and accounting for general aspects of the form and content of utterances. In recent years, however, we have witnessed a sharp increase in work on the pragmatic aspects of utterances, that is, their *use* in communication, as well as the development of a serious interest in individual differences in all aspects of language and language behavior.

2. What are the psychological mechanisms by which speech is produced, comprehended, and memorized?
3. What is the course of development of linguistic knowledge and of linguistic performance capabilities?
4. How are linguistic knowledge and linguistic performance capabilities acquired, and what are the variables that influence their acquisition?
5. How are linguistic knowledge and linguistic performance capabilities represented and organized neurologically?
6. How does language interact with thought and other aspects of cognition?
7. Do linguistic knowledge and performance vary as a function of social variables?

Clearly, the major thrusts of basic research and theory in psycholinguistics are first-language acquisition and performance, and the variables that influence them, in normal individuals, whereas the field of applied psycholinguistics concerns itself with: (1) the acquisition, utilization, and impact of those communicative and other cognitive achievements in normal language users that are dependent on first-language acquisition and performance (i.e., reading, writing, textual and classroom learning, second-language learning, and bilingualism); (2) the application of basic principles of psycholinguistics and related areas of cognitive psychology to research and practice in the design of written and oral information (e.g., documents, instructions, advertisements) and computer language; (3) the study of the impact of dialect and social-class differences in first-language acquisition on linguistic and communicative performance and on reading, writing, and learning from texts and lectures; (4) the application of basic research and theory in psycholinguistics and related areas of cognitive psychology to the study and treatment of language and communicative disorders in children and adults, including delayed language development, autistic language, reading disorders, writing disorders, phonological disorders, adult aphasia, adult schizophrenic language, and linguistic and communicative disorders associated with senile dementia, deafness, blindness, motor impairment, environmental deprivation, learning disabilities, and mental retardation); and (5) the assessment of linguistic maturity and communicative competence in language-disordered children and adults from the vantage point of what we know about first-language development and performance in non-language-disordered individuals. (The reader will note, of course, that a number of the subareas of applied psycholinguistics are interrelated.)

Publications in Applied Psycholinguistics

The influence of the "Chomskian revolution" in basic psycholinguistics and related areas of cognitive psychology on the field of applied psycholinguistics was evident in some of the papers that appeared in a book that was edited by

Rosenberg and Koplin (1968) and in the many books (see Table 1.1) and journal articles that have appeared since then. Not until 1980, however, did we witness the creation of an interdisciplinary behavioral science journal (*Applied Psycholinguistics*: Cambridge University Press) devoted entirely to the publication of original articles in all the subareas and on all aspects of applied psycholinguistics (as herein defined) by workers in such fields as psychology, speech and hearing, linguistics, educational psychology, special education, English composition, sociology, language learning, artificial intelligence, psychiatry, and neurology.

Major Questions in Applied Psycholinguistics²

For the reader who is not familiar with the scope of applied psycholinguistics and the nature and extent of its dependence on basic research and theory in psycholinguistics and related areas of cognitive psychology, I have listed following a number of the major questions in applied psycholinguistics in the context of relevant basic research and theory. In addition, for most of these applied questions, I have supplied some references to the relevant basic literature. Some of the references are to literature reviews and texts and some to source articles and books.

1. What is the nature and organization of mature linguistic knowledge in language-disordered and normal adults? (Chomsky, 1965, 1975, 1977, 1979, 1980; Fillmore, 1968; Greenberg, 1977; Halle, Bresnan, & Miller, 1978; Halliday, 1970; Halliday & Hasan, 1976; Jacobs & Rosenbaum, 1968; Levin, 1977; Quirk & Greenbaum, 1973; Searle, 1969, 1976; Smith, 1979; Smith & Wilson, 1979.)

2. What is the course of first-language development in the domains of syntax, semantics, phonology, and pragmatics in each of the populations of language-disordered children, and how does it compare with what has been observed in the case of normal first-language development? (Abrahamsen, 1977; Anglin, 1977; Bates, 1976a, 1976b; Brown, 1973; Clark & Clark, 1977; Collins, 1979; Crystal, Fletcher, & Garman, 1976; Dale, 1976; de Villiers & de Villiers, 1978; Fletcher & Garman, 1979; Foss & Hakes, 1978; Huxley & Ingram, 1971; Lenneberg & Lenneberg, 1975a; Menyuk, 1977; Morehead & Morehead, 1976; Nelson, 1978; Palermo & Molfese, 1972; Schiefelbusch, 1978a; Sinclair, Jarvella, & Levelt, 1978.)

3. What are the variables that influence first-language development in the various populations of language-disordered children, and how do they compare

²A fact that will not escape the reader's attention is that applied psycholinguistic research is an important source of confirmation and disconfirmation for many of the claims of basic psycholinguistic and cognitive theory.

TABLE 1.1
A Selected List of Book-Length Works in Applied Psycholinguistics

<i>Reading</i>	
Gibson and Levin, 1975	Reber and Scarborough, 1977
Kavanagh and Mattingly, 1972	Smith, 1973
	Vellutino, 1979
<i>Discourse learning</i>	
Anderson, Spiro, and Montague, 1977	Freedle, 1977, 1979
Cazden, John, and Hymes, 1972	Freedle and Carroll, 1972
deBeaugrande, 1980	
<i>Second-language learning</i>	
Albert and Obler, 1978	Hatch, 1978
Andersen, 1980	Hornby, 1978
Burt, Dulay, and Finocchiaro, 1977	McLaughlin, 1978
Burt, Dulay, and Hernandez-Chavez, 1973	Richards, 1974, 1978
Diller, 1980	Ritchie, 1978
<i>Language disorders</i>	
Aaronson and Rieber, 1975	Lee, 1974
Berry, 1976	Lenneberg and Lenneberg, 1975b
Bloom and Lahey, 1978	Lesser, 1978
Blumstein, 1973	Morehead and Morehead, 1976
Caramazza and Zurif, 1978	O'Connor, 1975
Conrad, 1979	Quigley, Steinkamp, Power, and Jones, 1978
Curtiss, 1977	Rochester and Martin, 1979
Edwards, 1979	Schiefelbusch, 1978a, 1978b
Goodglass and Kaplan, 1972	Schiefelbusch and Lloyd, 1974
Ingram, 1976	Schlesinger and Namir, 1978
Kavanagh and Strange, 1978	Wyke, 1978
Klima and Bellugi, 1979	

with those that influence first-language development in normal children? (Brown, 1973; de Villiers & de Villiers, 1978; Moerk, 1980; Parisi & Giannelli, 1979.)

4. What are the strategies and processes by which the first language is acquired by members of the various populations of language-disordered children, and how do they compare with strategies and processes of first-language acquisition in normal children? (Block & Kessel, 1980; Clark & Clark, 1978; Clark & Sengul, 1978; Corrigan, 1980; Craig & Gallagher, 1979; Cromer, 1976b; Erreich, Valian, & Winzemer, 1980; MacWhinney, 1978; Moerk, 1977; Slobin, 1970, 1973; Snyder & McLean, 1976; Snyder-McLean & McLean, 1978; Stewart & Hamilton, 1976; Trembath, 1972; Whitehurst, 1977.)

5. What are the extent and nature of individual differences in first-language and communicative development, competence, and performance in language-disordered individuals, and how do such differences compare with those that are found in studies of individual differences in normal individuals? (Fillmore,

Kempler, & Wang, 1979; Leonard, Newhoff, & Mesalam, 1980; Nelson, 1973, 1974.)

6. Is there any evidence for an impairment of the innate biological language acquisition system that many observers feel is involved in normal first-language acquisition in language development in any of the populations of language-disordered children? (Aitchison, 1977; Caplan, 1980; Collins, 1979; Cooper, 1975; Dingwall, 1975; Eilers, Wilson, & Moore, 1979; Goldin-Meadow, 1979; Greenberg, 1978; Hécaen, 1976; Hegde, 1980; Krashen, 1975; Lenneberg, 1967; Lenneberg & Lenneberg, 1975a; Levelt, 1975; Miller & Lenneberg, 1978; Morton, 1970; Munsinger & Douglass, 1976; Piatelli-Palmarini, 1980; Rosemont, 1978; Snow & Hoefnagel-Höhle, 1977, 1978; Walker, 1978.)

7. Are there any differences between any of the populations of language-disordered children and normal children in the hemispheric lateralization of language functions? (Bever, 1975; Caplan, 1980; Dennis & Whitaker, 1976; Hécaen, 1976; Huxley & Ingram, 1971; Hiscock & Kinsbourne, 1978; Kinsbourne, 1975; Lenneberg & Lenneberg, 1975a; Mirabile, Porter, Hughes, & Berlin, 1978; Satz, Bakker, Teunissen, Goebel, & Van der Vlugt, 1975; Tomlinson-Keasey, Kelly, & Burton, 1978; Van Duyne, Bakker, & de Jong, 1977.)

8. Are first-language performance processes (i.e., comprehension, production, memory for linguistic input) different in language-disordered children and adults from what they are in normal children and adults? (Benedict, 1979; Bonvillian, Raeburn, & Horan, 1979; Bridges, 1980; Chapman & Kohn, 1978; Chapman & Miller, 1975; Clark & Clark, 1977; Cole & Perfetti, 1980; de Villiers, Tager-Flusberg, Hakuta, & Cohen, 1979; Foss & Hakes, 1978; Huttenlocher, 1974; Jay, Routh, & Brantley, 1980; Keeton, 1977; Keil, 1980; Perry & Shwedel, 1979; Razel, 1978; Scholes, Rasbury, Scholes, & Dowling, 1976; Shatz, 1978; Starr, 1974; Tyler & Marslen-Wilson, 1978; Washington & Naremore, 1978; Wetstone & Friedlander, 1973.)

9. What is the impact of nonlinguistic cognitive development on first-language development in language-disordered children, and how does it compare with what we know concerning the relationship between nonlinguistic and linguistic cognitive development in normal children? (See Table 1.2.)

10. What is the impact of language on nonlinguistic cognitive development in the various populations of language-disordered children and in normal children? (Blank, 1974, 1975; Bowerman, 1978; Deutsch, 1979.)

11. What are the nature and role of the linguistic input to young language-learning language-disordered children, and how do they relate to what is known about the nature and role of the linguistic input to young language-learning normal children? (Blount & Padgug, 1977; DePaulo & Bonvillian, 1978; Fraser & Roberts, 1975; Furrow, Nelson, & Benedict, 1979; Messer, 1978, 1980; Snow, Arlman-Rupp, Hassing, Jobse, Joosten, & Vorster, 1976; Snow, 1977; Snow & Ferguson, 1977.)

TABLE 1.2
A Selection of References on the Relationship between Nonlinguistic
and Linguistic Cognitive Development in Normal Children

Beilin, 1975	Lenneberg and Lenneberg, 1975a
Bruner, 1975a, 1975b, 1978	Macnamara, 1972, 1977
Bullock, 1979	Moerk, 1975
Cairns and Hsu, 1978	Ninio and Bruner, 1978
Corrigan, 1978	Piattelli-Palmarini, 1980
Cromer, 1976a	Prawat and Jones, 1977
Donaldson, 1978	Ratner and Bruner, 1978
Donaldson and McGarrigle, 1974	Rodgon, 1976
Dore, 1979	Siegel, McCabe, Brand, and Matthews, 1978
Folger and Leonard, 1978	Sinclair, 1971, 1975
Golinkoff and Kerr, 1978	Sinclair-deZwart, 1973
Gowie and Powers, 1979	Tanz, 1974
Greenfield and Westerman, 1978	Wells, 1974
Huxley and Ingram, 1971	
Inhelder, 1978	

12. Do the general-purpose information-processing capacities (e.g., short-term memory) and operations (e.g., rehearsal, monitoring, perceptual encoding, retrieval) of members of the various populations of language-disordered children and adults differ from those of normal children and adults as to their influence on language and communicative performance? (Chi, 1977; Clark & Clark, 1977; Cohen & Sandberg, 1977; Foss & Hakes, 1978; Huttenlocher & Burke, 1976.)

13. Does metalinguistic awareness develop in the same way in the various populations of language-disordered children that it does in normal children? (Carr, 1979; deVilliers & deVilliers, 1972; Kuczaj, 1978; Leonard, Bolders, & Curtis, 1977; Sinclair, Jarvella, & Levelt, 1978.)

14. How do individual and group differences in language and communicative competence and performance in normal individuals influence speech intelligibility and communication?

15. Are there individual differences in normal language competence and performance that relate in any way to the ease with which children learn to read and write or learn a second language?

16. What do basic research and theory in psycholinguistics and related areas of cognitive psychology tell us about how best to prepare texts, lectures, instructions, advertisements, and documents so as to facilitate comprehension and learning? (The appropriate source material here is the literature in experimental psycholinguistics and information processing. See Clark & Clark, 1977, and Foss & Hakes, 1978, for reviews of work in the first area, and Anderson, 1980, and Bransford, 1979, for reviews of the literature in the second area.)

17. What are the implications of basic research and theory in psycholinguistics and related areas of cognitive psychology for the problem of assessing linguistic and communicative maturity in the various populations of language and

communicatively disordered children and adults? (See the references for Questions 1, 2, 5, 8, 12, and 14.)

18. What are the implications of basic research and theory in psycholinguistics and related areas of cognitive psychology for the problem of language training in the various populations of language-disordered children and adults? (See the references for Questions 1, 2, 3, 4, 9, 11, 12, and 13.)

19. In what ways are learning to read and write influenced by aspects of native-language competence and performance in normal children?

20. Does the development of metalinguistic awareness in normal children influence in any way their development of reading, writing, or a second language? (Donaldson, 1978; Sinclair, Jarvella, & Levelt, 1978.)

21. In what ways, if any, are second- and first-language acquisition in normal individuals similar as regards order of mastery of linguistic structures and acquisition processes? (Appropriate here, of course, is the literature on first-language development.)

22. What, if anything, is the impact of the development of writing on subsequent language development and performance in normal individuals? (Ingram, 1975; Olson & Nickerson, 1978.)

23. Do reading, writing, and second-language learning influence in any way subsequent cognitive development and performance in normal individuals? (Donaldson, 1978.)

24. Are linguistic knowledge and performance organized differently in aphasic adults than they are in normal adults? (Clark & Clark, 1977; Foss & Hakes, 1978.)

25. In what way (or ways) does the language of adult schizophrenics differ from that of normal adults? (See Question 24.)

It should be clear by now that there are many different kinds of questions that confront the field of applied psycholinguistics. The previous list is not exhaustive, however; but even so, the reader may wish to keep it in mind as he or she proceeds through the substantive chapters of the present volume.

The Measurement of Linguistic Maturity

In view of the fact that no separate chapter was included in the present volume that deals with language assessment, some remarks on this topic follow.

There are many reasons why one might wish to assess formally linguistic maturity or competence (Dale, 1976), including such communicative capabilities as the mechanisms of conversational interaction, for example, to evaluate the effects of experimental variables in research, to ascertain an individual's mastery of a second language, to evaluate a language enrichment program for primary-school children, to identify children or adults who may be in need of speech and language therapy, or to identify specific aspects of language-disordered children's or adults' problems prior to initiating a therapeutic program. An examina-

tion of the literature on language assessment, however, suggests that the major concern of applied psycholinguists interested in the development of formal language assessment programs has been the diagnosis of disorders of first-language development. We limit our remarks in this section, therefore, to this concern. Our intent, however, is not to review all or some particular portion of the literature in this area or the tests that have been published but, rather, to attempt to identify certain of the implications of basic research and theory in psycholinguistics and related areas of cognitive psychology for the problem of assessing first-language capabilities.

Reviews of work on assessment are to be found in Bloom and Lahey (1978), Carrow (1972), Cicciarella, Broen, and Siegel (1976), Crystal, Fletcher, and Garman (1976), Dale (1976), Irwin and Marge (1972), Miller, (1978), Muma (1978), and Yoder (1974). Examples of tests and other assessment procedures are those of Blank and Franklin (1980), Cantwell, Howlin, and Rutter (1977), Carrow (1968, 1973, 1974), Crystal, Fletcher, and Garman (1976), Fluharty (1974), Gaddes and Crockett (1975), Hedrick and Prather (1975), Ingram (1971), Lee (1971, 1974), Lee and Canter (1971), Muma (1973, 1978), Naor and Balthazar (1975), Quigley and King (1980), Rees and Shulman (1978), and Reynell and Huntley (1971)—see also the extensive list of tests in Appendix C of Bloom and Lahey (1978) and relevant items in the Buros (1972) *Yearbook*. Evaluations of specific assessment measures can be found in Crockett (1974), Kirk and Kirk (1978), Larson and Summers (1976), Longhurst and Schrandt (1973), Prutting, Gallagher, and Mulac (1975), Ratusnik and Koenigsknecht (1975), Scharf (1972), Shriner (1969), Sommers, Erdige, and Peterson (1978), Waryas and Ruder (1974), and Williams, Marks, and Bialer (1977). Some of the factors that influence assessment are identified in articles by Chapman and Kohn, (1978), Chapman and Miller (1975), Hart (1975), Huttenlocher (1974), Johnson (1974), Limber (1976), Perry and Shwedel (1979), Sattler (1970), Shatz (1978), Stick and Norris (1979), and Wetstone and Friedlander (1973). Some useful children's and developmental norms for assessment purposes can be found in Bloom and Lahey (1978), Craig and Gallagher (1979), Crystal, Fletcher, and Garman (1976), deVilliers and deVilliers (1978), Koenigsknecht and Friedman (1976), Miller (1978), Prutting (1979), Richardson, Calnan, Essen, and Lambert (1976), and Shriner and Miner (1968). (The reader should also consult the reference list for Question 17, p. 7.)

The achievements of basic research and theory in psycholinguistics and related areas of cognitive psychology have a variety of implications for the problem of assessing linguistic maturity. Two of the more obvious ones are listed in the following, for illustrative purposes.

1.0 A description of mature linguistic knowledge and its development is logically prior to any attempt to assess language maturity developmentally.

During the early years of the Chomskian revolution there was a total or nearly total dependence on transformational grammar for a description of mature lan-

guage. In recent years, however, changes that have taken place in linguistic theory (including semantics and the theory of speech acts) and in our knowledge of the psychological reality of linguistic structures in child and adult language users have led psycholinguists to adopt a more eclectic approach to the problem of representing linguistic knowledge. Thus, at present, in assessing language competence developmentally, we are likely to want to examine (against norms of normal language development, taking into account central tendencies and variability, evidence of differential mastery in the comprehension and production modes and dialect differences where appropriate) at least the following:

- 1.1 Intonation prior to the appearance of the first words and subsequently.
- 1.2 The form, content, and functions of one-word utterances prior to the appearance of productive combinatorial speech.
- 1.3 Phonological achievements and processes.
- 1.4 The use of multiword routines (i.e., multiword utterances that operate syntactically as if they were single words).
- 1.5 The form, content, and function (semantic relational and speech act) of "unmodulated" simple "sentence" structures, beginning with two-word utterances.
- 1.6 Pronominalization and deixis.
- 1.7 Word order.
- 1.8 Such "modulators" of the meaning of simple sentences as tense, number, possession, auxiliaries, negation, interrogatives, imperatives, and articles.
- 1.9 The elaboration of noun and verb phrases through the use of prepositional, adjectival, and adverbial structures.
- 1.10 The topic-comment, given-new relation as expressed through word order, contrastive stress and syntactic structure.
- 1.11 Sentence-combining operations, including relativization, complementation, nominalization, comparatives, and the use of coordinating and subordinating conjunctions.
- 1.12 The structures of discourse cohesion.
- 1.13 The mechanics of conversation (e.g., turn-taking, fulfillment of conversational obligations, conversational repairs).
- 1.14 Knowledge of indirect speech acts.
- 1.15 The form, content, and organization of the internal lexicon.

Because of the time involved, particularly in the case of children who are developing language at an abnormally slow rate, longitudinal assessment of individual children is impractical. However, the price one pays for not being able to assess linguistic maturity longitudinally may be high, inasmuch as most language structures, including lexical items, undergo gradual change that may include in the case, for example, of a syntactic structure, semantically inappropriate usage, ungrammatical usage (*vis-à-vis* the adult grammar), grammatical

but inconsistent usage, and consistent (grammatically and semantically) appropriate usage. The price one pays, of course, is not being able to determine whether or not the course of language development in a child shows evidence of deviance. The fact that a given structure in the adult grammar is used or not tells us nothing about the course of mastery of that structure.

2.0 It is necessary to take into account in the development of measures of language competence the likelihood that language *performance* (i.e., speech production, speech comprehension, and memory for linguistic input) can be influenced by a variety of factors other than the language user's knowledge of the phonological (including the intonational), syntactic, lexical, semantic, and pragmatic structure of his or her native language, including the conventions of conversation. For example:

2.1 The language user's knowledge of the world, including his or her knowledge of stereotyped everyday routines, such as *going to the doctor, to school, or to a restaurant* (Schank & Abelson, 1977).

2.2 Cognitive strategies peculiar to language processing.

2.3 General-purpose information-processing capabilities (e.g., attention, perceptual encoding, short-term memory maintenance rehearsal, organization, serial processing, parallel processing, long-term memory search and retrieval, problem solving and conceptual capabilities, and self-monitoring).

2.4 Sensory status.

2.5 Motor proficiency.

2.6 Motivation and emotional maturity.

2.7 Social traits.

2.8 Redundancies created by context, linguistic, and nonlinguistic.

2.9 Idiosyncratic linguistic performance styles.

2.10 The language user's knowledge of and attitude toward characteristics of the speaker or hearer.

We need to take such factors into account, of course, in order to avoid, wherever possible, designing assessment procedures that confound the measurement of linguistic knowledge with the measurement of factors that influence an individual's ability to utilize his or her linguistic knowledge. However, inasmuch as many linguistic performance factors are organismic in nature, we are only able to validly assess (or approximate an assessment of) linguistic knowledge or competence in many language-disordered children if we also assess directly sensory status (hearing and vision) motor proficiency, emotional maturity, *fluid* and *crystallized* intelligence (Horn, 1976), short-term memory capacity, neurological status, and the like. Moreover, because it is likely that certain linguistic performance disorders may also retard or otherwise interfere with language acquisition itself, the assessment of these disorders is essential to the task of prescribing appropriate language intervention.

In view of the fact that some of the linguistic performance factors we have been discussing apply differentially to the comprehension, production, and memory performance modes (e.g., entries 2.2, 2.3, and 2.4), it should be possible to identify children who may be suffering from a linguistic performance disorder by administering language assessment procedures in all three performance modes. Conversely, we are not likely to consider that a child might be suffering from a competence disorder unless he or she fails to show mastery of linguistic structures in at least the comprehension and production modes.

It should be clear from this discussion that a thoroughgoing developmental assessment of linguistic and related capabilities should indicate, ideally: (1) the *presence* of disordered language; (2) the *nature* of the disorder, that is, whether it involves (with specifics) phonology, intonation, syntax (including grammatical morphology), lexicon, semantics, pragmatics, discourse cohesion, or some combination of these components of language; (3) the *origin* of the language disorder, that is, whether it involves a failure to acquire aspects of linguistic knowledge, the loss of linguistic knowledge, or a performance deficit, or a combination of these factors; and (4) the *course* of the language disorder—whether it has resulted in delayed language development, deviant language or language development, or a combination of delay and deviance.

The interested reader will find further discussions of the implications of relevant basic research and theory for the problem of assessing linguistic maturity in Crystal, Fletcher, and Garman (1976), Dale (1976), Miller (1978), and Muma (1978).

Language Intervention

No systematic attempt was made in the present volume to review in detail the available work on language intervention, although some authors (see chapters by Fay and Mermelstein, Rosenberg, and Quigley and King) did choose to discuss this topic. It would have been too large an undertaking to have attempted to include a detailed treatment of this topic; besides, there have appeared recently in the literature a number of volumes devoted exclusively or partially to language intervention (Bloom & Lahey, 1978; Muma, 1978; Schiefelbusch, 1978a, 1978b; Schiefelbusch & Lloyd, 1974), as well as a number of articles and chapters containing proposals regarding language intervention (Bowerman, 1976; Crystal, Fletcher, & Garman, 1976; Lahey & Bloom, 1977; MacDonald & Blott, 1974; Mahoney, 1975; Mahoney & Seely, 1976; L. Miller, 1978; Prutting & Connally, 1976; Rees, 1975; Snyder & McLean, 1977; Snyder-McLean & McLean, 1978; Waryas, 1973; Willbrand, 1977; Yule, Berger, & Howlin, 1975).

Other articles that are likely to be of interest to applied psycholinguists involved with language intervention are those of Brown, 1976; Clark and Clark, 1978; Corrigan, 1980; Elardo, 1971; Friedman and Friedman, 1980; Leonard,

1975; Moerk, 1977; Sachs, Bard, and Johnson, 1981; Stewart and Hamilton, 1976; Whitehurst, 1977; Whitehurst and Vasta, 1975; and Wilcox and Leonard, 1978.

Finally, the basic research and theory in psycholinguistics and related areas of cognitive psychology that has influenced language intervention research and program development is identified in Question 18 (p. 7). Of importance have been information on the representation of mature linguistic knowledge, the course of first-language development, the variables that influence first-language development, the strategies and processes by which the first language is acquired, the impact of nonlinguistic cognitive development on first-language development, the nature and role of the linguistic input to young language-learning children, general-purpose information-processing capacities and operations, and the development and significance of metalinguistic awareness.

Other Areas

Several areas of applied psycholinguistics, it was decided, were not sufficiently developed to warrant a chapter in the present volume. These areas are listed now, with one or more references.

Language and learning disability (Wiig, 1976).

Language and environmental deprivation (Curtiss, 1977, 1979, 1980; Curtiss, Fromkin, Krashen, Rigler, & Rigler, 1974; Edwards, 1979; Fromkin, 1975; Sachs, Bard, & Johnson, 1981).

Language and mania (Durbin & Martin, 1977).

Language and senile dementia (deAjuriaguerra & Tissot, 1975; Gustafson, Hogberg, & Ingmar, 1978; Obler & Albert, 1980).

The design of written and oral information—including, for example, documents, instructions, and advertisements—and computer language (Felker, 1980).

Overview

The linguistic knowledge and communicative competencies of normal individuals continue to grow during the elementary school years and beyond, as reflected in both comprehension and production. Applied psycholinguists, however, have a special interest in work in the domains of reading, writing, and second-language learning. It was important, therefore, that these three topics be represented in the present handbook. However, these topics are not only important in their own right but because of a growing belief that the development and achievements of reading, writing, and a second language may figure in the subsequent development of linguistic knowledge (in particular, complex lexical

knowledge and complex sentential and discourse structures) and nonlinguistic capabilities (Donaldson, 1978; Genesee & Hamayan, 1980; Ingram, 1975; Kagan, 1980; Olson & Nickerson, 1978).

The reader will note that the extensive and critical review of research and theory in reading by Vellutino in the present volume encompasses three major aspects of this topic (i.e., reading processes, development, and disorders), each of which is frequently treated in a separate review. The advantage of Vellutino's broad coverage of the literature, however, is that it gave him an opportunity to formulate an integrated characterization and interpretation of the many issues and research findings in this massive area. Moreover, Vellutino makes clear throughout his chapter the extent to which work on reading has been influenced by basic research and theory in psycholinguistics and related areas of cognitive psychology and, in particular, normal first-language development. At the heart of his account, from a substantive standpoint, one finds emphasis placed upon the importance of understanding: (1) the unitization process in word recognition; (2) that the unit of perception in word recognition is relative; (3) the contribution of contextual cues to reading; (4) the contribution of the reader to the word recognition process (in particular, the linguistic and nonlinguistic knowledge and information-processing strategies he or she brings to the task of reading development and performance); and (5) how characteristics of word stimuli influence reading.

The first thing one notes, when he or she views the literature on writing for the first time, is that research and theory in this area are in their infancy. Clearly, serious psycholinguistic and other cognitive work on writing processes and their development represent a recent development in applied psycholinguistics. This is not surprising, however, inasmuch as related basic research and theory in speech production were neglected for years by experimental and developmental psycholinguists, as well as by cognitive information-processing theorists (Rosenberg, 1977). We were fortunate, therefore, when Black agreed to prepare a critical review of the literature on writing relevant to the objectives of applied psycholinguistics. The level of importance that writing has achieved in recent years in the schools (in elementary and secondary schools and in colleges), however, will most assuredly result in a rapid increase in the amount of attention that applied psycholinguists devote to this topic. Indeed, I am willing to hazard the prediction that writing will soon become as important an area as reading has been and that a major source of inspiration for this development will be the growing belief that the acquisition and maturation of writing skills will enhance an individual's already available linguistic and related nonlinguistic capabilities.

Before we can achieve any serious understanding of the impact of writing in other areas, however, we have to make progress in understanding writing *per se*, including how individuals make use of available first-language knowledge and speech production capabilities in writing development and performance and in understanding the relationship between writing and reading.

Some progress has been made in our understanding of basic speech planning and execution processes in mature language users in recent years (Clark & Clark, 1977; Cooper & Paccia-Cooper, 1980; Cooper & Walker, 1979; Foss & Hakes, 1978; Rosenberg, 1977; Siegman & Feldstein, 1979), but little is known about their development in children.

Like reading, second-language learning is a well-developed area of applied psycholinguistics and, therefore, one that reflects extensively the impact of basic research and theory. Additionally, however, second-language learning has become one of the battlegrounds on which certain of the claims of some of the theorists who propose that there is a strong innate biological component in first-language acquisition are being tested (Snow & Hoefnagel-Höhle, 1977, 1978). Moreover, the related area of bilingualism has figured in our understanding of basic first-language acquisition processes (Slobin, 1971).

A question concerning second-language learning that has evidently never been raised as regards reading or writing is whether learning another language interferes with one's first-language development and/or performance. This question, however, has been and continues to be an important one in the area of second-language learning and bilingualism, as McLaughlin's review indicates (this volume; also Gray & Cameron, 1980).

One of the highlights of McLaughlin's chapter is, for example, his discussion of the processes of second-language learning and, in particular, the similarities, differences, and interactions involving second- and first-language acquisition at different stages of development (i.e., childhood, adolescence, adulthood). Another highlight is his critical treatment of the literature on biological factors in second-language learning, which leads him to conclude that "the evidence for a biologically based critical period in second-language learning is not convincing."

Another highlight is of special interest in that it is part of the general question of the impact of reading, writing, and second-language learning on cognitive development. I refer here to his treatment of the question "Does a bilingual have more cognitive flexibility than a monolingual does?"

The final topic in the present volume that is not concerned with language disorders is discourse processes. Students of discourse processes have addressed such problems as learning from texts and lectures (Anderson, Spiro, & Montague, 1977; Carroll & Freedle, 1972), document design (Felker, 1980), advertising (Bruno & Harris, 1980), general aspects of prose comprehension (Freedle & Fine, this volume), and cross-cultural communication processes—in particular the problem of miscommunication (Freedle & Fine).

Freedle and Fine introduce the reader to basic concepts in the general domain of prose comprehension that are clearly applicable in a variety of areas, one of them being writing. Thus, to the extent that there are constraints on the creation of prose that relate to the requirement of listener or reader comprehension, there

is a need to train writers to be sensitive to these constraints. The problem of miscommunication, therefore, arises not only in cross-cultural communication but in writing as well.

As Freedle and Fine point out, the problem of cross-cultural miscommunication arises in the area of bilingual education, which is an area that is also treated by McLaughlin (this volume).

As we saw earlier, in the section Major Questions in Applied Psycholinguistics, a number of issues relate to all the populations of children who suffer from disorders of first-language development (i.e., Questions 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 17, 18): (1) the course of first-language (including communicative) development; (2) the variables that influence first-language development; (3) the strategies and processes by which the first language is acquired; (4) individual differences in first-language development; (5) the innate biological language acquisition system; (6) the hemispheric organization of language functions; (7) first-language performance processes; (8) the relationship between nonlinguistic cognitive and first-language development; (9) the impact of language on nonlinguistic cognitive development; (10) the nature and role of adult linguistic input in first-language development; (11) general-purpose information-processing capacities and operations; (12) metalinguistic awareness; (13) language assessment; and (14) language intervention.

It was not possible to address all of these issues in the chapters on developmental language disorders in the present handbook, one of the reasons being the availability of relevant research and/or theory pertaining to the various issues.

Among the issues Leonard treats in his critical review of the literature on specific language impairment (or what some investigators call delayed language development) are those of individual differences in first-language development, adult linguistic input in first-language development, the relationship between nonlinguistic cognitive and first-language development, first-language performance processes, and the course of first-language development. Thus Leonard makes the reader aware at the start that language-impaired children do not constitute a homogeneous population but display individual differences in both production and comprehension. This has led some investigators to adopt rigorous criteria for subject selection, but, as Leonard points out, the fact of individual differences raises questions concerning the generality of the findings of particular studies sampling particular subgroups of language-impaired children.

When language interactions between adults and language-impaired children are compared with language interactions involving adults and normal children, some differences emerge that will require careful examination in future research.

Leonard's review of the available literature on nonlinguistic cognitive and first-language development in language-impaired children reveals instances in which difficulties were encountered on some Piagetian and nonverbal intelligence tasks that led him to conclude that "language impairment might best be

described as a set of conditions where language ability is considerably more depressed than nonverbal intelligence, not as a set of conditions where language disability exists in the presence of normal nonverbal intelligence." Thus it is likely that there are factors other than nonlinguistic cognitive ones that are implicated in the language difficulties of language-impaired children. One possible factor is the difficulties some language-impaired children appear to encounter processing certain rapidly presented acoustic stimuli, thus suggesting that a performance factor may be involved in their language impairment.

As regards the question of the course of first-language development in language-impaired children, Leonard's review reveals a picture of developmental lag and/or arrest at an early age in the domains of syntax, semantics, pragmatics, and phonology rather than a picture of linguistic deviance. This picture is complicated, however, by language-impaired children's persistent use of linguistic structures that are more in evidence at earlier ages in normal children and by some differences between language-impaired and normal children in the relationship among linguistic structures.

It is clear from Leonard's review that although progress has been made in our understanding of language impairment in children, much work still remains to be done. In addition to the important question of the etiology or etiologies of language impairment in children, there is, among other things, a strong need for detailed extended longitudinal investigations of the course of first-language development in individual language-impaired children and detailed assessments of the final achievements in the language capabilities of adults who were language impaired as children.

On the basis of Rosenberg's review in the present volume, it appears that the mentally retarded present a picture of disordered language development associated with serious disordered nonlinguistic cognitive development and motivational and other linguistic performance problems as well. However, like language-impaired children, they too display a wide range of individual differences, both linguistically and nonlinguistically, and, moreover, differential rates of development of different aspects of language. Furthermore, like language-impaired children, the mentally retarded display a developmental lag and/or arrest in language development in the domains of syntax, semantics, and phonology. Their achievements in the domain of pragmatics (specifically in conversational interaction), however, may, to some extent, outdistance their achievements in the other domains of language competence (Rosenberg, this volume; Abbeduto & Rosenberg, 1980).

Three other conclusions arrived at in the course of Rosenberg's review of literature on the language of the mentally retarded that are of interest in light of Leonard's findings for language-impaired children are the conclusions that "No convincing case has been made for the frequent claim that certain nonlinguistic achievements necessarily antedate and/or pace language development in the mentally retarded"; that "Mothers' speech to young language learning mentally

retarded children has not been shown to differ from mothers' speech to young language learning nonretarded children."; and that "Etiology *per se* does not appear to be implicated in language development and functioning in the mentally retarded."

Autistic children also present a picture of language delay and/or arrest (rather than deviance) but one that is complicated by the presence of severe emotional and interpersonal problems and, in many or most instances, mental retardation as well. Moreover, unlike language-impaired and nonautistic mentally retarded children, autistic children, most likely as a result of their severe emotional and interpersonal problems, tend to be especially vulnerable in the domain of language use (i.e., pragmatics; Fay & Mermelstein, this volume; Blank & Milewski, 1981). It is interesting to note, however, the existence of some evidence that autistic children may outdistance language-impaired children in the domain of phonological development.

As one would expect, there are proposals in the literature regarding an involvement of nonlinguistic cognitive deficits in the language disorders of autistic children, but, as Fay and Mermelstein point out, the claims that have been made thus far are not convincing.

The previous summary statement regarding the course of first-language development in autistic children, it should be pointed out, applies primarily to syntax and phonology, because little is known regarding semantic development in this population of language-disordered children.

A significant feature of both Rosenberg's and Fay and Mermelstein's chapters is their treatment of work on language intervention, although the treatment in Fay and Mermelstein is more extensive than that in Rosenberg's chapter.

Finally, it should be pointed out that Leonard, Rosenberg, and Fay and Mermelstein as well paint a picture of development of language competence or knowledge complicated by the presence of certain linguistic performance deficits.

Prelingual deafness, in particular, profound deafness, carries with it some problems of language development that are not faced by the other populations of language-disordered children that we have been discussing. Some linguistic contact of an interactive nature with an adult or older child appears to be required for normal auditory-vocal language development (Sachs, Bard, & Johnson, 1981). However, because the auditory-vocal channel is not the only means by which our capacity for language can be realized (there is also, for example, the visual-manual domain), the impact of prelingual deafness on language development will vary depending on the nature and extent of early compensatory intervention in cases of prelingual deafness, including that provided by parents.

However, a complicating factor in the study of language development in deaf children, as Quigley and King indicate in their present review, is the result of the fact that "Most deaf children are exposed in infancy and early childhood to a variety of systems, the relative merits and effectiveness of which are continually

being debated." These may include signing, finger spelling, speech, lipreading, writing (and reading), gestures, or some combination of systems.

The development of reading and writing competence have become important goals of language training for the deaf, evidently not only because of their importance in school and in evaluating language training programs but because of the role they play in communication generally for the deaf. However, as Quigley and King's review indicates, the deaf are at an obvious disadvantage in these areas, even after years of formal education. (Not surprisingly, they also suffer at the same time from serious problems of speech intelligibility.)

The reader will recall at this point my earlier remarks concerning the possibility of a positive relationship between literacy and subsequent linguistic and nonlinguistic cognitive development in normal children. Should future research confirm this relationship, we would want to examine in the laboratory its implications for the continued development of language and other aspects of cognition in older deaf children and deaf adults.

Worthy of special note is Quigley and King's critical discussion of literature on language and cognition in deaf children. As Quigley and King indicate, according to the work of Furth and his associates, "the cognitive development of deaf people is similar to that of hearing people when language is not a factor in the cognitive task." They indicate further, however, that the presence of serious methodological problems in this research means that "their conclusions need to be tempered. . . ."

The issues raised by Quigley and King in their section on language and cognition are crucial to the question of which first-language system (e.g., finger spelling versus American sign language) best meets the communicative and other (in particular, the reading education) needs of deaf individuals.

The course of language development in the deaf is examined by Quigley and King in the context of a variety of modes of exposure to English. The picture that emerges is not altogether clear in the case of exposure to oral English, at least as far as the course of language development is concerned. In the visual-manual channel, however, observations of manual counterparts of syntax, semantics, and phonology suggest that the course of language development in the deaf is similar to what it is in the auditory-vocal channel in normal hearing children.

The reader with a special interest in language development in deaf children will also want to read Quigley and King's (1980) recently published review of the research program of Quigley and his associates on the development of English syntax as assessed through writing (and to some extent reading) tasks. In the main, according to Quigley and King (1980), syntactic development in deaf and hearing individuals is similar although "greatly retarded" in the deaf. Moreover, deaf subjects appear to be particularly vulnerable in the domain of complex sentences, which suggests that language development may level off earlier in deaf than in normal individuals. Additionally, the kinds of errors deaf subjects make suggest that they acquire language in a manner similar to that of normal hearing individuals.

Thus, once again, we find, amid evidence of differences, fundamental similarities between a population of language-disordered children and normal children vis-a-vis aspects of language development. And, moreover, despite the differences the present discussion of disorders of first-language development have revealed among disorders associated with: (1) minimal nonlinguistic cognitive dysfunction; (2) mental retardation; (3) emotional, social, and nonlinguistic cognitive dysfunctions; and (4) auditory deprivation, there exist some fundamental similarities.

Needless to say, these findings suggest that there may be certain built-in (i.e., innate) biases in our capacity for first-language acquisition that to a significant extent serve to protect us from widely differing kinds of developmental insult.

Consistent with this notion of built-in biases, it should be noted, have been observations of the spontaneous development of communicative gestures in young prelingual deaf children (Goldin-Meadow & Feldman, 1977; Quigley & King, this volume).

There is one final point I would like to make here (see, also, the relevant discussion in Quigley & King, this volume). To the extent that there are differences between a manual language acquired early and a subsequent vocal language, the problems the deaf encounter with the second language can be examined in the context of what we already know about second-language learning and bilingualism in normal hearing children.

The impact basic research and theory in psycholinguistics and related areas of cognitive psychology has had on applied problems is nowhere better illustrated than it is in the area of adult aphasia, as the present review by Caramazza and Berndt indicates. In the main, the work in this area has been concerned with determining in adults who have suffered left hemispheric damage to critical language areas: (1) the structure (phonological, lexical, syntactic, semantic) of the language spoken and comprehended; (2) whether or not there has been a loss of linguistic competence or knowledge; (3) whether linguistic performance (e.g., speech planning, speech comprehension) and general-purpose information-processing factors (e.g., attention, memory) have been affected; (4) the impact of the language dysfunction on other areas of cognitive functioning; and (5) whether compensatory linguistic performance mechanisms and strategies have been developed by the aphasic patient.

The most striking finding in the applied psycholinguistic research in the area of aphasia, as the present review indicates, is that to a significant extent, when language functions break down in adults in the face of neurological insult, the breakdown is organized and consistent with what we know or can reasonably surmise concerning the organization of linguistic knowledge and the organization and operation of linguistic performance and related general-purpose information-processing capabilities in normal adults.

However, this finding is not just significant for our understanding of adult aphasia, for as Caramazza and Berndt point out, the results of contemporary psycholinguistic research in adult aphasia are helping basic researchers in

psycholinguistics and neurolinguistics to evaluate the psychological reality and origin of proposed structures, components, and operations of normal language capabilities. The contribution of contemporary psycholinguistic research in adult aphasia to basic issues is exemplified in the following excerpt from Caramazza and Berndt's chapter.

Our impression is that it is relatively easy to characterize syntactic impairments and that such impairments are closely associated with lesions in the anterior zones of the language area. In contrast, phonological and semantic deficits appear to take many different forms and can result from insult to widely varying sites. There are probably several explanations for this observed pattern, and the most interesting is that syntactic processing enjoys some special biological status that is not shared by the other components.

Caramazza and Berndt go on to cite some evidence in support of this view from, for example, studies of split-brain patients.

Of all the areas we have discussed in the present overview, adult schizophrenic language has been influenced least by developments in basic research and theory in psycholinguistics. Moreover, as Rosenberg and Abbeduto's review chapter has revealed, research in this area has been plagued by serious methodological and other problems. Therefore, what we have available to us from this research are working hypotheses rather than firm conclusions.

One of these is that the evidence suggests that the occasional disruptions one notes in the speech of some schizophrenics are more suggestive of the existence of a linguistic performance rather than a linguistic competence disorder and one, moreover, that is associated with high arousal (anxiety), attentional disturbances, and delusional thinking. These disruptions, furthermore, tend to occur at the level of discourse and may or may not produce speech that is incoherent to the listener. Incoherent speech, however, with the features of schizophrenic speech, is not unique to this population, because it has also been observed to occur sometimes in some manics, in some adult aphasics, and in some normals.

Some interesting proposals have appeared in the literature that have to do with the cortical organization of language and other cognitive functions in schizophrenics that will require careful further evaluation in the laboratory.

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READING, WRITING AND LANGUAGE LEARNING

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2 Theoretical Issues in the Study of Word Recognition: The Unit of Perception Controversy Reexamined

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INTRODUCTION

How does a skilled reader recognize a word? This question has generated an impressive body of literature over the years, and exploration of its parameters and dimensions has consumed the energies of researchers studying mental processes since before the turn of the century (Cattell, 1886a, 1886b; Erdmann & Dodge, 1898; Pillsbury, 1897). Understanding of the word recognition process is, of course, related to the more general question of how an individual extracts meaning from written language and is, in fact, propaedeutic to an understanding of the critical processes involved in learning to read. Historic and contemporary interest in reading is no accident because, to reiterate Huey's (1908) much quoted comment: To completely analyze what we do when we read would almost be the acme of a psychologist's achievements, for it would be to describe very many of the most intricate workings of the human mind [p. 6].

Ironically, the theoretical issues of central concern to investigators who were among the first to conduct laboratory study of the reading process continue to preoccupy present-day researchers, and many of these issues are yet unresolved. Reminiscent of the early inquiries of Cattell and others are the multitude of studies and theoretical expositions that seek to define the unit of perception in word recognition. And debated no less now than in years past are certain critically related issues—namely, the degree to which word recognition involves serial versus parallel or holistic processing of component letters, direct versus phonologically mediated access to lexical entries, and sequential/hierarchical (bottom-up) versus context driven (top-down) and/or interactive processing of letter and word features. The present chapter is primarily concerned with the first

of those mentioned—the unit of perception issue. The controversy that surrounds this issue stems from vastly different theoretical views as to the level of analysis at which word recognition is most likely facilitated. The currently debated alternatives correspond to processing units at the level of word features, component letters, letter clusters, and whole words, but there is as yet no research evidence that unequivocally favors one over the other. At the same time, there is reason to believe that any one of these units might be critically involved in the recognition process, depending on the nature and purpose of the task set before the perceiver, the construction of the materials he or she encounters in that task, and the competencies he or she has available to engage it. A number of studies have recently shown, for example, that the level of visual analysis may vary in accord with task demands, implying perhaps that word recognition necessitates a variety of strategies that the skilled reader apparently has at his or her disposal. Such findings could also be taken as an indication that the unit of perception is relative rather than absolute, the latter being the explicit assumption adopted by most researchers studying the problem over the years. If so then the concept would require redefinition. Thus a major objective of this chapter is to reexamine the unit of perception issue in light of certain research findings and theoretical arguments that highlight the variable nature of the word recognition process as well as the flexibility that characterizes the human information processor in achieving veridical perception. This latter point, itself, underscores a factor that has been sorely neglected in the literature and that is the qualitative differences in word recognition that might be occasioned by individual differences in the skill of the reader.

A curious paradox exists in that almost all the research available in the study of word perception and the models that have been offered to characterize this process have been generated on the basis of work done with highly skilled adult readers—typically college students. Furthermore, very few of those who have attempted to formalize the structural and functional components of word recognition have made an effort to incorporate developmental and/or individual difference variables into their conceptualizations of the process. Yet consideration of these variables could conceivably alter or at least illuminate even critical dimensions of given models so as either to limit or to increase their explanatory power. At the same time, it is likely that qualifications issueing from pointed study of developmental and individual differences in the process variables involved in learning to read would eventuate in the construction of more comprehensive models of word perception that would not only increase our understanding of the process but could also account for differences that might be found between the skilled and less skilled reader. Thus, a second major objective of the present chapter is to analyze critically the unit of perception issue within a developmental framework, systematically relating alternative conceptualizations emanating from work done with mature readers to theoretical arguments and

empirical findings emanating from the study of reading ability in young children. The assumption motivating this analysis is that a comprehensive understanding of the complex mechanisms employed by fluent readers in identifying a word cannot be achieved without a comprehensive understanding of the mechanisms employed by the developing reader in doing so. Although no claim is made that such understanding has been achieved, there is now enough suggestive evidence from comparative study of skilled and less skilled readers to qualify theoretical constructs that have emerged from the study of word recognition in fluent adult readers.

The exposition that follows is divided into *four* sections. The first presents a brief description of the major concepts and schematics that are employed in the word recognition models to be discussed and is designed to lend structure to the discussions of those models. The second section defines the unit of perception issue, presenting both a brief chronology of the opposing viewpoints as well as more detailed descriptions of contemporary theories that advocate respective units of processing (i.e., features, letters, letter clusters, and whole words). Although the bulk of the discussion in this and subsequent sections is concerned with the unit of perception controversy, certain related issues are, of necessity, touched upon, in particular, the question of whether the letters in a word are processed serially or in parallel, the importance of phonologic mediation in word recognition, and the role of context in the recognition process.

The third section constitutes documentation of the contention that the unit of perception is relative and is itself divided into three major subsections. The first of these subsections is concerned with the influence of contextual factors on word recognition and specifically discusses the methodological differences in the studies that have yielded conflicting results and highlights two significant observations: (1) that experimental procedures employed in these studies typically created perceptual biases in their subjects that favored particular theories being evaluated; and (2) that these subjects were quite able to vary their perceptual strategies in accord with the dictates of the task presented to them. The second subsection is focused upon the structural and functional differences among the words that may be encountered by the reader and presents evidence that such differences necessitate different processing strategies for recognition and identification. The arguments advanced in the latter sections are buttressed in the third subsection, which discusses the unit of perception issue within a developmental framework. The major theme that evolves in this section is that skilled reading represents the end product of a protracted developmental progression characterized by a gradual transition from constrained to flexible modes of visual analysis, some of which are unconscious and automatic and some of which are optional and deliberate. The converse of this theme is that unskilled reading implies inflexible and idiosyncratic modes of analysis, and research contrasting processing strategies in skilled and unskilled readers is presented.

The final section summarizes and integrates the major points made in the main body of the text, and the need for a model of word perception with greater ecological validity is stressed.

Two Convenient Heuristics

A Three-Stage Model of Memory

Before proceeding to the substantive issues to be discussed, it would seem useful to characterize briefly the component systems theoretically involved in word recognition and the types of information processed by those systems. Figure 2.1 presents a three-stage model of memory taken from Atkinson, Herrmann, and Wescourt (1974). In simplified form, the model depicts the processing components that might be involved in recognizing and identifying a word, from initial pickup of its physical features to production of an identifying response. The first

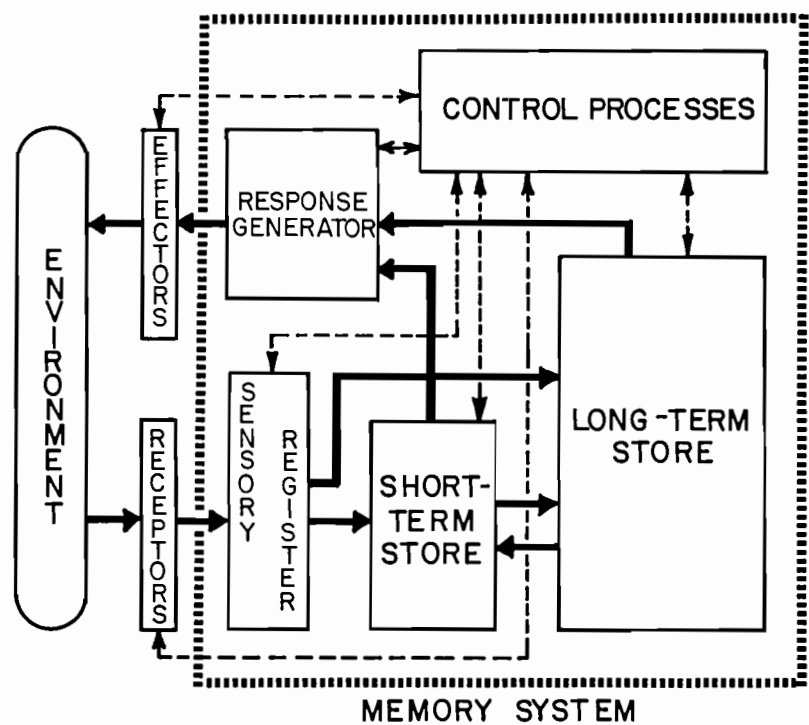


FIG. 2.1. Three-stage model of memory depicting stages of information processing (taken from Atkinson, Hermann, & Wescourt, 1974, with permission of the authors and publisher).

component—*sensory register*—encompasses processes that record physical stimuli in raw uncoded forms for very brief durations (e.g., 200–300 msec for visual stimuli, Sperling, 1963). It is during this stage of processing that the visual features of letters and words are believed to be analyzed and encoded.

The second major component depicted is *short-term store*, or working memory, as it is called by some. This is believed to be a limited capacity system, able to retain from five to nine “chunks” of information for short durations (approximately 30 sec, Glanzer & Cunitz, 1966), depending on one’s ability to organize and rehearse the material to be retained. It seems reasonable to suppose that the type of lexical information processed by short-term memory would vary with the skill of the reader and the nature of the reading task. In the case of word analysis, an enterprise that often consumes the energies of beginning readers, letter and word features as well as letters and/or letter clusters might constitute respective processing units. The fluent reader, in contrast, more often utilizes short-term memory for temporary storage of words and phrases, while processing the constituents of sentences encountered in running text.

Long-term memory is an unlimited capacity system that retains information indefinitely, but retrieval of particular items is dependent on one’s ability to set up a mental “filing system” that facilitates efficient search and location. With regard to word recognition and identification, long-term memory might be considered the repository of all the information contained within and about a written word, which obviously includes associations with its verbal counterpart in spoken language. Such information encompasses a word’s *graphic* or visual features, its *orthographic* or structural components, its *phonologic* or auditory characteristics, and its *syntactic* and *semantic* properties, the latter two referring, respectively, to its functional use in sentences and its meaning (Gibson, 1971). That component of long-term memory that records and catalogs lexical information—that is, information about a word’s featural characteristics—is often termed the *lexicon*.

The output component of the processing model presented in Fig. 2.1 is referred to as the *response generator*. The response generator is intended to refer to the complex of processes responsible for selecting the naming response and for programming the articulatory movements necessary for pronunciation.

Some models of the word recognition process incorporate an executive component that links memorial subsystems to one another, facilitates selective attention, determines coding and rehearsal strategies, and (by virtue of multiple feedback loops) generally performs a monitoring function that serves to validate accurate perceptions and correct misperceptions. This component is termed *control processes* in the model depicted in Fig. 2.1. Control processes are almost certainly involved in new learning (Calfee, 1975; Vellutino, 1979) and by some accounts (Rumelhart, 1977) play a dynamic role in identifying familiar words as well.

The final point to be made concerning the memory model presented in Fig. 2.1 is that the subsystems are interconnected, both by direct lines of transmission and by virtue of the links that two component systems commonly have with a third. This feature of the model will be especially useful in contrasting theories of word recognition that respectively advocate direct and mediated access to word meanings stored in long-term memory.

Types of Information Involved in Word Recognition

The information-processing model discussed in the preceding section provides a broad schematic that roughly corresponds with stages of memory that might be involved in word recognition and identification, but it does not detail particular mechanisms that characterize respective stages relative to the types of information processed by those mechanisms. Table 2.1 provides such detail. The information outlined is arrayed in rough correspondence with the sensory, perceptual, and cognitive components of word recognition and identification, but (as indicated by the asterisks) the so-called "unit of perception" varies with given theories. The processes listed in items 1, 2, and 3 constitute the sensory components of word recognition, the mechanisms responsible for these components encompassing the sensory register stage of information processing (Fig. 2.1). Item 1 refers to the light-wave pattern created by the word stimulus. Item 2—the icon—refers to an encoded representation of the physical energy given off by the stimulus, maintained in temporary storage for approximately 250 msec. This stage of visual processing is what Massaro (1975) terms preperceptual visual storage (see Fig. 2.2) and initiates feature detection, a process characterized by differential sensitivity to the graphic features of a word stimulus (lines, curves, angles, supraletter features such as the "roundness" of CO or the "squareness" quality of IN) and, by some accounts (Estes, 1977, Johnson, 1977), information as to the orientation and position of letters. Feature detection thereafter energizes the feature analysis process (item 3), during which the unique characteristics of letters (item 4), letter groups (item 5), and/or whole words (item 6) are analyzed and mapped onto corresponding codes in long-term memory that transform a word's graphic features into units of recognition. The output of feature analysis constitutes the input to the perceptual component of word recognition, as conceptualized in given models to be discussed. The perceptual component is not graphically depicted in the memory model presented in Fig. 2.1 but is characterized in most models as a processing stage intermediate to the sensory and short-term memory stages of information processing (see Fig. 2.2). Item 4 earmarks component letters as the units of perception, and items 5 and 6 earmark letter clusters and whole-word patterns as perceptual units.

Item 7 refers to the phonologic component of word recognition, which corresponds, respectively, to phonologic recoding and articulatory programming. Phonologic recoding is the process whereby letter strings are transformed into abstract representations of the sound sequences that comprise a printed word,

TABLE 2.1
Types of Information, Component Processes, and Output Responses Hypothesized
in Different Theories of Word Recognition

Types of Information	Process	Responses	Types of Theories			
			Feature Theories	Component Letter Theories	Letter Cluster Theories	Whole-Word Pattern Theories
1. Light energy	Stimulation of visual receptors		X	X	X	X
2. Icon	Brief visual storage	Feature detection	X	X	X	X
3. Letter and/or supraletter features	Analysis of letter features	Feature discrimination and encoding	X	X	X	X
4. Letter strings	Letter recognition	Letter encoding		X ^a	X	
5. Orthographic patterns (spelling clusters, vocalic center groups, etc.)	Letter parsing and grouping	Letter cluster and/or syllable encoding		X	X ^a	
6. Whole-word features and/or patterns	Whole-word pattern analysis	Whole-word pattern encoding	X ^a			X ^a
7. Phonologic	Phonologic recoding and/or articulatory programming	Pronunciation and/or naming		X	X	
8. Semantic and syntactic	Cognition and conceptualization	Comprehension of meaning	X	X	X	X

^aType of information constituting unit of perception.

considered by some to be prerequisite to its recognition (Gough, 1972; Spoehr & Smith, 1973). Articulatory programming accords roughly with response selection and pronunciation.

Finally, item 8 depicts what may be termed the *cognitive* or *conceptual component* of the word recognition process. The cognitive component stores information as to a word's meaning and its use in sentences, referring, respec-

tively, to its semantic and syntactic characteristics. Atkinson et al. (1974) suggest that such knowledge depends in part on the storage of "conceptual codes" that define the "classes of conceptual relations that may be entered by the concept represented by a word [p. 104]." It is noted subsequently that although there is considerable agreement as to the type of information processed by the conceptual component of the memory system, by no means is there a consensus as to the role of such information in word recognition.

In sum, the schematics presented in Fig. 2.1 and Table 2.1 should make it clear that the word recognition process is exceedingly complex, involving the integration of five major classes of information: *graphic*, *orthographic*, *phonologic*, *semantic*, and *syntactic*. The use of such information in the word recognition process and the means by which it may be utilized has been the object of close scrutiny for over 80 years, and research in the area has generated certain controversial issues that are yet unresolved. It is those issues to which I now turn my attention.

THE UNIT OF PERCEPTION IN WORD RECOGNITION: CONTEMPORARY THEORIES

As already noted, one of the unresolved controversies in the study of word recognition is the processing level at which visual analysis of a letter string facilitates discrimination of a familiar word, otherwise termed the *unit of perception* (see Table 2.1). This question was originally raised by Cattell (1886a, 1886b), who found that subjects could identify two four-letter words better than three or four unrelated letters at brief tachistoscopic exposures. He also found that the time taken to perceive a whole word (measured in latencies) was no greater than the time taken to perceive a single letter. Cattell concluded from these results that words must be recognized as integrated wholes and that we do not therefore perceive their component letters separately. Thus for Cattell the word rather than the letter was the unit of perception. This idea was reinforced by research undertaken by Erdmann and Dodge (1898), who demonstrated that whole words could be identified at distances too great to permit identification of their letters.

Cattell's suggestion that the whole word is the unit of perception was the dominant theme in the scattered accounts that appeared during the first half of the twentieth century. This view was no doubt buttressed by the work of the Gestalt psychologists (Kohler, 1929; Wertheimer, 1923), whose influential theories eschewed atomistic explanations of perceptual phenomena and gave rise to the deceptively simple but rather encompassing characterization that the "whole is something other than the sum of its parts." The whole-word theory therefore went unchallenged until the middle of the fifth decade when Miller, Bruner, and Postman (1954) produced results that suggested that the word advantage ob-

served on short-term memory tasks need not be attributed to the preeminence of the word as an integrated unit and may instead be associated with the sequential redundancy that characterizes English orthography. These authors found that briefly exposed pseudowords, having letter distributions that closely approximated the statistical structure of printed English (e.g., *vernalit* and *ricaning*), were identified much better than random letter strings presented under identical stimulus conditions. It was suggested, in explanation of these findings, that an implicit knowledge of orthographic structure facilitates interletter predictability, thereby compensating for short-term memory limits by increasing the size of the processing unit (or "chunk") while maintaining invariance in the total amount of information to be processed. Thus the word *CHUNK* contains three processing units rather than five, because the letters in the clusters *CH* and *NK* often appear in the same sequence in printed English and therefore constitute redundant information. The net affect is that *CHUNK* would be no more difficult to remember on a short-term memory task than the three unconnected letters, *ZTQ* and less difficult than the letter string *ZTQMR*, which contains five processing units rather than three.

Miller et al.'s (1954) study is significant in that it provided initial evidence that it is not necessary to postulate a perceptual unit as large as the word in order to account for the word advantage effect observed by Cattell (1886a, 1886b) and others, inasmuch as a similar effect was demonstrated in comparisons of pseudowords and randomly arrayed letters. It is also important because the research findings and the conclusions drawn constitute a sharp departure from traditional interpretations of perceptual phenomena (e.g., Gestalt theorizing) and are more in line with the information-processing theories of cognitive functioning that emerged at the time (Shannon, 1951). However, the results of this investigation did not permit specification as to whether the word advantage effect is a perceptual phenomenon or an interpretive phenomenon resulting from inferential or decision processes at the level of short-term memory (Broadbent, 1967; Neisser, 1967). The data also left unanswered the more basic question of just how a familiar word is recognized and at what level of processing. Thus, Gibson, Pick, Osser, and Hammond (1962) essentially replicated Miller et al.'s (1954) findings, systematically varying the "pronounceability" of letter strings presented to subjects, and concluded that the word advantage is a perceptual effect. They also concluded that the spelling cluster rather than the word or letter is the unit of perception. Both conclusions were based on the idea that words and pronounceable pseudowords are inherently more perceptible than random letter strings, because, unlike random letter strings, they can be analyzed in accord with spelling-sound correspondences, which were thought to be perceptual invariants that facilitate economy of processing and discrimination of distinctive features (Gibson, 1971). This interpretation was not widely accepted, in part because the beneficial effect of pronounceability was later observed with deaf subjects (Gibson, Shurcliff, & Yonas, 1970). And while a conceptualization of word percep-

tion that is quite similar to the spelling cluster hypothesis materialized a short time later (Spoehr & Smith, 1973), other investigators have provided support for the alternative possibilities that the letter (Massaro, 1973) and the letter feature (Rumelhart & Siple, 1974; Smith, 1971) constitute respective units of perception.

Complicating the picture still further is the fact that the whole-word theory proved to be more tenacious than might have been predicted earlier. Specifically, Reicher (1969), using a postcue (partial report) procedure that controlled for sequential redundancy and short-term memory factors, demonstrated that single letters could be recognized better when embedded in words than within the context of random letter strings. To be specific, on trials on which subjects were presented with brief exposures of real words (e.g., *WORD*) and asked to report a single letter from that word immediately after, the (forced choice) response alternatives were always the target letter and a foil that completed the spelling of another real word (e.g., *K* and *D*). Reicher also found that a letter could be recognized better within a word than when presented alone and concluded from these results that a word must be a higher-order unit that provides more information for component letter recognition than does a random letter string or a letter itself. He therefore suggested that previous interpretations attributing the "word superiority" effect to orthographic redundancy or guessing biases may be in error. Wheeler (1970) replicated Reicher's findings, controlling for sensory processing factors as well as attentional and response bias, and came to a similar conclusion. Although these findings did not go unchallenged (Massaro, 1973; Thompson & Massaro, 1973), the word as perceptual unit hypothesis was effectively revived and came to have a number of latter day advocates (Johnson, 1975, 1977; Johnston & McClelland, 1973) who have argued with refreshed vigor against word perception theories that postulate subword components as units of recognition.

It should be clear from this brief chronology that the theoretical arguments generated by psychologists' attempts to define the unit of perception in word recognition has gone full circle during the past 85 years. Indeed, there seems to be little more consensus than during the period directly following Cattell's initial paper on the topic. This is somewhat disconcerting, given the fact that the conflicting arguments issue from relatively well-articulated theories evaluated, for the most part, by well-designed and well-executed studies that have frequently yielded directly opposite findings. How can we account for this state of affairs? Is there any way that these disparate positions can be reconciled? One obvious possibility is that particular experimental procedures, employed in studies addressing the issue, may have differentially biased subjects toward processing word constituents at different levels of analysis. As evident in a later section, there is reason to believe that this explanation can account for much of the disparity in the research findings reported in the literature. However, a more

encompassing explanation can be offered. I would like to suggest that ultimate resolution of the controversy surrounding the perceptual unit issue may well be occasioned by serious consideration of the possibility that the unit of perception in word recognition is relative rather than absolute and depends on three important factors: (1) the conditions under which a given word is encountered; (2) the structural characteristics of the word itself; and (3) the knowledge, experience, and skill of the reader.

The first of these is exemplified in the possibility that the level of processing required for word perception may vary in accord with whether or not a given word is encountered in isolation, as in most studies addressing the unit of perception issue, or within the context of meaningful sentences. It seems to me that a word presented in a meaningful context often necessitates only a global analysis of intraword components, inasmuch as the number of contextually appropriate alternatives having graphic and orthographic characteristics in common with the stimulus word is greatly reduced. In contrast, a word presented in isolation often requires a more fine-grained analysis before a discrimination can be made, because without meaningful context the number of possible alternatives having (graphic and orthographic) characteristics in common with the stimulus is greatly magnified. This, of course, underscores the second factor just mentioned, that the level of processing will be significantly influenced by the structural characteristics of the word itself.

In all likelihood, words that have a high degree of visual and structural similarity will necessitate a good deal more processing at subword levels than do words that have a minimal degree of similarity. Thus word pairs such as *was* and *saw* no doubt prompt visual analysis at the letter level, whereas the words *hippopotamus* and *Mississippi* are easily discriminated from most other words at the whole-word level.

However, the probability that a given processing strategy will be employed in discriminating one word from another would itself seem to be dependent on the skill of the reader such that the greater the skill, the more flexible and efficient the level of analysis. This presents the possibility of individual differences with respect to typical processing modes, the implication being that there is some degree of variability in the tendency to analyze words more often at one level than at another.

I discuss each of these factors in greater detail in a later section and attempt to document my arguments with recent research findings issuing from the study of processing differences in skilled as compared with less skilled readers. However, before doing so, it is instructive to review each of the competing theories of word recognition that advocate particular units as the basis for word perception, adding my own editorial comments as seems indicated. In each instance, the unit of perception is taken as the level of processing required to effect recognition and identification of a letter string as a familiar percept.

Feature Theories

Extraction-Type Theories

In an extensive review of the topic, Smith and Spoehr (1974) distinguish between "extraction"- and "interpretation"-type theories of word perception, both typically emphasizing word features as the basis for recognition (see Table 2.1). The earliest type of extraction theory that appeared in the literature is exemplified in Pillsbury's (1897) suggestion that the features that distinguish a word's shape (ascenders, descenders, etc.) constitute the primary basis for its recognition. This particular explanation, though once popular, no longer has much currency and would seem to be questioned by the fact that words can be recognized regardless of whether they are printed in lowercase letters, uppercase letters (E. Smith & Haviland, 1972), or alternating cases (F. Smith, Lott, & Cronnell, 1969). Thus extraction theories that emerged subsequently typically posit that the features that discriminate given words are, more often, the unique features of the individual letters that comprise those words and/or the supraletter features that characterize combinations of letters (e.g., the "squareness" quality of NI). For example, in attempting to account for the word superiority effect (i.e., that letters can be perceived better in words than in nonwords or when presented alone), Wheeler (1970) suggested that words contain "more features" with which to discriminate component letters, including overall shape and supraletter and letter characteristics. Implied here is an interactive process whereby familiarity with a word's multiple features directly influence one's ability to extract discriminating information as, for example, in distinguishing between the response alternative *K* and *D* after a brief exposure to the stimulus word, *WORK*.

An alternative suggestion made by Wheeler (1970) is that extraction of relevant features may occur more selectively, such that features extracted initially may direct subsequent processing so as to maximize the probability of detecting features that facilitate discrimination (Feigenbaum, 1963). The common factor in both of these suggestions is attentional limitations, compounded by short-term memory constraints that impede perception of letters in the whole word less than perception of letters presented singly or in random strings, inasmuch as the information contained in the word facilitates selective processing of relevant featural information.

Wheeler's second suggestion is compatible with Rumelhart's (1970) limited capacity theory of letter recognition, in that both make reference to attentional limitations in the extraction of featural information. However, this aspect of the two theories would seem to be questioned by Shiffrin and Gardner's (1972) finding that sequential presentations of letter stimuli occasion no better performance in letter recognition than simultaneous presentations, suggesting that feature extraction is an automatic process that is not influenced by selective attention and capacity limitations. Although it is not difficult to imagine ways in which selective attention might affect letter and word discrimination, it may be that

attentional limitations reflect processes subsequent to feature extraction, as suggested by Herman and Kantowitz (1970). The question is yet open and depends on additional research for its resolution; however it is worth noting that it relates to the more general question of whether or not higher-order cognitive processes can directly influence feature extraction, which it will be seen is a critical issue in the study of word recognition.¹

Interpretation or Feature Redundancy-Type Theories

F. Smith's Theory. To continue, the second variety of feature theory discussed by Smith and Spoehr (1974)—that is, the “interpretation” theory—has received somewhat greater accord in the literature. Interpretation theories assign much more responsibility to decision processes than do extraction theories and place particular emphasis on the reader's implicit knowledge of orthographic structure as a functional component of these processes. I first discuss the feature redundancy theory of F. Smith (1971).

Smith assumes that the features that uniquely define a word are the features of the component letters in that word, extracted simultaneously from all letter positions. However, in Smith's model, word recognition is mediated neither by prior recognition of a word's component letters nor by recognition of combinations of those letters. He suggests instead that a word's representation in long-term memory includes several functionally equivalent feature lists for each letter in that word, along with information as to the sequential dependencies, which can occur among given letters, as defined by English orthography. The feature lists for each letter are functionally equivalent in that each defines a different size or shaped character, corresponding to a particular letter category (e.g., A, a, α). This aspect of the model is in keeping with the observation that words can be recognized in a variety of different fonts and cases.

In an attempt to circumvent the obvious strain on memory that would seem to be occasioned by the acquisition and functional use of such detailed information (Massaro, 1975), Smith proposes that the sequential dependencies that characterize the letters in English orthography facilitate the development of what he terms “criterial sets” of features defining a given word. These constitute a limited

¹Wheeler (1970) offered a third alternative, which in essence suggests that the feature extraction process may yield fragmented information that prompts “sophisticated guessing” (Neisser, 1967; Newbigger, 1961) as to a word's identity. Although sophisticated guessing cannot be ruled out as a partial explanation for performance under some circumstances (e.g., with highly degraded stimuli), it falls short as a general explanation for word recognition phenomena and for the word superiority effect in particular. This is illustrated by Reicher's (1969) finding that letters were recognized better in words than in nonwords, even when the letter alternatives were known beforehand. Similarly, E. Smith and Haviland (1972) equated words with nonwords for distributional and sequential redundancy and found that the word-nonword difference was maintained.