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GOVERNMENT REGULATION. [*This entry comprises two articles*: Federal Regulation *and* State Regulation. *See also the independent entries on* Competency; Ethics; Licensure; *and* Mandated Reporting.]

Federal Regulation

Much of the legal regulation of psychology occurs at the state rather than the federal level. This is especially true for the regulation of clinical practice. However, federal law greatly influences psychological research by regulating experimentation with human subjects and animals. Federal law also governs the use of psychological testing and other professional issues.

Experimentation with Human Subjects

Federal law requires the Department of Health and Human Services to issue regulations concerning experimentation involving human subjects. These regulations require institutions receiving federal research grants to establish boards to review all institutional research involving human subjects. The Institutional Review Board (IRB) must have at least five members of diverse social and professional backgrounds. The board must include at least one member whose primary interest is in science, at least one member in a nonscientific area, and at least one member not affiliated with the institution.

The purpose of the review is to determine that risks to subjects are minimized and are reasonable in relation to any anticipated benefits, that selection of subjects is equitable, that truly informed consent is obtained, and that adequate provisions are made to protect the safety and privacy of subjects and to maintain the confidentiality of data. If any of the subjects are likely to be vulnerable to coercion or undue influence (as with, for example, children and prisoners), the review must ensure additional safeguards are used to protect their welfare.

Experimentation with Animals

The United States Department of Agriculture issues regulations regarding experimentation with animals. Each animal research facility must register with the Department of Agriculture and update that registration every three years. With the registration form, the facility must acknowledge receipt of standards and regulations from the department's Animal and Plant Health Inspection Service and agree to comply with them.

Each research facility must appoint an Institutional Animal Care and Use Committee (IACUC). In addition to the chair, the committee must include at least one doctor of veterinary medicine with training in laboratory animal science and medicine and at least one person unaffiliated with the research facility to represent general community interests.

The IACUC must regularly review the research facility's program for the humane care and treatment of animals and inspect all animal facilities. It also must review and approve all proposed activities (or significant changes in ongoing activities) involving animals for compliance with the regulations. It has the additional responsibility to investigate concerns involving the care and use of animals resulting from public complaints or from persons working at the research facility.

Psychological Testing

Federal law significantly affects the use of psychological tests in employment and education settings. Title VII of the Civil Rights Act of 1964 (Equal Employment Opportunity Act) is the primary vehicle for challenges to testing practices in employment settings, although challenges also may be based on other grounds such as the Equal Protection Clause of the Fourteenth Amendment to the United States Constitution. Under

Bates, E., Thal, D., Trauner, D., Fenson, J., Aram, D., Eisele, J., & Nass, R. (1997). From first words to grammar in children with focal brain injury. *Developmental Neuropsychology, 13*, 275–343.

Bavelier, D., Corina, D., Jezzard, P., Padmanabhan, S., Clark, V. P., Karni, A., Prinster, A., Braun, A., Lawlani, A., Rauschecker, J. P., Turner, R., & Neville, H. J. (1997). Sentence reading: A functional MRI study at 4 tesla. *Journal of Cognitive Neuroscience, 9*, 664–686.

Caplan, D. (1992). *Language: Structure, processing, and disorders.* Cambridge, MA: MIT Press.

Damasio, A. R., & Damasio, H. (September, 1992). Brain and language. *Scientific American*, 89–95.

Fitch, R. H., Miller, S., & Tallal, P. (1997). Neurobiology of speech perception. *Annual Reviews in Neuroscience, 20*, 331–353.

Just, M. A., Carpenter, P. A., Keller, T. A., Eddy, W. F., Thulborn, K. R. (1996). Brain activation modulated by sentence comprehension. *Science, 274*, 114–116.

Leonard, L. (1998). *Children with specific language impairment.* Cambridge, MA: MIT Press.

Pickett, E. R., Kuniholm, E., Protopapas, A., Friedman, J., & Lieberman, P. (1998). Selective speech motor, syntax and cognitive deficits associated with bilateral damage to the putamen and head of the caudate nucleus: A case study. *Neuropsychologia, 30* (2), 173–188.

Tallal, P., Galaburda, A. M., Llinas, R., & VonEuler, C. (Eds.). (1993). *Temporal information processing in the nervous system, special reference to dyslexia and dysphasia. Annals of the New York Academy of Science* (Vol. 682). New York: New York Academy of Sciences.

Tallal, P., Miller, S., & Fitch, R. (1993). Neurobiological basis of speech: A case for the preeminence of temporal processing. In P. Tallal, A. M. Galaburda, R. R. Llinas, & C. von Euler (Eds.), *Temporal information processing in the nervous system: Special reference to dyslexia and dysphasia. Annals of the New York Academy of Sciences* (Vol. 682, pp. 27–47). New York: New York Academy of Sciences.

Zurif, E. B., Caramazza, A., Meyerson, R. (1972). Grammatical judgements of agrammatic aphasics. *Neuropsychologia, 10*, 405–417.

Paula Tallal and Michael Patterson

Language Development, Syntax, and Communication

All natural languages, spoken or signed, are structured at many levels. Meaningless units, called phonemes, combine to create morphemes, the smallest meaningful units of a language, which in turn combine to form words, phrases, and sentences. Very early in development children begin to learn the phonemic categories and systems underlying their language, freeing them to tackle larger units. Independent of the language learned, children tend to enter the system of larger units at the level of the word, not the morpheme or sentence. Between ten and fifteen months, children produce their first words, always using each word as an isolated unit. Children then proceed in two directions, learning (1) that the word can be composed of smaller, meaningful parts (morphology), and (2) that the word is a building block for larger, meaningful phrases and sentences (syntax).

Overview of Grammatical Development

Because early progress consists of accruing morphemes both within and across words in a sentence, the *mean length of utterance* (MLU, counted in morphemes) originally proposed by Roger Brown (*A First Language*, Cambridge, Mass., 1973), is an excellent tool for measuring grammatical growth in the early stages of language acquisition. In his groundbreaking longitudinal study of three children known by the pseudonyms Adam, Eve, and Sarah, Brown showed that there were large differences in the ages at which the children displayed evidence of grammatical development. MLU, rather than age, turns out to be a reliable index of grammatical ability, at least up until an MLU of 3 or 4. Beyond this point, other indexes (such as the index of productive syntax, which captures the range of structures in spontaneous speech) provide better measures.

Breaking Words into Morphemes. Children learning languages rich in morphology (for example, Hebrew) learn the parts of words earlier in the course of language development than do children acquiring morphologically impoverished languages (such as English). Languages that have regular morphological structures are relatively easy to master. For example, children acquiring Turkish, which has a rich, predictable, and perceptually salient inflectional system, produce words with grammatical morphemes even before they combine words. In contrast, children acquiring English generally do not begin to learn the morphemes of their language until after they begin to combine words into sentences.

At the earliest stages, children learn morphologically complex words as unanalyzed wholes. For example, "shoes" may not, in the child's mind, be composed of the stem "shoe" plus the plural "s," particularly if the child never produces "shoe" and uses "shoes" to refer to footwear in singles and in pairs. At some point, the child discovers that "shoes" is composed of parts ("shoe," "s") and that each part has a meaning (footwear, plural). It is often not easy to tell when this analysis has taken place. One key piece of evidence, possible only when the pattern in the language is not completely regular, comes from children's overregularizations—exceptions to an adult pattern (for example "feet," "ate") that children alter to conform to a regularity they have extracted ("foots" suggests that the child has extracted the plural morpheme "s" and "eated," the past tense morpheme "ed"). By 3 to 4 years of age, children can be given nonsense words and asked to generate novel forms for different sentence frames, as Jean Berko did in her well-known *wug* test ("This is a wug. Now there are two of them. There are two ___"; the child should supply the word "wugs").

In languages in which all morphemes have approximately equal phonological salience, children tend first to acquire morphemes occurring in the perceptually salient positions at the ends of words. These are the inflectional (as opposed to the derivational) morphemes, which tend also to be obligatory and therefore frequent. For example, in English, the possessive inflection "s" is further from the stem than the diminutive derivation "y" (for instance, "doggy's") and is, in fact, acquired earlier.

Combining Words into Sentences: Word Order and Argument Structures. At around 18 months, children begin to produce two-word strings. The two-word combinations children produce across languages are highly similar in two respects. First, the content is the same. Children note the appearance and disappearance of objects, their properties, locations, and owners, and they comment on the actions done to and by objects and people. Second, the words in these short sentences are consistently ordered. The particular orders that children use mirror the orders provided by the language models they experience. Even when the language children are learning has relatively free word order, children tend to follow a consistent pattern (based on a frequently occurring adult order).

Word order is an important device used by languages to convey who did what to whom. Even before children produce two-word combinations, they have some knowledge of this device. Children who produce single words only, when shown two scenes (Big Bird washing Cookie Monster versus Cookie Monster washing Big Bird), will look reliably longer at the scene that matches the sentence they are listening to (the first scene for the sentence "Big Bird is washing Cookie Monster," for example). The order of words must be conveying information to the child about who is the agent and who is the object of the action.

Moreover, children who are limited to two words per sentence appear to know something about the larger argument structures underlying their sentences. They produce, at times, all of the appropriate arguments that a given predicate allows ("baby drink," "drink juice"; "mommy give," "give juice," "give me"; and so on). Indeed, for children at the two-word stage, the rate at which a semantic element (like juice) is put into words depends on the argument structure underlying the sentence. For example, the child is more likely to produce "juice" in a two-word sentence with a two-argument structure (*x* drinks *y*) than in a two-word sentence with a three-argument structure (*x* gives *y* to *z*); that is, "juice" is more likely to appear with "drink" than with "give," presumably because there is less competition for one of the two surface "slots" in a sentence with two versus three underlying arguments. At some implicit level, the child seems to know how many arguments there ought to be in each frame. Moreover, when provided with sentences that differ in their argument structures, children can make the appropriate inferences about the type of action described. For example, children will look longer at a scene in which Cookie Monster is making Big Bird turn (as opposed to one in which each is turning independently) when they hear the two-argument sentence "*Cookie Monster* is turning *Big Bird*" than when they hear the one-argument sentence "*Cookie Monster* is turning with Big Bird."

Grammatical Categories. Young children produce words in consistent orders as soon as they combine them and, in this sense, adhere to a syntax. But is it the syntax of adults? Adult regularities are formulated in terms of syntactic categories—subject, object, noun phrase, verb phrase, and so on. Is there evidence for categories of this sort in the young child's language?

The earliest orders that children produce can all be described at a semantic level and thus do not *require* a syntactic analysis (although they do not violate one either). For example, the sentence "baby drink" can be described as agent-action, as opposed to subject-verb. Indeed, the fact that young children often interpret sentences like "babies are pushed by dogs" to mean the babies are the pushers (not the pushees) suggests that, for these children, the first word is an agent, not a subject. A subject-verb description becomes unavoidable when the words that fill the first position are no longer restricted to a single semantic category (consider "bottle falls"—the bottle is not affecting an object and thus is not an agent) and when other aspects of the sentence depend on this nonsemantic category (such as subject-verb agreement). It is not until children begin to fill in their telegraphic utterances with grammatical morphemes (for example tense endings on verbs that must agree in number with the subject: bottle falls versus bottles fall) that clear evidence for syntactic categories can be found. However, the fact that children use their grammatical morphemes appropriately as soon as they appear in their repertoires suggests that the groundwork for syntactic categories may have been laid quite early, perhaps from the start.

Elaborating Sentence Frames: Sentence Modalities and Constituent Structure. Children are able to say no, ask questions, and make demands from the outset (they do so gesturally or through simple lexical devices); with the advent of grammatical morphemes they begin to accomplish these goals using sentential forms expressing these various modalities. Negatives and questions are not, however, completely adultlike, even after grammatical morphemes appear. For the most part, they deviate from the adult form in that children often omit subjects and auxiliary verbs (do, is, have). From the few within-child analyses that have been done, subjects and auxiliaries appear to be introduced into both negatives and questions at about the same time. Negative markers are placed between the auxiliary and the verb ("baby *is* **not** *drinking*"); however, some period of time is needed before children consistently invert the subject and the auxiliary in questions ("**is** *baby* drinking?).

In addition to elaborating one element of a single proposition ("baby drinking big bottle"), children also begin combining sentences to express complex or compound propositions. For example, English-learning children produce object complements ("I hope I don't hurt it"), embedded clauses ("that a box that they put it in"), coordinate clauses ("maybe you can carry that and I can carry this"), and subordinate clauses ("I gave him some so he won't cry").

The advent of two-proposition constructions brings with it the problem of appropriately relating the propositions, not only in production but also in comprehension. Children can show some remarkably subtle behaviors in this regard. For example, consider a child who is told that a little girl fell and ripped her dress in the afternoon and reported the event to her mother later that night. When 3-year-old children are asked "When did the girl say she ripped her dress?" they will provide one of the two possible answers (in the afternoon, or at night), but when they are asked "When did the girl say how she ripped her dress?" they will provide only one (at night). The reason for this interpretive pattern has to do with how the two propositions ("say," "rip") are linked in the probe question (that is, their constituent structure). The important point is that, at the young age of 3, children appreciate this subtlety, which would, in fact, be difficult to teach.

However, children do make errors in interpreting complex sentences that adults find easy. When asked to act out the sentence "The lion tells the bear to climb up the ladder," they appropriately make the bear do the climbing. But when asked to act out the sentence "The lion pushes the bear after climbing up the ladder," many children incorrectly make the bear climb rather than the lion. The reason the climber differs in the two sentences again has to do with the structural relations between the constituents in each sentence. Here, however, children have not yet achieved adult performance.

Theoretical Explanations for the Course of Grammatical Development

A series of theories have been offered to account for the trajectory of grammatical development described above.

Behaviorist Accounts. Consistent with the psychological theories of the day, language prior to the late 1950s was considered just another behavior, governed not by its own rules and constraints but by the general laws of learning. Mechanisms of imitation and reinforcement were considered adequate to produce the grammatical habits that made up language. The behaviorist account of language was severely challenged in 1959 with the publication of Noam Chomsky's review of B. F. Skinner's *Verbal Behavior* (*Language*, 35, 26–58). Chomsky argued that adult language use cannot be adequately described in terms of chained sequences of behaviors or responses. A system of abstract rules underlies each individual's knowledge and use of language, and it is these rules that children acquire when they learn language. When viewed in this way, the language acquisition problem requires an entirely different sort of solution.

Nativist Accounts. The premise of the Chomskian perspective is that children are learning a linguistic system governed by subtle and abstract principles without explicit instruction and, indeed, without enough information from the input to support induction of these principles (as opposed to other principles)—the *poverty of the stimulus* argument. Language-learning must therefore be supported by innate syntactic knowledge and language-specific learning procedures. The theory of *universal grammar* (UG) formulates this a priori knowledge in terms of principles and parameters that determine the set of possible human languages. UG is assumed to be part of the innately endowed knowledge of humans. Some principles of UG do not account exhaustively for properties of grammars; they are underspecified, leaving several (constrained) options open. For example, word order freedom apparently is a parameter of variation. Some languages (English) mandate strict word orders; others (Russian, Japanese) list a small set of admissible orders; still others (Warlpiri, an Australian aboriginal language) allow almost total scrambling of word order within a clause. Input from a given language is needed for learners to "set" the parameters of that language.

One important aspect of this theory is that setting a single parameter can cause a cluster of superficially unrelated grammatical properties to appear in the language. For example, the "null-subject" parameter involves a number of properties: whether overt subjects are required in declarative sentences (yes in English, no in Italian), whether expletive elements such as "it" in "it seems" or "there" in "there is" are exhibited (yes in English, no in Italian), whether free inversion of subjects is allowed in simple sentences (no in English, yes in Italian), and so on. The prediction is that the input necessary to set the null-subject parameter results in the simultaneous alignment of all of these aspects within a child's grammar. There is, at present, controversy over whether predictions of this sort are supported by the child language data.

Innate knowledge of the principles underlying language is, however, not sufficient to account for how children acquire language. How are children to know what a noun or a subject is in the language they are learning? They need to identify subjects and verbs in their language before they can determine whether the two are strictly ordered in that language and before they can engage whatever innate knowledge they might have about how language is structured. Thus, in addition to innate syntactic knowledge, children also need learning procedures, which may themselves be language specific. One example is a set of rules *linking* semantic and syntactic categories. Children are assumed to know innately that agents are likely to be subjects, objects affected by action are likely to be direct objects, and the like. All they need do is identify (using context) the agent in a scene; the linking rules allow them to infer that the term used to refer to that agent is the subject of the sentence. Their innate knowledge about how these elements are allowed to be structured can then take over. Again, controversies exist over whether child language data support these assumptions.

Social/Cognitive Accounts. The nativist position entails two claims: (1) at least some of the principles of organization underlying language are language-specific and not shared with other cognitive systems, and (2) the procedures that guide the acquisition of these principles are themselves innate. Note that although these two claims often go hand in hand, they need not. One can imagine that the principles underlying linguistic knowledge might be specific to language and, at the same time, acquired through general, all-purpose learning mechanisms (although they must be more substantial than the mechanisms behaviorist accounts have offered). This constitutes the position that has come to be known as a social or cognitive account of language-learning.

Children do not sound like adults when they begin to speak; there clearly is developmental work that needs to be done. The question is what type of work is required? One possibility, favored by some nativists, is that children have in place all of the grammatical categories and syntactic principles they need; they just lack the "operating systems" that will allow those principles to run. The developmental work to be done does not, under this view, involve a changing grammatical system.

In contrast, the child's language may change dramatically during development, from a system based on semantic categories to one based on syntactic categories. This transformation could be maturationally determined or guided by innate linking rules, preserving a nativist account. However, the transformation could also result from an inductive leap children make on the basis of the linguistic data available to them, in conjunction with the cognitive and social skills they bring to the task.

Cognitive underpinnings may be necessary but they are rarely sufficient for the onset of linguistic skills. For example, the onset of gesture + speech combinations that convey two elements of a proposition ("open" + point at box) precedes the onset of two-word combinations ("open box") by several months, suggesting that the cognitive ability to express two semantic elements is not the final stumbling block. More than likely, extracting linguistic patterns from the input presents the largest problem.

The social/cognitive account holds that there is in fact enough information in the linguistic input children hear, particularly in the context of the supportive social environments in which they live, to induce a grammatical system. Ample research indicates that adults alter the speech they direct to their children. Speech to children (often called *motherese*) is slower, shorter, higher pitched, more exaggerated in intonation, more grammatically well formed, and more directed in content to the present situation than speech addressed to adults. And children pay particular attention to this fine-tuned input, interpreting it in terms of their own biases or "operating principles" (for example, paying attention to the ends of words). One problem that arises, however, is that child-directed speech is not universal. In many cultures, children participate in communicative interactions as overhearers (rather than as addressees) and the speech they hear is not at all simplified. Nevertheless, they become competent users of their grammatical systems in roughly comparable time frames, suggesting that there may be many developmental routes to the same end—a reasonable conjecture given the robustness of language.

In fact, language learners may have ways to simplify the input themselves. For example, young children's memory limitations may make them less able to recall entire strings of words or morphemes. As a result, they end up doing the analytic work required to abstract linguistic regularities on a smaller, filtered database ("less is more"). This filtering may be just what children require to arrive at their linguistic systems. Moreover, the process is a general one that children across the globe presumably bring, in equal measure, to the language-learning situation.

Connectionist Accounts. In a sense, connectionism is more of a technique for exploring language-learning than an explanatory account, although most connectionist models are based on the assumption that language (and all other cognitive skills) can be explained without recourse to rules. Behavior is produced by a network of interconnected units. Language development is a process of continuously adjusting the relative strengths of the connections in the network until they produce an output that resembles the input.

Connectionism offers a tool for examining the tradeoff between the three components central to all theories of language learning—input, structures the child brings to the learning situation (architectures of the artificial system), and learning mechanisms (learning algorithms). The latter two are considered innate on the nativist account and specific to language. Connectionism provides a technique for determining the structures and learning processes that must be present, given the input children typically receive, to achieve learning. As an example, networks have been shown to arrive at appropriate generalizations from strings of sentences *only if* the memory span of the network for previously processed words begins small and gradually increases (reminiscent of the less-is-more hypothesis described previously).

Language-Learning in Atypical Environments and Atypical Learners

Early language-learning is remarkably similar given the variability in input that children receive across cultures. Indeed, language-learning proceeds apace even when the child is faced with learning two languages simultaneously. Children who are in bilingual environments from birth are not dramatically slowed in their development and appear to develop each language as they would had it been their only language (as a monolingual). Bilingualism is not, in fact, an atypical situation—half the world's population is functionally bilingual. We turn now to unusual learning situations and learners.

Learning Language in a Different Modality. Children who are exposed to a conventional sign language from birth acquire that language as effortlessly, and along the same developmental course, as children acquiring a spoken language. This fact is remarkable, as it suggests that children treat inputs from different modalities as equipotential inputs for language-learning. If language is offered via hand and eye, it is learned and processed as easily as if it is presented via mouth and ear.

Learning Language Without a Language Model. Ninety percent of deaf children are born to hearing parents and thus are not immediately exposed to a sign language. If exposed to input from a spoken language only, profoundly deaf children (even if given intensive training) are not likely to acquire that spoken language, confirming that adequate input is necessary for children to learn a *particular* language.

However, deaf children who cannot learn spoken language and are not exposed to sign language do not fail to communicate. They do so via gesture, and their gestures are structured in languagelike ways. Their gestures are used to request and comment about the present and nonpresent and to "talk" about their own gestures. The gestures display sentence-level structure (following ordering and deletion regularities, and girded by argument structures for both simple and complex gesture sentences), word-level structure (hand shape and motion morphemes), and grammatical categories (distinctions between nouns, verbs, and adjectives). These characteristics are not found in the spontaneous gestures their hearing parents use when communicating with them and thus may be the "default" system that children themselves bring to the language-learning situation. In this regard, it is interesting that the deaf children tend to omit subjects/agents and follow consistent word/gesture order, displaying what might be considered the default values for these parameters.

Learning Language Without Visual Input. Children who are blind from birth might be expected to have difficulty learning language simply because they map the words they hear onto a world that is not informed by vision. In fact, they have little difficulty with grammatical development, suggesting that the formal learning involved in acquiring a grammatical system does not depend in any necessary respect on a precise mapping between the grammatical system and the visual world.

Learning Language with Varying Cognitive and Social Abilities. Language development does not proceed in lockstep with the development of other mental abilities. For example, children with Down syndrome are delayed in language-learning relative to mental age; yet children with Williams syndrome, who in terms of IQ are as mentally retarded as children with Down syndrome, display considerably better grammatical skills. Thus low intelligence does not, in all cases, preclude grammatical development (assuming IQ is a sufficiently sensitive index for these comparisons).

On the other hand, children with Specific Language Impairment, by definition, have no cognitive disabilities but do have difficulty learning language. As a final piece of evidence, adults (who are cognitively mature) typically have difficulty learning a second language (and even a first), suggesting that cognitive maturity is not sufficient to guarantee grammatical development (and after some "critical period" may even become an impediment).

A similarly complex pattern holds for social skills. Children with Down syndrome are socially adept yet have difficulty learning grammar. In contrast, autistic children's social interactions are atypical, yet when they are able to learn language, their grammatical skills are intact.

Language and Thought

Do we need language to think? Since children do indeed think prior to the onset of language, thought is clearly possible without language. However, the fact that a given language may require its speakers to mark, for example, the number of the objects they refer to (while other languages make no such obligatory demands) could, after many years of use, affect the way speakers of that language partition the world, not only when they speak but also in nonlinguistic tasks. The *Sapir-Whorf* hypothesis, as it is called, has found some support in adults. English speakers treat implements (say, rakes), in *both* linguistic and nonlinguistic tasks, in the same way as they treat animates (that is, like individuated countable objects, such as pigs). In contrast, Mayan speakers treat rakes in the same way as they treat substances (like formless uncountable masses, such as corn). Recent work has shown that children acquire the particular characteristics of the languages to which they are exposed from the start, thus using the categories of their languages to partition their worlds as they speak. The interesting question here is how often these linguistic categories generalize to nonlinguistic tasks and, if they do, at what point in development does the spread from language to thought take place.

[*See also* Infancy; *and* Middle Childhood.]

Bibliography

Bates, E., Benigni, L., Bretherton, I., Camioni, L., & Volterra, V. (1979). *The emergence of symbols: Cognition and communication in infancy*. New York: Academic Press. A series of chapters by Bates and her colleagues exploring possible cognitive prerequisites for language-learning.

Bishop, D., & Mogford, K. (Eds.). (1988). *Language development in exceptional circumstances*. New York: Churchill-Livingtone. It is seldom possible to design experiments that manipulate variables thought to affect language-learning. This book takes an alternative, more naturalistic approach to the problem and considers language acquisition in children who are developing in exceptional physical or environmental circumstances.

Bloom, L. (1970). *Language development: Form and function in emerging grammars*. Cambridge, MA: MIT Press. The first attempt to use context systematically to infer the intended message of a child's utterance and to then analyze form in relation to meaning.

Bloom, P. (Ed.). (1993). *Language acquisition: Core readings*. New York: Harvester Wheatsheaf. An anthology of seminal readings in the acquisition of language, including chapters on learning language late in life and the "less is more" hypothesis (Newport), language invention by deaf children of hearing parents (Goldin-Meadow and Mylander), and connectionist (Rumelhart and McClelland) and nativist (Pinker) accounts of the acquisition of morphology.

Bowerman, M. (1996). The origins of children's spatial semantic categories: Cognitive versus linguistic determinants. In J. J. Gumperz & S. C. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 145–176). Cambridge: Cambridge University Press. An example of how children learn the categories of the language to which they are exposed from the onset of language-learning. The edited volume itself presents modern-day approaches to the language and thought question.

Braine, M. D. S. (1976). Children's first word combinations. *Monographs for the Society for Research in Child Development, 41* (1), 1–97. A detailed description of the earliest word combinations children produce shedding light on the kinds of categories that can be attributed to children's first sentences.

Crain, S. (1991). Language acquisition in the absence of experience. *Behavioral and Brain Sciences, 14* (4), 597–650. The target article takes a nativist approach to language-learning and reviews a number of studies showing very early competence in understanding sentences with complex constituent structures. Commentaries from 26 scholars in the field and a response from the author follow.

Elman, J. L. (1993). Learning and development in neural networks: The importance of starting small. *Cognition, 48*, 71–99. A connectionist approach to language learning, illustrating how limitations in the "learner" can improve learning.

Fletcher, P., & MacWhinney, B. (Eds.). (1995). *The handbook of child language*. Oxford, UK: Blackwell Publishers. A compendium of articles written for the handbook, including excellent reviews of the connectionist approach (Plunkett), the input children receive across (Ochs & Schieffelin) and within (Snow) cultures and in bilingual situations (de Houwer), the syntactic knowledge children display in comprehension (but not production, Golinkoff & Hirsh-Pasek), the developmental path taken in learning morphology (Peters) and complex sentences (DeVilliers), and nonnormal language development.

Kessel, F. (Ed.). (1988). *The development of language and language researchers*. Hillsdale, NJ: Erlbaum. Essays written by students of Roger Brown in his honor, including papers on the acquisition of sign language by deaf children of deaf parents (Bellugi; Petitto), language acquisition in autistic children (Tager-Flusberg) and bilinguals (Hakuta), and a cross-linguistic look at the problem of language acquisition (Maratsos). The book offers an interesting historical perspective on the field of language acquisition spawned by Brown.

Landau, B., & Gleitman, L. R. (1985). *Language and experience: Evidence from the blind child*. Cambridge, MA: Harvard University Press. A detailed description of blind children's acquisition of language, focusing on the lessons learned for language-learning in all children.

MacWhinney, B. (Ed.). (1987). *Mechanisms of language acquisition*. Hillsdale, NJ: Erlbaum. A series of papers reflecting different approaches to the problem of *how* language acquisition proceeds, including explorations of the processes that underlie learning as well as the innate biases that constrain those processes.

Pinker, S. (1994). *The language instinct: How the mind creates language*. New York: Morrow. An easy-to-read book about language and language-learning written for the interested novice and taking a nativist point of view.

Slobin, D. I. (Ed.). (1985a,b, 1992, 1996a,b). *A cross-linguistic study of language acquisition* (Vols. 1–5). Hills-

dale, NJ: Erlbaum. These volumes present acquisition data on 28 languages from thirteen language families. The focus is on establishing a common framework for understanding both uniformity and diversity in language-learning across the globe. Slobin's operating principles hypothesis is presented in volume 2.

Susan Goldin-Meadow

LASHLEY, KARL SPENCER (1890–1958), American neuropsychogist and comparative psychologist. Lashley was born in Davis, West Virginia, the only child of Charles Gilpen Lashley and Margaret Blanche Spencer. His father was a merchant, banker, and municipal politician; his mother was a schoolteacher. From 1894 to 1899, the family led a somewhat peripatetic existence, including a period in Alaska and the Klondike during the goldrush of 1898. In 1899, the Lashleys returned to Davis where Karl entered the public school system and completed high school in 1905.

His subsequent university training was diverse and, as he himself noted, atypical for psychologists of the time. During his freshman year at the University of West Virginia, Lashley took an introductory zoology course and this set him on a career path in the life sciences. He completed his A.B. degree in 1910 with a major in zoology and went on to study bacteriology at the University of Pittsburgh, obtaining an M.Sc. degree in 1911. He then shifted to genetics and spent a summer doing research at the Cold Spring Harbor Biological Laboratory. Entering Johns Hopkins University in the fall of 1911, he conducted research in zoology and genetics under the supervision of Herbert S. Jennings and earned a Ph.D. degree in 1914. However, it was work on comparative psychology and learning with John B. Watson from 1911 to 1915 and on the neuropsychology of learning with Shepherd I. Franz from 1915 to 1917 that was most formative to his career.

Lashley held appointments at the University of Minnesota (1917–1926), the Behavior Research Fund in Chicago (1926–1929), the University of Chicago (1929–1935), and Harvard University (1935–1955). During his tenure at Harvard, he became Research Professor of Neuropsychology in 1937 and then Director of the Yerkes Laboratories of Primate Biology in Orange Park, Florida, from 1942 until his retirement in 1955.

Lashley's scientific contributions were numerous, varied, and significant. He is best remembered for a series of investigations of cerebral function and learning beginning in 1917 and continuing until the early 1930s. The basic results were described in his monograph, *Brain Mechanisms and Intelligence* (Chicago, 1929). In general, surgical lesions of the rat's cortex impaired the animal's ability to learn and retain a complex maze habit. The key outcome, however, was that the decrement depended on the extent of the lesion, not its location. From such results emerged two empirical generalizations: *equipotentiality* (within a functional area of the brain, no part is more important than any other to performance of the function: here, the maze habit) and *mass action* (the extent of any deficit in performance is proportional to the amount of injury to the functional area). Lashley saw his data as being opposed to the idea that psychological and behavioral functions are cortically localized. But it was only an unqualified localization to which he objected. He readily acknowledged—indeed his own investigations plainly showed—that many functions were cortically localized. Nevertheless, he continually questioned how useful that position was to understanding how cerebral integration worked.

The implication of his findings that Lashley most vigorously promoted was that they refuted the hypothesis that learning is based on specific, restricted input-output paths or connections in the nervous system, or as he termed it, the *reflex theory*. His criticism of reflex theory (and thus implicitly of the Russian Pavlov) was particularly severe in his presidential address of 1929 to the American Psychological Association (*Psychological Review*, 1930, *37*, 1–24). As much as anything, this hard-hitting attack seemed to establish his reputation as uncompromisingly opposed not just to connectionism but to any psychological theorizing whatsoever. Although there is some truth to this perception—Lashley was indeed critical of virtually all psychological theories bearing on problems in which he was interested—it does little justice to the depth, creativity, and versatility of his thinking, qualities so beautifully evident in his theoretical and integrative articles of the final two decades of his career. Nevertheless, there is no denying the negativity of Lashley's research of the 1920s with respect to connectionist ideas of the day, and it undoubtedly played a role in the decline of the influence of the physiological point of view in experimental psychology during the 1930s and 1940s.

Lashley left his stamp on a number of other research topics. From 1930 to 1948, he published an impressive series of articles on the neurophysiology and psychology of vision that dealt with such problems as a method for studying visual discrimination in rats, the role of cortical structures in brightness and pattern discrimination in rats, and the neuroanatomy of the rat's visual system. Throughout his career, Lashley was a frequent contributor to theoretical and empirical research on the psychology of learning. He made important statements on neuroanatomy, behavior genetics, the neurophysiological basis of emotion, and ethology and animal behavior. His involvement in research on sexual behavior was ahead of its time. So was his highly original article of 1951, "The Problem of Serial Order in Behavior," which emphasized the importance of central (rather than peripheral) integrative processes in thought and action and helped move such problems to center stage in neuropsychology. His bibliography of over 100 publications also includes contributions to the mind-brain problem, psychoanalysis, and applied psychology.

Two other aspects of Lashley's legacy may be noted. First, as director of the Yerkes Laboratories of Primate Biology from 1942 to 1955, he established Yerkes as one of the leading primate research centers in the world. Second, Lashley's influence was felt through a number of students and colleagues who went on to prominent careers in their own right, among them, Frank A. Beach, Kao Liang Chow, Donald Griffin, Donald Hebb, Carlyle Jacobsen, Karl Pribram, Austin Riesen, Roger W. Sperry, and Calvin Stone. Hebb's book, *The Organization of Behavior: A Neuropsychological Theory* (New York, 1949), which led to the revitalization of the study of brain and behavior, merits special mention: In the problems with which it dealt and the conceptual solutions it proposed, it owed a heavy debt to Lashley.

Lashley died in 1958 while vacationing in France. D. O. Hebb in his tribute to Lashley (1959) observed that his death brought "to an end a brilliant career, perhaps the most brilliant in the psychology of this century" (p. 142). The passage of 50 years has hardly diminished that assessment.

[*Many of the people mentioned in this article are the subjects of independent biographical entries.*]

Bibliography

Works by Lashley

Beach, F. A., Hebb, D. O., Morgan, C. T., & Nissen, H. W. (Eds.). (1960). *The neuropsychology of Lashley*. New York: McGraw-Hill. A collection of 31 of Lashley's most important articles from 1915 to 1958. The volume begins with introductory essays by E. G. Boring and S. Cobb on Lashley's contributions and his place in the history of neuroscience.

Lashley, K. S. (1929). *Brain mechanisms and intelligence*. Chicago: University of Chicago Press.

Lashley, K. S. (1950). In search of the engram. *Society of Experimental Biology Symposium No. 4: Physiological mechanisms in animal behavior* (pp. 454–482). Cambridge, U.K.: Cambridge University Press. Here Lashley sums up 30 years of research, mostly his own, on the relation of brain to learning and memory and concludes, among other things, that there is no localization of the memory trace within the nervous system.

Lashley, K. S. (1951). The problem of serial order in behavior. In L. A. Jeffress (Ed.), *Cerebral mechanisms in behavior: The Hixon symposium* (pp. 112–146). New York: Wiley. Perhaps Lashley's most significant theoretical article, it anticipated the cognitive revolution in psychology of the late 1950s and strongly influenced later research and theory in language, learning and memory, motor control, and perception and action. For an extensive discussion of the paper, see D. Bruce (1994). Lashley and the problem of serial order. *American Psychologist, 49*, 93–103.

Works about Lashley

Orbach, J. (Ed.). (1982). *Neuropsychology after Lashley: Fifty years since the publication of* Brain Mechanisms and Intelligence. Hillsdale, NJ: Erlbaum. A wide-ranging volume that deals with Lashley's life and science. Contributors describe their own work and its connections to Lashley's research and thinking. The book is especially valuable for its account of investigations carried out at Yerkes Laboratories of Primate Biology during Lashley's tenure as director.

There are a number of biographical accounts of Lashley. Those that provide an extended consideration of his science are the following:

Bartlett, F. C. (1959). Karl Spencer Lashley 1890–1958. *Biographical Memoirs of Fellows of the Royal Society, 5*, 107–118.

Beach, F. A. (1961). Karl Spencer Lashley: June 7, 1890–August 7, 1958. *Biographical Memoirs of the National Academy of Sciences, 35*, 162–204.

Bruce, D. (1991). Integrations of Lashley. In G. A. Kimble, M. Wertheimer, & C. L. White (Eds.), *Portraits of pioneers in psychology* (pp. 306–323). Hillsdale, NJ: Erlbaum.

Hebb, D. O. (1959). Karl Spencer Lashley: 1890–1958. *American Journal of Psychology, 72*, 142–150.

Morgan, C. T. (1968). Lashley, Karl S. In *International encyclopedia of the social sciences* (Vol. 9, pp. 27–30). New York: Macmillan.

Darryl Bruce

LATENT LEARNING. Learning that is not apparent in performance at the time of training, but is revealed later when conditions are changed, is referred to as *latent learning*. Demonstrations of latent learning have established the basic principle that a lack of performance does not necessarily imply a lack of learning or memory. Research on latent learning has also shaped thinking about the conditions that produce learning, the nature of what is learned, and the manner in which learning is linked to performance.

Learning Without Reward

The term *latent learning* was first used in 1929 by the American experimental psychologist, H. C. Blodgett. Blodgett measured the number of errors made by hungry rats as they traversed a complex, multiunit maze. What distinguished this experiment from earlier studies of maze learning was that the rats in Blodgett's experimental group were not rewarded when they entered the goal box of the maze. The fact that these rats showed no improvement in performance under these