# Corpus Study: Cognitive Implications

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## Cognition

"Perception is of definite and probable things" (James, 1890, p. 82). From its very beginnings, psychological research has recognized three major experiential factors that affect cognition: frequency, recency, and context (e.g., Anderson, 2000). Learning, memory, and perception are all affected by frequency of usage: the more times we experience something, the stronger our memory for it, and the more fluently it is accessed. The more recently we have experienced something, the stronger our memory for it, and the more fluently it is ~~accessed (hence~~ your more fluent reading of the previous sentence than the one before). The more times we experience conjunctions of features, the more they become associated in our minds and the more they subsequently affect perception and categorization; so a stimulus becomes associated with a context and we become more likely to perceive it in that context. The power law of learning describes the relationships between practice and performance in the acquisition of a wide range of cognitive skills—the greater the practice, the greater the performance, although effects of practice are strongest at early stages of learning, thereafter diminishing and eventually reaching asymptote (Newell, 1990). The power function relating probability of recall to recency is known as the *forgetting curve* (Ebbinghaus, 1885).

William James's words which begin this entry concern the effects of frequency upon perception. There is a lot more to perception than meets the eye, or ear. A percept is a complex state of consciousness in which antecedent sensation is supplemented by consequent ideas which are closely combined with it by association. The cerebral conditions of the perception of things are thus the paths of association radiating from them. If a certain sensation is strongly associated with the attributes of a certain thing, that thing is almost sure to be perceived when we experience that sensation. But where the sensation is associated with more than one reality, unconscious processes weight the odds, and we perceive the most probable thing: "all brain-processes are such as give rise to what we may call FIGURED consciousness" (James, 1890, p. 82). Accurate and fluent perception thus rests on the perceiver having acquired the appropriately weighted range of associations for each element of the sensory input.

It is human categorization ability which provides the most persuasive testament to our incessant unconscious figuring or "tallying" (Ellis, 2002). We know that natural categories are fuzzy rather than monothetic. Wittgenstein's (1953) consideration of the concept *game* showed that no set of features that we can list covers all the things that we call games, ranging as the exemplars variously do from soccer, through chess, bridge, and poker, to solitaire. Instead, what organizes these exemplars into the *game* category is a set of family resemblances among these members—son may be like mother, and mother like sister, but in a very different way. And we learn about these families, like our own, from experience. Exemplars are similar if they have many features in common and few distinctive attributes (features belonging to one but not the other); the more similar are two objects on these quantitative grounds, the faster are people at judging them to be similar. Prototypes, exemplars which are most typical of a category, are those which are similar to many members of that category and not similar to members of other categories. Again, the operationalization of this criterion predicts the speed of human categorization performance —people more quickly classify as *birds* sparrows (or other average-sized, average-colored, average-beaked, average-featured specimens) than they do birds with less common features or feature combinations like those of kiwis or penguins (Rosch, Mervis, Gray, Johnson, & Boyes-Braem, 1976). Prototypes are judged faster and more accurately, even if they themselves have never been seen before: someone who has never seen a sparrow, yet who has experienced a range of other birds, will still be fast and accurate in judging it to be a bird (Posner & Keele, 1970). Such effects make it very clear that although people don't go around consciously counting features, they nevertheless have very accurate knowledge of the underlying frequency distributions and their central tendencies. Cognitive theories of categorization and generalization show how schematic constructions are abstracted over less schematic ones that are inferred inductively by the learner in acquisition. So psychology is committed to studying these implicit processes of cognition.

## Language Cognition

The last 50 years of psycholinguistic research has demonstrated language processing to be exquisitely sensitive to usage frequency at all levels of language representation: phonology and phonotactics, reading, spelling, lexis, morphosyntax, formulaic language, language comprehension, grammaticality, sentence production, and syntax (Ellis, 2002). Language knowledge involves statistical knowledge, so humans learn more easily and process more fluently high frequency forms and "regular" patterns which are exemplified by many types and which have few competitors. Psycholinguistic perspectives thus hold that language learning is the implicit associative learning of representations that reflect the probabilities of occurrence of form–function mappings. Frequency is a key determinant of acquisition because "rules" of language, at all levels of analysis from phonology, through syntax, to discourse, are structural regularities which emerge from learners' unconscious lifetime analysis of the distributional characteristics of the language input. In James's terms, learners have to figure language out.

It is these ideas which underpin the last 30 years of investigations of language cognition using connectionist and statistical models (Christiansen & Chater, 2001), the investigation of how frequency and repetition bring about form in language and how probabilistic knowledge drives language comprehension and production (Bybee & Hopper, 2001; Bod, Hay, & Jannedy, 2003), and the proper empirical investigations of the structure of language by means of corpus analysis exemplified elsewhere in this encyclopedia. Corpus linguistics allows us to count the relevant frequencies in the input.

Frequency, learning, and language come together in usage-based approaches which hold that we learn constructions while engaging in communication, the "interpersonal communicative and cognitive processes that everywhere and always shape language" (Slobin, 1997). Goldberg's (2006) construction grammar argues that all grammatical phenomena can be understood as learned pairings of form (from morphemes, words, idioms, to partially lexically filled and fully general phrasal patterns), and their associated semantic or discourse functions: "the network of constructions captures our grammatical knowledge *in toto*, i.e. it's constructions all the way down" (Goldberg, 2006, p. 18). Such beliefs, increasingly influential in the study of child language acquisition, have turned upside down generative assumptions of innate language acquisition devices, the continuity hypothesis, and top-down, rule-governed processing, bringing back data-driven, emergent accounts of linguistic systematicities. Constructionist theories of child language acquisition use dense longitudinal corpora to chart the emergence of creative linguistic competence from children's analyses of the utterances in their usage history, and from their abstraction of regularities within them (Tomasello, 2003; Goldberg, 2006). Children typically begin with phrases whose verbs are only conservatively extended to other structures. A common developmental sequence is from formula, to low-scope slot-and-frame pattern, to creative construction.

## Second Language Cognition

What of second language acquisition (L2A)? Language learners, both L1 and L2, share the goal of understanding language and how it works. Since they achieve this based on their experience of language usage, there are many commonalities between first and second language acquisition that can be understood from corpus analyses of input and cognitive- and psycholinguistic analyses of construction acquisition following associative and cognitive principles of learning and categorization. Thus usage-based approaches, cognitive linguistics, and corpus linguistics are increasingly influential in L2A research (Robinson & Ellis, 2008; Collins & Ellis, 2009; Ellis & Cadierno, 2009), albeit with the twist that since they have previously devoted considerable resources to the estimation of the characteristics of another language—the native tongue in which they have considerable fluency—L2 learners' computations and inductions are often affected by transfer, with L1-tuned expectations and selective attention (Ellis, 2008) blinding the acquisition system to aspects of the L2 sample, thus biasing their estimation from naturalistic usage and producing the limited attainment that is typical of adult L2A.

## Construction Learning as Associative Learning from Usage

If constructions as form–function mappings are the units of language, then language acquisition involves inducing these associations from experience of language usage. Constructionist accounts of language acquisition thus involve the distributional analysis of the language stream and the parallel analysis of contingent perceptual activity, with abstract constructions being learned from the conspiracy of concrete exemplars of usage following statistical learning mechanisms. Psychological analyses of the learning of constructions as form–meaning pairs is informed by the literature on the associative learning of cue–outcome contingencies where the usual determinants include: factors relating to the form such as frequency and salience; factors relating to the interpretation such as significance in the comprehension of the overall utterance, prototypicality, generality, and redundancy; factors relating to the contingency of form and function; and factors relating to learner attention, such as automaticity, transfer, overshadowing, and blocking (Ellis, 2008). Corpus linguistic and psycholinguistic research together show how these various factors conspire in the acquisition and use of any linguistic construction.

### Input Frequency

Construction frequency. That language users are sensitive to the input frequencies of constructions (Ellis, 2002) entails that they must have registered their occurrence in processing. These frequency effects are thus compelling evidence for usage-based models of language acquisition which emphasize the role of input.

Type and token frequency. Token frequency counts how often a particular form appears in the input. Type frequency, on the other hand, refers to the number of distinct lexical items that can be substituted in a given slot in a construction, whether it is a word-level construction for inflection or a syntactic construction specifying the relation among words. For example, the "regular" English past tense *-ed* has a very high type frequency because it applies to thousands of different types of verbs, whereas the vowel change exemplified in *swam* and *rang* has a much lower type frequency. The productivity of phonological, morphological, and syntactic patterns is a function of type rather than token frequency (Bybee & Hopper, 2001). This is because (a) the more lexical items that are heard in a certain position in a construction, the less likely it is that the construction is associated with a particular lexical item and the more likely it is that a general category is formed from the items that occur in that position; (b) the more items the category must cover, the more general are its criterial features and the more likely it is to extend to new items; and (c) high type frequency ensures that a construction is used frequently, thus strengthening its representational schema and making it more accessible for further use with new items. In contrast, high token frequency promotes the entrenchment or conservation of irregular forms and idioms; the irregular forms only survive because they are of high frequency.

Zipfian distribution. In the early stages of learning categories from exemplars, acquisition is optimized by the introduction of an initial, low-variance sample centered on prototypical exemplars. This low variance sample allows learners to get a fix on what will account for most of the category members. The bounds of the category are defined later by experience of the full breadth of exemplar types. Goldberg, Casenhiser, and Sethuraman (2004) demonstrated that in samples of child language acquisition, for a variety of verb-argument constructions (VACs), there is a strong tendency for one single verb to occur with very high frequency in comparison to other verbs used, a profile which closely mirrors that of the mothers' speech to these children. In natural language, Zipf's law (Zipf, 1935) describes how the highest-frequency words account for the most linguistic tokens. Goldberg, Casenhiser, and Sethuraman (2004) showed that Zipf's law applies within VACs too, and they argue that this promotes acquisition: tokens of one particular verb account for the lion's share of instances of each particular argument frame; this pathbreaking verb is also the one with the prototypical meaning from which the construction is derived.

Ellis and Ferreira-Junior (2009a, 2009b) investigated effects on naturalistic L2A of type/token distributions in the islands comprising the linguistic form of English verb-argument constructions (VL verb locative like *go there*, VOL verb object locative like *put it in the fridge*, VOO ditransitive like *give him the money*) in the ESF corpus (Perdue, 1993). They showed that VAC verb type/token distribution in the input is Zipfian and that learners first acquire the most frequent, prototypical, and generic exemplar (e.g., *put* in VOL, *give* in VOO, etc.). Their work further illustrates how acquisition is affected by the frequency and frequency distribution of exemplars within each island of the construction (e.g., [Subj V Obj $\text{Obl}_{\text{path/loc}}$]) and by their prototypicality.

Recency. Language processing also reflects recency effects. This phenomenon is known as *priming* and may be observed in phonology, conceptual representations, lexical choice, and syntax. Syntactic priming refers to the phenomenon of using a particular syntactic structure given prior exposure to the same structure. This behavior has been observed when speakers hear, speak, read, or write sentences (Pickering & Ferreira, 2008). There is now a growing body of research demonstrating such L2 syntactic priming effects (McDonough & Trofimovich, 2008).

## Form: Salience and Perception

The general perceived strength of stimuli is commonly referred to as their salience. Low salience cues tend to be less readily learned. Many grammatical meaning–form relationships, particularly those that are notoriously difficult for second language learners, like grammatical particles and inflections such as the third person singular *-s* of English, are of low salience in the language stream. For example, some forms are more salient: *today* is a stronger psychophysical form in the input than is the morpheme *-s* marking third person singular present tense, thus while both provide cues to present time, *today* is much more likely to be perceived, and *-s* can thus become overshadowed and blocked, making it difficult for second language learners of English to acquire (Ellis, 2008).

## Function

Prototypicality of meaning. Categories have graded structure, with some members being better exemplars than others. The prototype as an idealized central description is the best example of the category, appropriately summarizing the most representative attributes of a category. As the typical instance of a category, it serves as the benchmark against which surrounding, less representative instances are classified. The greater the token frequency of an exemplar, the more it contributes to defining the category, and the greater the likelihood it will be considered the prototype. Ellis and Ferreira-Junior (2009a) show that the verbs that second language learners first used in particular VACs are prototypical and generic in function (*go* for VL, *put* for VOL, and *give* for VOO). The same has been shown for child language acquisition, where a small group of semantically general verbs, often referred to as light verbs (e.g., *go*, *do*, *make*, *come*) are learned early.

Redundancy. Redundant cues tend not to be acquired (Rescorla & Wagner, 1972). Not only are many grammatical meaning–form relationships low in salience, but they may also be redundant in the understanding of the meaning of an utterance. For example, it is often unnecessary to interpret inflections marking grammatical meanings such as tense because they are usually accompanied by adverbs that indicate the temporal reference. Second language learners' reliance on adverbial over inflectional cues to tense has been extensively documented in longitudinal studies of naturalistic acquisition (Dietrich, Klein, & Noyau, 1995).

### Contingency of Form–Function Mapping

Psychological research into associative learning has long recognized that while frequency of form is important, so too is contingency of mapping. Consider how, in the learning of the category of birds, while eyes and wings are equally frequently experienced features in the exemplars, it is wings which are distinctive in differentiating birds from other animals. Wings are important features for learning the category of birds because they are reliably associated with class membership, unlike eyes. Raw frequency of occurrence is less important than the contingency between cue and interpretation. Contingency, and its associated aspects of predictive value, information gain, and statistical association, is a driving force for all associative learning (Shanks, 1995). It is central in psycholinguistic theories of language acquisition too (Ellis, 2006), with the most developed account for second language acquisition being that of the competition model (MacWhinney, 2009). Ellis and Ferreira-Junior (2009b) show how psychological measures of form–function contingency, as well as collostructional analysis measures (Gries, 2008), predict VAC acquisition. Boyd and Goldberg (2009) argue that conditional probability is a more appropriate measure. This is still an active area of inquiry, and more research is required before we know which statistical measures of form–function contingency relate more strongly to acquisition and processing.

## Language Learning as Estimation from Sample

Language learners have limited experience of the target language. Their limited exposure poses them the task of estimating how linguistic constructions work from an input sample that is incomplete, uncertain, and noisy. Native-like fluency, idiomaticity, and selection present another level of difficulty. For a good fit, every utterance has to be chosen, from a wide range of possible expressions, to be appropriate for that idea, for that speaker, for that place, and for that time. And again, learners can only estimate this from their finite experience.

As with other estimation problems, successful determination of the population characteristics is a matter of statistical sampling, description, and inference. There are three fundamental instructional aspects of this conception of language learning relating to statistical sampling and estimation, and corpus linguistics is central to each.

(1) The first and foremost concerns *sample size*. As in all surveys, the bigger the sample, the more accurate the estimates, but also the greater the costs. Native speakers estimate their language over a lifespan of usage. L2 and foreign language learners just don't have that much time or resources. Thus, they are faced with the task of optimizing their understanding of language from a limited sample of exposure.

Corpus linguistic analyses are essential to the determination of which constructions of differing degrees of schematicity are worthy of instruction, their relative frequency, and their best (= prototypical and most frequent) examples for instruction and assessment. Gries (2008) describes how three basic methods of corpus linguistics (frequency lists, concordances, and collocations) inform the instruction of second language constructions.

(2) The second concerns *sample selection*. Principles of survey design dictate that a sample must properly represent the strata of the population of greatest concern. Corpus linguistics, genre analysis, and needs analysis have a large role to play in identifying the linguistic constructions that are of most relevance to particular learners. For example, every genre of English for Academic Purposes and English for Special Purposes has its own phraseology, and learning to be effective in the genre involves learning this (Swales, 1990). Lexicographers develop their learner dictionaries based on relevant corpora and dictionaries focus on examples of usage as much as on definitions, or even more so. Good grammars are now frequency-informed. Corpus linguistic analysis techniques have been used to identify the words most relevant to academic English (the Academic Word List, Coxhead, 2000) and this, together with knowledge of lexical acquisition and cognition, informs vocabulary instruction programs (Nation, 2001). Similarly, corpus techniques have been used to identify formulaic phrases that are of special relevance to academic discourse, and to inform learners' instruction (the Academic Formulas List: Ellis, Simpson-Vlach, & Maynard, 2008).

(3) The third concerns *sequence of exposure*. Corpus linguistics also has a role to play in informing the ordering of exemplars for optimal acquisition of a schematic construction. The research reviewed above suggests that an initial, low-variance sample centered on prototypical exemplars allows learners to get a "fix" on the central tendency of a schematic construction, and then the introduction of more diverse exemplars helps learners to determine the full range and bounds of the category. Although there is work to be done on determining its applicability to particular constructions, and particular learners and their L1s, in second language acquisition, this is probably a generally useful instructional heuristic. Readings in Robinson and Ellis (2008) show how an understanding of the item-based nature of construction learning inspires the creation and evaluation of instructional tasks, materials, and syllabi, and how cognitive linguistic analyses can be used both to inform learners how constructions are conventionalized ways of matching certain expressions to specific situations, and also to guide instructors in isolating and presenting the various conditions that motivate speaker choice.

## Future Research Directions in Corpus Linguistics and Cognition

Usage is rich in latent linguistic structure, thus frequencies of usage count in the emergence of linguistic constructions. Nevertheless, as Einstein observed, "Everything that can be counted does not necessarily count; everything that counts cannot necessarily be counted." Corpus linguistics provides the proper empirical means whereby everything in language texts can be counted. But not everything that we can count in language counts in language cognition and acquisition. If it did, the English articles *the* and *a* alongside frequent morphological inflections would be among the first learned English constructions, rather than the most problematic in L2A.

The study of applied linguistics from corpus linguistic perspectives is a two-limbed stool without triangulation from an understanding of the psychology of cognition, learning, attention, and development. Sensation is not perception, and the psychophysical relations mapping physical onto psychological scales are complex. The world of conscious experience is not the world itself but a perception crucially determined by attentional limitations, prior knowledge, and context. Not every experience is equally important: effects of practice are greatest in early stages but eventually reach asymptote. The associative learning of constructions as form–meaning pairs is affected by: factors relating to the form such as frequency and salience; factors relating to the interpretation such as significance in the comprehension of the overall utterance, prototypicality, generality, and redundancy; factors relating to the contingency of form and function; and factors relating to learner attention, such as automaticity, transfer, and blocking.

We need models of usage and its effects on acquisition. Univariate counts are vague indicators of how the demands of human interaction affect the content and ongoing coadaptation of discourse, how this is perceived and interpreted, how usage episodes are assimilated into the learner's system, and how the linguistic system reacts accordingly. We need models of learning, development, and emergence that take all these factors into account dynamically.

**SEE ALSO**: Cognitive Linguistics of Second Language Acquisition; Competition Model; Construction Grammar; Corpora in the Language-Teaching Classroom; Corpus Analysis of Child Language; Corpus Analysis of Spoken English for Academic Purposes; Corpus Analysis of Written English for Academic Purposes; Corpus Software for Applied Linguistics; Emergentism; Statistical Analysis of Test Results

## References


Anderson, J. R. (2000). *Cognitive psychology and its implications* (5th ed.). New York, NY: W. H. Freeman.

Bod, R., Hay, J., & Jannedy, S. (Eds.). (2003). *Probabilistic linguistics*. Cambridge, MA: MIT Press.

Boyd, J. K., & Goldberg, A. E. (2009). Input effects within a constructionist framework. *Modern Language Journal, 93*(2), 418–29.

Bybee, J., & Hopper, P. (Eds.). (2001). *Frequency and the emergence of linguistic structure*. Amsterdam, Netherlands: Benjamins.

Christiansen, M. H., & Chater, N. (Eds.). (2001). *Connectionist psycholinguistics*. Westport, CO: Ablex.

Collins, L., & Ellis, N. C. (2009). Input and second language construction learning: frequency, form, and function. *Modern Language Journal, 93*(2), whole issue.

Coxhead, A. (2000). A new academic word list. *TESOL Quarterly, 34*, 213–38.

Dietrich, R., Klein, W., & Noyau, C. (Eds.). (1995). *The acquisition of temporality in a second language*. Amsterdam, Netherlands: John Benjamins.

Ebbinghaus, H. (1885). *Memory: A contribution to experimental psychology* (Trans. H. A. Ruger & C. E. Bussenues, 1913). New York, NY: Teachers College, Columbia.

Ellis, N. C. (2002). Frequency effects in language processing: A review with implications for theories of implicit and explicit language acquisition. *Studies in Second Language Acquisition, 24*(2), 143–88.

Ellis, N. C. (2006). Language acquisition as rational contingency learning. *Applied Linguistics, 27*(1), 1–24.

Ellis, N. C. (2008). Usage-based and form-focused language acquisition: The associative learning of constructions, learned-attention, and the limited L2 endstate. In P. Robinson & N. C. Ellis (Eds.), *Handbook of cognitive linguistics and second language acquisition*. London, England: Routledge.

Ellis, N. C., & Cadierno, T. (2009). Constructing a second language. *Annual Review of Cognitive Linguistics, 7*, special section.

Ellis, N. C., & Ferreira-Junior, F. (2009a). Construction learning as a function of frequency, frequency distribution, and function. *Modern Language Journal, 93*, 370–86.

Ellis, N. C., & Ferreira-Junior, F. (2009b). Constructions and their acquisition: Islands and the distinctiveness of their occupancy. *Annual Review of Cognitive Linguistics*, 111–39.

Ellis, N. C., Simpson-Vlach, R., & Maynard, C. (2008). Formulaic language in native and second-language speakers: Psycholinguistics, corpus linguistics, and TESOL. *TESOL Quarterly, 42*(3), 375–96.

Goldberg, A. E. (2006). *Constructions at work: The nature of generalization in language*. Oxford, England: Oxford University Press.

Goldberg, A. E., Casenhiser, D. M., & Sethuraman, N. (2004). Learning argument structure generalizations. *Cognitive Linguistics, 15*, 289–316.

Gries, S. T. (2008). Corpus-based methods in analyses of SLA data. In P. Robinson & N. C. Ellis (Eds.), *Handbook of cognitive linguistics and second language acquisition* (pp. 406–31). London, England: Routledge.

James, W. (1890). *The principles of psychology* (Vol. 1). New York, NY: Holt.

MacWhinney, B. (2009). A unified model. In P. Robinson & N. C. Ellis (Eds.), *Handbook of cognitive linguistics and second language acquisition* (pp. 341–71). New York, NY: Routledge.

McDonough, K., & Trofimovich, P. (2008). *Using priming methods in second language research*. London, England: Routledge.

Nation, P. (2001). *Learning vocabulary in another language*. Cambridge, England: Cambridge University Press.

Newell, A. (1990). *Unified theories of cognition*. Cambridge, MA: Harvard University Press.

Perdue, C. (Ed.). (1993). *Adult language acquisition: Crosslinguistic perspectives*. Cambridge, England: Cambridge University Press.

Pickering, M. J., & Ferreira, V. S. (2008). Structural priming: A critical review. *Psychological Bulletin, 134*, 427–59.

Posner, M. I., & Keele, S. W. (1970). Retention of abstract ideas. *Journal of Experimental Psychology, 83*, 304–8.

Rescorla, R. A., & Wagner, A. R. (1972). A theory of Pavlovian conditioning: Variations in the effectiveness of reinforcement and nonreinforcement. In A. H. Black & W. F. Prokasy (Eds.), *Classical conditioning II: Current theory and research* (pp. 64–99). New York, NY: Appleton-Century-Crofts.

Robinson, P., & Ellis, N. C. (Eds.). (2008). *A handbook of cognitive linguistics and second language acquisition*. London, England: Routledge.

Rosch, E., Mervis, C. B., Gray, W. D., Johnson, D. M., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology, 8*, 382–439.

Shanks, D. R. (1995). *The psychology of associative learning*. New York, NY: Cambridge University Press.

Slobin, D. I. (1997). The origins of grammaticizable notions: Beyond the individual mind. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition* (Vol. 5, pp. 265–323). Mahwah, NJ: Erlbaum.

Swales, J. M. (1990). *Genre analysis: English in academic and research settings*. Cambridge: Cambridge University Press.

Tomasello, M. (2003). *Constructing a language*. Boston, MA: Harvard University Press.

Wittgenstein, L. (1953). *Philosophical investigations* (Trans. G. E. M. Anscombe). Oxford, England: Blackwell.

Zipf, G. K. (1935). *The psycho-biology of language: An introduction to dynamic philology*. Cambridge, MA: MIT Press.

## Suggested Readings

Collins, L., & Ellis, N. C. (Eds.). (2009). Input and second language construction learning: Frequency, form, and function. *Modern Language Journal, 93* (3), special issue.

Ellis, N. C. (2002). Frequency effects in language processing: A review with implications for theories of implicit and explicit language acquisition. *Studies in Second Language Acquisition, 24*(2), 143–88.

Ellis, N. C., & Larsen-Freeman, D. (Eds.). (2009). Language as a complex adaptive system. *Language Learning, 59*, Supplement 1, special issue.