

Language Emergence: Implications for Applied Linguistics—Introduction to the Special Issue

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We share an interest in language. We want to understand it, its origins, structure, functions, use, acquisition, instruction, and change. We seek causes for observed effects. Scientific studies of language representation and competence and of language acquisition and use are complementary. Yet these two theoretical enterprises have traditionally been kept distinct, with models of representation (property theories) focusing on static competence, and models of acquisition (transition theories) and use focusing on dynamic process and performance. This Special Issue is motivated by the belief that our interests in language can better be furthered when it is conceived of as the emergent properties of a multi-agent, complex, dynamic, adaptive system, a conception that usefully conflates a property theory with a transition theory.

L2 AREAS OF APPLIED LINGUISTICS RESEARCH AND THEIR SIGNIFICANCE

Consider the history of research in the following key areas of Applied Linguistics, and some morals of each quest.

Case 1: Interlanguage developmental sequences: The morpheme order studies

In the 25 years following Brown's (1973) classic descriptions of developmental sequences of first language acquisition, the 'morpheme order studies' investigated the order of L2 acquisition of the English grammatical functors, progressive *-ing*, auxiliary *be*, plural *-s*, possessive *-s*, articles *a*, *an*, *the*, third person singular present *-s*, copula, and regular past *-ed*. These studies show remarkable commonality in the orders of acquisition of these functors across the interlanguage of a wide range of learners of English as a second language, enough for Larsen-Freeman and Long (1991) to conclude that they were sufficiently consistent in their general findings for their commonalities not to be ignored: as the hunter put it, 'There is something moving in the bushes'

(Larsen-Freeman and Long 1991). Yet, although each of the factors of input frequency, semantic complexity, grammatical complexity, phonological form, and perceptual salience had been historically considered for their sufficiency of cause, with input frequency being the favored account (Larsen-Freeman 1976), nevertheless, as Larsen-Freeman concluded, '[a] single explanation seems insufficient to account for the findings' (Larsen-Freeman 1975). More recently, Goldschneider and DeKeyser (2001) performed a meta-analysis of these studies, investigating whether instead a combination of the five determinants (perceptual salience, semantic complexity, morphophonological regularity, syntactic category, and frequency) could account for the acquisition order. Oral production data from twelve studies, together involving 924 subjects, were pooled. Each of the factors of frequency, salience, and regularity alone was a significant predictor of acquisition order, but each independently only explained a small part (16–36 per cent) of the variance: perceptual salience $r=0.63$, frequency $r=0.44$, morphophonological regularity $r=0.41$. Yet when these three factors were combined with semantic complexity and syntactic category in a multiple regression analysis, this combination of five predictors jointly explained a substantial 71 per cent of the variance in acquisition order. Add to these analyses the contribution of language transfer, and still more of the data are accounted for (Ellis 2006b; Shin and Milroy 1999), particularly when stage of L2 acquisition is factored in (Taylor 1975).

Moral 1: With just one variable $r=0.4$, no more; no magic bullets

Take a language phenomenon of interest as the dependent variable, take a preferred probable cause, look for the correlation between the two in an appropriate sample of participants. It is rarely greater than 0.4. The 'cause' explains just 16 per cent of the variance. Maybe $R^2=0.25$ with a fair wind, perhaps 36 per cent on a very good day, but it is an uncommon study indeed which gets an r greater than 0.6. There are no magic bullet explanations for the phenomena of language that concern us. Each variable is but a small part of a complex picture. The notion of interlanguage has, from its very beginnings (Corder 1967; Selinker 1972), been characterized as reflecting the interactions of many sources of different types of knowledge of the L1 and the L2.

Case 2: Cross-linguistic transfer: L2–L3 lexical intrusions

The determinants of cross-linguistic transfer have been a longstanding goal of our field, from Weinreich (1953) on *interference*, through the rise and fall of the strong version of Contrastive Analysis (James 1980; Lado 1957), the consolidation of the research in the major reviews of the 1980s (Gass and Selinker 1983; Odlin 1989), the recent surge of psycholinguistic investigations of the bilingual lexicon (Kroll and De Groot 2005; Schreuder and

Weltens 1993), and now even the particular issue of transfer in third language acquisition (Cenoz *et al.* 2001; Jarvis 2000; Murphy 2003). During L3 learning, language learners often find themselves unintentionally producing interlanguage forms where an L2 lexical item substitutes for that intended from the L3, that is the speaker fails to adequately inhibit the previously learned second language. What are the determinants of this? As we saw with the morpheme order studies, there are many (Jarvis 2000; Murphy 2003), and once, again, each on its own explains only a little of the variance. Of the linguistic variables: the more frequent the L2 item, the more likely it will intrude; the more frequent the L3 item, the more it will resist; function words intrude far more than content words; free morphemes interfere more than bound morphemes; if the L2 and L3 are typologically similar, transfer is greater.

However, in addition to the complexity and the fact that each variable explains only a small part of the variance, it is important to note that these variables interact in non-additive ways: L2 and L3 lexical frequency factor in dynamic competition; L2–L3 transfer of function words is amplified in situations of typological closeness. They are modulated by a wide range of learner-based variables too: varying degrees of L2 and L3 proficiency; amount of L3 exposure and use; language mode (Grosjean 2001); recency; learner perceptions of the relatedness of L2 and L3 and their linguistic awareness of transferability (psychotypology, Kellerman 1995); age; educational background; level of formality of context; attentional demands of the task (the more the working memory load of the production task, the less cognitive resources are available to inhibit the L2); and so on. So there are not only many variables, each on its own contributing a part, but also the variables interact, sometimes overriding each other, sometimes converging as powerful multiple effects (Andersen 1983; Herdina and Jessner 2002; Murphy 2003; Selinker and Lakshmanan 1993). And they do so always as a function of time (MacWhinney 1998), time on all scales: in thousands of years—the recency of the diachronic divergence of the L2 and L3 in the evolution of languages, in years—the age of the learners and their length of exposure to the language, in milliseconds—the particular point in language processing in dynamical patterns of interactive-activation, both excitatory and inhibitory (Dijkstra 2005; Green 1998; McClelland and Elman 1986).

Moral 2: Complexity; Multivariate causes; nonlinear interactions

There are many agencies and variables that underpin language phenomena, even as apparently simple a phenomenon as that of cross-linguistic lexical intrusions. Language is complex. Learners are complex. These variables interact over time in a nonlinear fashion, modulating and mediating each other, sometimes attenuating each other, sometimes amplifying each other in positive feedback relationships to the point where their

combined weight exceeds the tipping point (Gladwell 2000), which results in a change of state. Just as there are no magic bullet solutions, so no one discipline of inquiry has the monopoly on language, not literature, not education, not psychology, not linguistics, not ethnography, not even brain science.

Case 3: Variability in tense marking

A prominent characteristic of interlanguage in English L2 acquisition is the lack of tense marking. Unmarking in sentences such as *Last year he take the boat*, or *Yesterday he is tired* can be found regardless of the background of the speaker and constitutes a significant hurdle to overcome in L2 learning (Bailey *et al.* 1974; Dulay and Burt 1974). But tense marking is not something that learners either do or do not do. There can be considerable variability in its expression, non-random variability resulting from systematic constraints favoring or inhibiting its production (Dulay and Burt 1974; Wolfram 1985). Tense marking is favored with irregular forms over regular ones, in part a result of salience and frequency. The phonological environment is important—/t/ or /d/ following a voiceless or voiced consonant as in /kɪst/ 'kissed' or /reɪzd/ 'raised' respectively, is susceptible to the phonological process of cluster reduction resulting in /kɪs/ or /reɪz/ completely apart from the grammatical process of unmarking, a process which occurs in some native dialects of English (Guy 1980), in L2 learners (Tarone 1980), and particularly in L2 learners whose L1 does not have final consonant clusters (Wolfram 1985). Such cluster reduction is more likely when the following word begins with a consonant as opposed to a vowel, so /kɪs mi/ for 'kissed me' is more likely than /kɪs It/ for 'kissed it' (Labov 1969). Frequently occurring irregular verb forms are more often marked for tense than their infrequent counterparts. The more distinct phonetically the past tense irregular form is from the non-past, the more likely it will be marked for tense (in order of salience, suppletive forms *go/went* > internal vowel change *sit/sat* > final consonant replacement *have/had*). *Learner* factors (age of arrival, length of residency), *instructional* factors (the degree to which the learner has been exposed to explicit study of the L2), *discourse* factors (genre type and informational load), *social* factors (interlocutor norms and status), and *motivational* factors (integrative motivation, respect for teachers, desire to succeed at school) all conspire in the expression of this form, resulting in a great deal of variability and necessitating multi-level and interactional analyses (Hatfield 1986; Preston 1996; Tarone 1997; Young and Bayley 1996).

Moral 3: Ubiquitous variability; variable competence

Variability pervades language production. But such demonstrations of pattern are too profound to allow us to relegate this to noise and random

performance factors. What should we infer about a learner's linguistic competence if they reliably mark tense on a variety of irregular forms, but not on regular ones? Have they acquired tense or have they not? It does not seem as black or white as that. Psycholinguistic, sociolinguistic, corpus, and probabilistic analyses of these productions seem to make sense of them (Ellis 2002b; Labov 1972; Preston 2000; Tarone 2002). There is systematicity despite persistent instability (Larsen-Freeman 1997); however, the systematicity is to be seen in dynamic, contextualized patterns, not only in rule-governed behavior. More sharp than dull, we think; the term 'variable competence' (R. Ellis 1985, 1999) is no oxymoron. Competence and performance both emerge from the dynamic system that is the frequency-tuned conspiracy of memorized exemplars of construction usage, with competence being the integrated sum of prior usage and performance being its dynamic contextualized activation (Ellis 2006a, 2006b; 2006c).

Case 4: Motivation and language achievement

What is motivation to learn a language and how does it impact upon achievement? This question too has been a long stay in our field, from the pioneering Canadian social psychological analyses of Gardner and Lambert (1972) and their associates, the fractionation of the concept into integrative and instrumental orientations (Gardner 1985), the further division of the integrative motive into integrativeness, attitudes towards the learning situation, motivational intensity, linguistic self-confidence and self-efficacy (Clément *et al.* 1994), the determination of the associations between these factors and language achievement (Gardner *et al.* 1997), and the last decade's development of sophisticated process-oriented models of motivation (Dörnyei 2001; Dörnyei and Skehan 2005). These evolutions have been powered by the realizations that any one of these aspects of motivation correlates only marginally (about 0.4) with achievement; that each is but a part of a multi-faceted construct whose parts interact (hence motivation research as the prime area within applied linguistic research for the application of structural equation modeling—confirmatory factor analysis, latent trait models, and causal path analysis); and that an adequate model of student motivation needs to have a rich temporal dimension that can accommodate systematic patterns of transformation and evolution in time, both long- and short term:

During the lengthy process of mastering certain subject matters, motivation does not remain constant, but is associated with a dynamically changing and evolving mental process, characterized by constant (re)appraisal and balancing of the various internal and external influences that the individual is exposed to. Indeed, even within the duration of a single course of instruction, most learners experience a fluctuation of

their enthusiasm/commitment, sometimes on a day-to-day basis. In Ushioda's (1996) words, 'within the context of institutionalized learning especially, the common experience would be motivational flux rather than stability' (p. 240). (Dörnyei and Skehan 2005).

Dörnyei (2001) shows how time, as an organizing principle, offers a natural way of ordering the relevant motivational influences of language learning into distinct stages of a sequence (choice motivations at the pre-actional stage, executive motivations at the actional stage, and motivational retrospection and attribution setting at the post-actional stage); how ignoring time in motivational models results in situations where two theories are equally valid yet contradict one another because they refer to different phases of the motivational process; how much of the recent work on L2 motivation is rooted in different perceptions of the temporal reality of motivation; and how, by adopting a dynamic model, these various approaches can be successfully synthesized. Motivation is less a trait than a fluid play, an ever-changing one that emerges from the processes of interaction of many agents, internal and external, in the ever-changing complex world of the learner.

Moral 4: Time is of the essence; nothing should be taken out of context

To attribute causality to any one variable (or even a constellation of variables) without taking time and context into account is misguided. The fact is that the effect of variables waxes and wanes. The many actors in the cast of language learning have different hours upon the stage, different prominences in different acts and scenes. The play evolves as goals and subgoals are set and met, strong motives once satisfied fade into history, forces gather then dissipate once the battle is done, a brief entrance can change fate from tragedy to farce, a kingdom may be lost all for the want of a horseshoe nail. The correlation between 'cause' and 'effect' might be negligible at one point in time, or in one particular context, but substantial at others. All individuals, all phenotypes, all genotypes react differently to different environmental conditions, making simple generalizations impossible. There is no one environment; individual agents select their own environments; the world inhabited by living organisms is constantly being changed and reconstructed by the activities of all those organisms (Lewontin 2000).

Case 5: An SLA index of development

The question of measuring second language development has also been a long-standing and particularly vexing one: what are the features of linguistic performance that enter into making one learner more

developmentally advanced than another? Are the features such as expanding vocabulary size or increasing accuracy ones that have independent status in learner performance (Robinson 2001; Skehan 1998)? Do such features grow in such a way that they can serve as the basis for a second language acquisition index of development (Hakuta 1976)?

An SLA index of development, analogous with the MLU of first language acquisition, would be an incredible boon to researchers, replacing the subjective and vague designations of learner populations as 'beginning,' 'intermediate,' and 'advanced,' which researchers are forced to employ (Larsen-Freeman 1978). Although language development is not the same as proficiency level, measures of language development ought to be able to distinguish among learners at different levels of proficiency. With a common yardstick, researchers would be able to make statements about the relative influence of different variables for learners exhibiting different developmental portraits.

Because of the enormous value that such an index would bring, much research has been done in the quest for an SLA index of development. Wolfe-Quintero *et al.* (1998) reviewed 39 research studies, which included English and French as both second and foreign languages, Swedish as a second language, and German and Russian as foreign languages. They considered over a hundred measures of fluency, accuracy, and complexity that were used in studies of second language writing. They found that certain of these were the best measures in that they were consistently linear and significant related to program or school levels. These included accuracy and fluency measures such as the average length of T-units, the number of error-free T-units per T-unit (Larsen-Freeman and Strom 1977), the number of words in error-free T-units, as well as measures of grammatical and lexical complexity, such as the number of dependent clauses per clause and the word types per T-unit (Wolfe-Quintero *et al.* 1998).

Unfortunately, while some of these proved to be better than others at discriminating different developmental levels for groups, at the level of the individual, the results are less heartening. Clearly, the measures are not always sensitive to individual differences (Larsen-Freeman 1983), with some learners not conforming to the general patterns of development at all.

Moral 5: What generalizations exist at the group level often fail at the individual level

Researchers understandably seek the broadest possible generalizations for their findings. From a dynamic systems perspective, however, individual variability should not be seen as merely noise. Instead, it may be seen as a source of development as well as the specific moment in a developmental process (van Dijk 2003). Intrinsic in this view is the idea that individual developmental paths, each with all its variation, may be quite different from

one another, even though in a 'grand sweep' view, these developmental paths seem quite similar (de Bot *et al.* in press; Larsen-Freeman this issue).

Case 6: Exemplar-based learning, restructuring, and U-shaped development

Psycholinguistic research demonstrates that language processing in all domains (phonology and phonotactics, reading, spelling, lexis, morphosyntax, formulaic language, language comprehension, grammaticality, sentence production, and syntax) is exquisitely sensitive to frequency of occurrence (Ellis 2002a). This implies that language acquisition, and language representation too, is exemplar based. The knowledge underlying fluent, systematic, apparently rule-governed use of language is the learner's entire collection of memories of previously experienced utterances. These exemplars are linked, with like kinds being related in such a way as to resonate as abstract linguistic categories, schema, and prototypes. Morphogenesis (the order or structure that emerges beyond the order and structure present in the 'input') characterizes the grammaring process ('the act of playing the game has a way of changing the rules') (Larsen-Freeman 2003). Linguistic regularities emerge as central-tendencies in the conspiracy of this data-base. So Cognitive Linguistic (Barlow and Kemmer 2000; Croft and Cruise 2004; Langacker 1987; Robinson and Ellis in press; Taylor 2002; Ungerer and Schmid 1996), Construction Grammar (Goldberg 1995), and Probabilistic and Frequency-based (Bod, Hay *et al.* 2003; Bybee and Hopper 2001; Ellis 2002a, 2002b; Jurafsky 2002; Jurafsky and Martin 2000) Usage-Based theories of language hold that acquisition is the piecemeal learning of many thousands of constructions and the frequency-biased abstraction of regularities within them.

How exactly does the relative frequency of patterns in the input affect acquisition? Token frequency is how often in the input particular words or specific phrases appear; 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. 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 much lower type frequency. Bybee (1995; Bybee and Thompson, 2000) and the researchers gathered in Bybee and Hopper (2001) show how the productivity of phonological, morphological, and syntactic patterns is a function of their type rather than their token frequency. In contrast, high token frequency promotes the entrenchment or conservation of irregular forms and idioms—the irregular forms only survive because they are high frequency. Type frequency determines productivity because: (1) 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 over the

items that occur in that position; (2) 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; (3) 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 (Bybee and Thompson, 2000).

One consequence is that development, which for the most part seems gradual and incremental, also evidences sudden changes in performance suggesting fundamental restructuring (McLaughlin 1990) of the underlying grammar. Consider again past tense marking, but now particularly its growth-curve: Learners initially fail to mark past tense; their first marking involves frequent irregular verbs such as *came* and *went*; next appears regular marking (addition of the default ending) in verbs such as *talked* and *cooked* and the productivity of this schema is evidenced by the disappearance of irregulars from the interlanguage as they are replaced by overextensions (incorrect forms that have regular endings like *goed*, *wented*). The irregulars eventually reappear, their acquisition thus following a 'U-shaped' function overall. The stage at which irregulars disappear and are replaced by regularized forms is sudden and suggests that learners' grammars are restructuring themselves to make everything regular even though such forms as *goed* are not part of the input.

Moral 6: Regularities are emergent; growth is nonlinear; cognition is adaptive

Systematic regularities emerge from the conspiracy of exemplars of experience, and consequently growth is often non-linear, with effects being disproportionate to proximal causes. Connectionist, Competition, and Rational models of language explore the ways in which generalizations emerge from the interactions of constructions large and small, the ways in which different cues and their reliabilities compete for activation, and the ways in which the organization of the learner's model of language is optimized for usage (Anderson 1989; Anderson and Schooler 2000; Bates and MacWhinney 1987; Christiansen and Chater 2001; Ellis 1998, 2006a; Elman *et al.* 1996; MacWhinney 1987, 1997; MacWhinney and Leinbach 1991; Plunkett and Marchman 1993; Rumelhart and McClelland 1987). Knowledge is only of value if it is organized and marshaled appropriately. The guiding principle of Rational Analysis (Anderson 1990) is that the cognitive system optimizes the adaptation of the behavior of the organism, that is that human psychological behavior can be understood in terms of the operation of a mechanism that is 'optimally adapted' to its environment in the sense that the behavior of the mechanism is as efficient as it conceivably could be, given the structure of the problem space, and thus our cognitive apparatus provides optimal inference in the presence of uncertainty.

Case 7: Language use → Language change → L2 learnability

Languages change over time. They change as a result of use. Bybee (1995, 2000; Bybee and Hopper 2001) argues that grammaticization is a process of automatization of frequently-occurring sequences of linguistic elements. The basic principles of automatization apply to all kinds of motor activities: playing a musical instrument, cooking, or playing an Olympic sport. With repetition, sequences of units that were previously independent come to be processed as a single unit or chunk (Ellis 1996). This repackaging has two consequences: the identity of the component units is gradually lost, and the whole chunk begins to reduce in form. A phrase such as (*I'm going to (verb)*), which has been frequently used over the last couple of centuries, has been repackaged as a single processing unit. The identity of the component parts is lost (children are often surprised to see that *gonna* is actually spelled *going to*), and the form is substantially reduced.

Frequency is the driving force of language change: (1) Frequency of use leads to weakening of semantic force by habituation; (2) Phonological changes of reduction and fusion of grammaticizing constructions are conditioned by their high frequency; (3) Increased frequency conditions a greater autonomy for a construction, which means that the individual components of the construction (such as *be*, *go*, *to*, or *-ing* in the example of *be going to*) weaken or lose their association with other instances of the same item (as the phrase reduces to *gonna*); (4) The loss of semantic transparency accompanying the rift between the components of the grammaticizing construction and their lexical congeners allows the use of the phrase in new contexts with new pragmatic associations, leading to semantic change; (5) Autonomy of a frequent phrase makes it more entrenched in the language and often conditions the preservation of otherwise obsolete morphosyntactic characteristics (Boyland 1996; Bybee 2000; Croft 2000; Kemmer and Israel 1994).

The result is that grammatical functors are both difficult to perceive, even in speech that is produced slowly and deliberately (Bates and Goodman 1997) or directed to children (Goodman *et al.* 1990), and they lack semantic transparency. These two factors alone are sufficient in making them hard to learn, yet grammatical functors are additionally often of low contingency of form–function mapping and, furthermore, frequently redundant in the interpretation of communication. These variables, together with language transfer (learners' attention to language being tuned by their native language experience) play a large role in explaining the limited success typical of naturalistic L2 acquisition (Ellis 2006a, 2006b, 2006c), the 'Basic Variety' (Klein 1998) of interlanguage, which, although sufficient for everyday communicative purposes, predominantly comprises just nouns, verbs, and adverbs, with little or no functional inflection and with closed-class items, in particular determiners, subordinating elements, and prepositions, being rare, if present at all. Of course, these features are also explicable socially,

as can be seen in the study of English as a Lingua Franca and, with it, the awareness that correctness does not have to be commensurate with native speaker norms (Cook 2002; Jenkins 2000; Seidlhofer 2004).

In sum, dynamic cycles of language use, language change, language perception, and language learning in the interactions of members of language communities results in learning challenges for adult language learners (Ellis in press). High frequency use of grammatical functors causes their lenition and erosion. Lower salience cues are harder to perceive and show reduced L2 associative learning because of blocking and overshadowing. What results is the 'Basic Variety' of interlanguage from naturalistic learning, an attractor state that can only be escaped by the social recruitment of the dynamics of learner consciousness, attention, and explicit learning, and the desire to conform to native speaker norms.

Moral 7: The very thing that makes a known language easy, makes a new language hard; contrariness will out

The fluency with which native speakers use the high frequency forms of their language makes these grammatical constructions predictable in their experience, richly supported by prior knowledge, expectation, and top-down processing. And it is this same facility which, paradoxically, makes these forms particularly difficult for second language learners who aspire to speak as native speakers. The very things that make a known language easy make a new language hard. Some observers, particularly learners themselves suffering the travails of second language acquisition, might say perverse.

Case 8: The interface

The interface question is fundamental to Applied Linguistics (N. C. Ellis 1994). Our answers to it determine how we teach and learn languages. Krashen's (1982) Input Hypothesis argued that adult L2 students of traditional instruction, who can tell more about a language than a native speaker, yet whose technical knowledge of grammar fails to sustain them in speaking and listening, demonstrate that conscious learning about language and subconscious acquisition of language are different things, and that any notion of a 'Strong Interface' between the two must be rejected. His extreme 'Non-Interface' position thus countered that subconscious acquisition dominates in second language performance and that learning cannot be converted into acquisition. Critical theoretical reactions to Krashen's Input Hypothesis (McLaughlin 1987), analyses of learners in 'grammar-free' immersion L2 and FL programmes demonstrating significant shortcomings in the accuracy of their language (Lightbown *et al.* 1993), and empirical investigations demonstrating that it is those language forms that are attended to that are subsequently learned, prompted Schmidt (1990) to propose that conscious cognitive effort involving the subjective experience of

noticing is a necessary and sufficient condition for the conversion of input to intake in SLA. Schmidt's Noticing Hypothesis was the theoretical motivation for subsequent research efforts, both in laboratory experiments (Hulstijn and DeKeyser 1997) and in the classroom (Doughty and Williams 1998), into the role of consciousness in SLA. The limited success of naturalistic learners, together with the demonstrable role of noticing in SLA, obliged some form of a 'Weak Interface' position (R. Ellis 1994; Long 1991) whereby explicit knowledge plays a role in the perception of, and selective attending to, L2 form by facilitating the processes of 'noticing' (i.e. paying attention to specific linguistic features of the input) and by 'noticing the gap' (i.e. comparing the noticed features with those the learner typically produces in output (Swain 2005)). Other weak-interface variants additionally identified a role of consciousness in skill-building, with explicit knowledge coaching practice, particularly in initial stages, and this controlled use of declarative knowledge guiding the proceduralization and eventual automatized implicit processing of language as it does in the acquisition of other cognitive skills (DeKeyser 2001). These matters lie still at the core of Applied Linguistics research.

But with hindsight, *interface* was an unfortunate appellation for this issue. The metaphor connotes physical, structural connections. It has driven us to look for representations of explicit language, representations of implicit knowledge, separate places in the brain where these two different types of knowledge are stored, and then connections between them. Too much so, perhaps, if the identification of separate neural loci of explicit and implicit language knowledge is taken to support the conclusion of a non-interface position (Paradis 1994, 2004). Instead we should heed the terms we use in Applied Linguistics to address the mechanisms of interface: *noticing*, *selective attending*, *noticing the gap*, *skill-building*, *coaching*, *processing*, every one of them a gerund, and, with the exception of course of *consciousness* itself, every one a mental action. The process nature of these mechanisms led Larsen-Freeman (2001; Larsen-Freeman and Long 1991) to coin the term *grammaring*. Thus, the search for a structural interface between implicit and explicit language knowledge is as naïve as the search for a single specific neural locus for consciousness. There is no pineal gland for the interface. Consciousness *is* the interface, and like consciousness, the interface is dynamic: it happens transiently during conscious processing, but the influence upon implicit cognition endures thereafter (Ellis 2005).

Moral 8: Learning is a process; consciousness *is* the interface

Learning is dynamic; it takes place during processing, as Hebb (1949), Craik and Lockhart (1972), Pienemann (1998), and O'Grady (2003) have all reminded us from their neural, cognitive, and linguistic perspectives. There are different forms of language learning, broadly, the implicit tallying

and chunking that take place during usage (Ellis 2002a, 2002b) and the explicit learning in the classroom and that follows communication breakdown (Ellis 2005, sections 3–4). As for the question of their interface, it occurs through consciousness itself.

Case 9: Noticing and consciousness

Introspection confirms, indeed returns, the flow of consciousness. Heraclitus said ‘No man ever steps in the same river twice, for it’s not the same river and he’s not the same man’. So too for the stream of consciousness. There is massive context dependence. Consciousness gives ‘clout’: when processes compete for ongoing control of the body, the one with the greatest clout dominates the scene until a process with even greater clout displaces it (Dennett 2001). Functional brain imaging techniques demonstrate the dynamic nature of the neural correlates of consciousness, a surge of activity, widespread and multi-focal, involving a coalition of forebrain neurons involved in working memory and planning, interconnected via widespread cortico–cortico and cortico–thalamic feedback loops with sets of neurons in sensory and motor regions that code for particular features (Dehaene *et al.* 2001; Eichenbaum 2002; Frackowiak *et al.* 2004; Kanwisher 2001; Koch 2004; Rees 2001; Rees *et al.* 2002). Any one percept, real or imagined, corresponds to a winning coalition of the essential features coded by these different but related brain regions, reinforcing the firing activity of its member neurons, probably by synchronizing their spiking discharge, and suppresses competing ones in a winner-takes-all fashion. At any one moment the winning coalition, expressed in the content of consciousness at that point in its stream, is briefly sustained for a discrete epoch of somewhere between 20 and 200 msec before it is replaced by another coalition in the ongoing stream of snapshots of consciousness. Stabilization of the coalition seems to be achieved by massive feedback known as ‘re-entrant signaling,’ perhaps involving thalamo-cortical loops, that is synchronized in rhythmic action potential discharge in the 30–60 Hz gamma band of EEG frequency. There is considerable ongoing research into this ‘gamma band’ activity both as an index of attentive awareness and as a mechanism for solving the binding problem (Crick and Koch 2003; Dehaene and Changeux 2004; Edelman 1989; Edelman and Tononi 2000; Koch 2004; Singer 1999). Consciousness is perhaps the prototype example of an emergent phenomenon. The units of consciousness might be identifiable as patterns of brain synchrony in time.

‘What is Mind? No Matter’, punned Berkeley. This is the ‘stuff’ of noticing. Our conscious experience is what allows us to build novel linguistic representations from usage. Baars (1988; 1997) introduced ‘Global Workspace Theory’ by describing the likenesses between our cognitive architecture and a working theatre. The entire stage of the theatre corresponds to working memory, the immediate memory system in which we talk to ourselves,

visualize places and people, and plan actions. In the working theatre, focal consciousness acts as a 'bright spot' on the stage. Conscious events hang around, monopolizing time 'in the limelight'. The bright spot is further surrounded by a 'fringe' (Mangan 1993) or 'penumbra' (James 1890; Koch 2004: ch. 14) of associated, vaguely conscious events. Information from the bright spot is globally distributed to the vast audience of all of the unconscious modules we use to adapt to the world. A theatre combines very limited events taking place on stage with a vast audience, just as consciousness involves limited information that creates access to a vast number of unconscious sources of knowledge. Consciousness is the publicity organ of the brain. It is a facility for accessing, disseminating, and exchanging information, and for exercising global coordination and control. This is the interface, the 'stuff' of learning.

Moral 9: Emergent consciousness as the 'stuff of learning'; massive context dependence

Applied Linguistics needs to redress the balance, from knowledge as static representation stored in particular locations to knowledge as processing involving the dynamic mutual influence of inter-related types of information as they activate and inhibit each other over time—as Sir Charles Sherrington, Nobel Laureate for Neurology and author of *The Integrative Action of the Nervous System* put it nigh a century ago, 'an enchanted loom, where millions of flashing shuttles weave a dissolving pattern, always a meaningful pattern though never an abiding one; a shifting harmony of subpatterns.'

Case 10: Sociocultural factors; scaffolding; action, reaction and negotiated discourse; socialized consciousness

The low salience of grammatical forms, the less than perfect contingency between their forms and functions, cue competition and redundancy, transfer, learned attention, and automatization all conspire to prevent usage-based acquisition from being as effective in L2 as it is in L1 (Ellis 2006b). The usual social-interactional or pedagogical reactions to the resultant non-nativelike utterances involve an interaction-partner (Gass and Varonis 1994) or instructor (Doughty and Williams 1998) intentionally bringing additional evidence to the attention of the learner by some clarification request, or negative feedback, or correction, or focus-on-form, or explicit instruction, recruiting consciousness to overcome the implicit routines that are non-optimal for L2. Analyses of classroom, mother-child, and NS-NNS interactions demonstrate how conversation partners can scaffold the acquisition of novel vocabulary and other constructions by focusing attention on perceptual referents or shades of meaning and their corresponding linguistic forms (Baldwin 1996; Chun *et al.* 1982; Ellis 2000; Gass 1997; Gelman *et al.* 1998; Long 1983; Oliver 1995; Swain and Lapkin

1998; Tomasello 1999; Tomasello and Akhtar 2000). An interlocutor has various means of making the input more comprehensible: (1) by modifying speech, (2) by providing linguistic and extralinguistic context, (3) by orienting the communication to the 'here and now' and, (4) by modifying the interactional structure of the conversation (Long 1982). Of course, learners are not passive recipients of modified input, but rather are agents of their own learning, playing an active role in negotiating meaning and selective attending (Larsen-Freeman 1985). Interaction in which participants' attention is focused on resolving a communication problem, and the consequent negotiation of form and meaning 'connects input, internal learner capacities, particularly selective attention, and output in productive ways' (Long 1996).

Learning is ever thus. It takes place in a social context, involving action, reaction, collaborative interaction, intersubjectivity, and mutually assisted performance (Donato 1994; Lantolf 2006; Lantolf and Appel 1994; Lantolf and Pavlenko 1995; Lantolf and Thorne 2006; Ricento 1995; van Geert 1994). Speech, speakers, and social relationships are inseparable (Norton 1997). Activity theory emphasizes how individual learning is an emergent, holistic property of a dynamic system comprising many influences, both social, individual, and contextual (Lantolf and Appel 1994). Action provides a context within which the individual and society, mental functioning and sociocultural context can be understood as interrelated moments (Wertsch 1998; Wertsch *et al.* 1995). Uttering invokes feedback that is socially provided (Tarone 1997) and that recruits the learner's consciousness. Indeed consciousness itself can be viewed as the end product of socialization (Vygotsky 1980; Wertsch 1985). Thus SLA is also Dialectic (Kramsch 2002; Lantolf and Pavlenko 1995; Lantolf and Thorne 2006; Larsen-Freeman 2002; Swain 2000), involving the learner in a conscious tension between the conflicting forces of their current interlanguage productions and the evidence of feedback, either linguistic, pragmatic, or metalinguistic, that allows socially scaffolded development.

Moral 10: Socioculturally situated cognition; consciousness and development as social constructions; dialectics

Language is socially constructed. Language use, social roles, language learning, and conscious experience are all socially situated, negotiated, scaffolded, and guided. They emerge in the dynamic play of social intercourse. Our expectations, systematized and automatized by prior experience, provide the thesis, our model of language, and we speak accordingly. If intelligibly and appropriately done, we get one type of social reaction, and conversation focuses further on the intended message, meaning and communication. If not, we may get another type of social reaction,

one that may undermine our confidence, but one that helpfully focuses our attention on what we do not yet know how to do. Through the provision of negative feedback, be it a clarification request or possibly a recast, some dialectic, an antithesis which contradicts or negates our thesis, our model of language, and the tension between the two, being resolved by means of synthesis, promotes the development of our language resources. Of course, for some socially-oriented researchers, success in learning is not defined by development of a well-constructed model of language, but rather by the development of language as a resource for participation in the activities of everyday life (Larsen-Freeman 2002; Zuengler and Miller 2006).

Case 11: L2 learners → language change

Although it is said that all languages are equally complex, more properly, though perhaps less politically correctly, 'all languages are complex to some degree' (McWhorter 2002). Some languages are easier for adults to learn, in an absolute sense, than others. 'If one were given a month to learn a language of one's choice, I think one would select Norwegian rather than Faroese, Spanish rather than Latin, and Sranan rather than English' (Trudgill 1983). The languages most easily learned are those that have undergone more contact, because more adult language contact means more adult language learning. Linguistic evolution proceeded by natural selection from among the competing alternatives made available from the idiolects of individual speakers which vary among them. Since adults are typically less successful than children at language learning, adult language learning typically means simplification, most obviously manifested in a loss of redundancy and irregularity and an increase in transparency (Trudgill 2002a; 2002b: ch. 7). The 'Basic Variety' of interlanguage (Klein 1998; Perdue 1993) shows similarities with pidgins (Schumann 1978) because pidgins are the languages that result from maximal contact and adult language learning (McWhorter 2001). Veronique (1999, 2001) and Becker and Veenstra (2003) detail many parallels between the grammatical structures of French Based Creoles and the Basic Variety of interlanguage of learners of French as a second language, particularly in the 1:1 iconicity of their mapping of function and form (Andersen 1984), their controller-first, focus last constituent ordering principles, their lack of verbal morphology, and the order of development of their means of temporal reference. Some creoles evolve as the complexification of pidgins resulting from the habitual use by children learning it as their native tongue. Others, such as the Atlantic and Indian Ocean French-related creoles developed from the interactions of adult speakers of nonstandard varieties of the target language and non-natives (Mufwene 2001). Creoles have systematic grammar, but not so many syntactic features as do languages such as West African Fula with

16 grammatical genders, or morphophonological features such as the complex system of consonant mutations of Welsh, or phonological features such as the tonal languages of South East Asia, all of these being languages that have had much longer to evolve their grammatical elaborations and diachronically motivated but synchronically obscure irregularities. Creoles typically have little or no inflection, they have little or no tone distinguishing words or expressing grammar, and their prefix/suffix + root combinations are semantically predictable (McWhorter 2001, 2002: ch. 5).

In contrast, the older a language, the more complexity it has, that is the more it overtly signals distinctions beyond communicative necessity. The most elaborate languages in these respects are those older, more isolated languages that are spoken by groups of people whose interactions are primarily with other speakers of the language and which thus are learned as native languages by children whose plastic brains are ready to optimally represent them. But their linguistic complexities pose great difficulties to second language learners, prejudiced by L1 transfer and entrenchment. It is no accident that Faroese, as a low-contact language not subject to adult language learning, has maintained a degree of inflectional complexity which Norwegian has lost. Stasis allows a language, left to its own devices, to develop historical baggage—linguistic overgrowths that, however interesting and valuable are strictly incidental to the needs of human exchange and expression. In the same way that in nature, niche-stability during the flat periods of punctuated evolution allows the continuation of elaborate vestigial forms while competition selects them out, so in language, isolation allows the slow accretion of complexity and its maintenance, while large amounts of external contact and adult language learning select out the less functional linguistic overdevelopments, such as what is happening these days in the development of English as a *Lingua Franca* (Seidhofer 2004).

What we are able to process is determined not only by the input, but also by our knowledge. Bartlett (1932) catalogued the distortions that take place as a story is repeatedly retold, one person telling the next person, and so on. In successive serial reproductions, information that fits a subject's existing experiences is well remembered, but that which is not is either rationalized or forgotten. The same is true of linguistic structure as it is repeated by second language learners (hence elicited imitation as an effective way of assessing interlanguage development; Bley-Vroman and Chaudron (1994)). The natural exchange of language therefore changes language, filtering it through the understanding of successive speakers and listeners: 'Languages are "streamlined" when history leads them to be learned more as second languages than as first ones, which abbreviates some of the more difficult parts of their grammars' (McWhorter 2004). Thus the interaction of language complexity by language age by adult language learning is continuous rather than categorical.

Moral 11: Language has the properties of complex adaptive systems in being open, adaptive, reciprocal, and self-organizing

As complex, adaptive systems, languages emerge, evolve, and change over time (Larsen-Freeman 1997; Lee and Schumann 2003, 2005). Just as they are socially constructed, so too they are honed by social discourse. They adapt to their speakers. Because children are better language learners than adults, languages that adults can learn are simpler than languages that only children can learn. Thus the circle is unbroken. The system is open, adaptive, reciprocal, and self-organizing. Languages evolve according to evolutionary principles of competition and selection (Croft 2000; Mufwene 2001). But adult language learners are not merely subject to these phenomena, they play a very active role (Donato 2000; Larsen-Freeman 2003): Second language acquisition by adults changes the very nature of language itself.

Case 12: Discourse

Applied Linguists are interested not only in how languages are acquired, but also in how they are used, with some applied linguists making no distinction between the two at all (Larsen-Freeman 2004). Applied linguists, with their concern for language in use, must recognize and deal with the situatedness of discourse. The context of discourse both constructs and constrains what is done with language (Cameron 1996; Duranti and Goodwin 1992).

In examining discourse, applied linguists have typically examined forms of attested language, be they single language texts or large corpora of such texts. The latter are especially helpful, of course, in assuring the dependability of the data (Larsen-Freeman 2006). However, attested data cannot tell us what transpired in the language up until the construction of the text, nor where it is destined. While this may seem obvious and forgivable, from a complexity theory perspective, by limiting our investigations to attested language, we miss the perpetually changing, perpetually dynamic nature of language (Larsen-Freeman *in press*). In order to understand the context of oral discourse, at least, 'we must start from its "behaviour" in the dialogic dynamics of contextualized interaction: that is, as people talk with each other' (Cameron and Deignan, *this issue*). This is precisely the position of conversation analysts who look at 'how syntax for conversation is deployed by members to achieve particular, situated courses of action' (Markee and Kasper 2004: 495).

Thus, although some applied linguists have taken a dynamic view of situatedness of discourse, a complex systems view offers a new way of understanding how people use language for real world purposes. Individuals in interactions can be seen as forming self-organizing and co-adapting systems, in which new understandings and new ways of speaking or

writing, or indeed of language subsystems themselves, emerge over time (Larsen-Freeman and Cameron in press).

Moral 12: 'In order to qualify as emergentist, an account of language functioning must tell us where a language behavior "comes from"' (MacWhinney 1999: xii)

Understanding how language forms contribute to and emerge from discourse, not only tells us about language; understanding how language is used may help us understand better how people think, how they make sense of the world and each other, and how they communicate (Cameron 2003).

LANGUAGE EMERGENCE

Each of the morals above is a characteristic of an emergent system. As such, each phenomenon is dynamic, complex, nonlinear, chaotic (at times), unpredictable, sensitive to initial conditions, open, self-organizing, feedback sensitive, adaptive, characterized by strange attractors, which are fractal in shape (Larsen-Freeman 1997). In short, language is a complex adaptive system. It comprises the ecological interactions of many players: people who want to communicate and a world to be talked about. It operates across many different levels (neurons, brains, and bodies; phonemes, morphemes, lexemes, constructions, interactions, and discourses), different human conglomerations (individuals, social groups, networks, and cultures), and different timescales (evolutionary, epigenetic, ontogenetic, interactional, neuro-synchronic, diachronic). As a complex system, its systematicities are emergent following adaptive, Darwinian principles. Chaos/Complexity Theory illuminates Applied Linguistics (Larsen-Freeman 1997; Larsen-Freeman and Cameron in press), as does Dynamic Systems Theory (de Bot *et al.* in press; Herdina and Jessner 2002), as do theories of the Emergence of Language (Ellis 1998; MacWhinney 1998, 1999, 2001). Each emergent level cannot come into being except by involving the levels that lie below it, and at each higher level there are new and emergent kinds of relatedness that are not found below: language cannot be understood in neurological or physical terms alone, nevertheless, neurobiology and physics play essential roles in the complex interrelations; equally from the top down, although language cannot be understood purely in experiential terms, nevertheless, phenomenology is an essential part too.

Changes in the system are engendered by agents' adaptation to their environment (van Lier 2004), often including the reciprocal feedback that they receive as a result of their joint activities. Language is more dance than reference book; language use is more dance than two fax machines exchanging information (de Bot *et al.* in press). Thus, the natural character of the linguistic system can be defined as a dynamic adaptedness to a specific

context (Tucker and Hirsch-Pasek 1993). It is the imperfect relationship between what the context demands and what the system provides that drives the system forward through successive reorganizations. Due to its self-organizing property, the new organization of the language system emerges qualitatively different and novel from earlier organizations. Such a conception of language makes it easier to behold and represent change in progress and to explain the systematicity that emerges:

Language learning can be viewed as a complex and dynamic process in which various components emerge at various levels. (Marchman and Thal 2005)

Development is a process of emergence. (Elman *et al.* 1996: 359).

Alternative approaches 'emphasize the ways in which the formal structures of language emerge from the interaction of social patterns, patterns implicit in the input, and pressures arising from the biology of the cognitive system. The emergentist approach to language acquisition views language as structure arising from interacting constraints. (MacWhinney 1998: 200).

Emergentists believe that simple learning mechanisms, operating in and across the human systems for perception, motor-action and cognition as they are exposed to language data as part of a communicatively-rich human social environment by an organism eager to exploit the functionality of language, suffice to drive the emergence of complex language representations. (Ellis 1998: 657)

Emergentism, as used in an Applied Linguistics context, assumes that the patterns of language development and of language use are neither innately prespecified in language learners/users nor are they triggered solely by exposure to input. Instead, language behavior is said to emerge from the interaction between the agent and the agent's environment. (Larsen-Freeman and Cameron in press).

Language learning and language use are dynamic processes in which regularities and system arise from the interaction of people, brains, selves, societies and cultures using languages in the world. The Applied Linguistics field is still evolving: which flowers thrive, how kempt the borders should be, who is entitled to tend them, and whether there should be a management strategy for this ecology, well, time will tell (Doughty and Long 2003; Firth and Wagner 1997, 1998; Gass 1998; Gregg 1993, 2005; Gregg *et al.* 1997; Jordan 2003, 2004; Lantolf 1996, 2002; Long 1997; Sealey and Carter 2004).

Each research methodology has its advantages. Ethnography brings together the individual, society, and consciousness in time and place, but it ignores implicit motivations that introspection cannot access (Nisbett and Wilson 1977). Brain imaging illustrates the dynamic patterns of neural activity involved in mental processing, but it isolates the learner's brain from society and its normal ecology of function. Laboratory experimentation

allows the controlled logic of the scientific method, but it sacrifices ecological validity in this goal. And so on. We need to bring these methods together, to strive after the linking relations, to develop the kind of account that Wertsch, a Socioculturalist, called 'translation at the crossroads that would make it possible to *link, but not reduce*, one perspective to another' (Wertsch 1998). The same message 'Interactions all the way down', 'Emergentism all the way down' has been championed from the other, Cognitive Science side of the traditional divide, where Elman, Bates, Johnson, Karmiloff-Smith, Parisi, and Plunkett, representing variously Connectionism, Developmental Psychology, Neuroscience, Mathematical Modeling, and Dynamical Systems, developed a framework for cognition based on dynamics, growth, and learning in *Rethinking Innateness* (Elman *et al.* 1996; Tomasello and Slobin 2005). The valid investigation of the construct of language requires the synergy of all these approaches.

THE PAPERS IN THIS SPECIAL ISSUE

An Emergentist perspective has informed the papers in this issue, allowing the authors to explain the systematicities that come from the development of second language learner language, the creation and evolution of lexical networks, the dynamic adaptation that occurs during interaction, and even in the evolution and change of language itself.

In the first article, Larsen-Freeman examines how the emergence of complexity, fluency, and accuracy in the *learner language of five Chinese learners of English* can be seen not as the unfolding of some prearranged plan, but rather as their adapting to a changing context, in which their language resources themselves are transformed through use. Furthermore, she shows how it is desirable to view language development both at the macro-level of a group of learners and at the micro-level of the individual, for to only do the former obscures the fact that learners adhere to *different trajectories of development*, one from another, depending on their learning orientations, the contextual differences, and how individuals take advantage of the affordances that exist in constructing their own linguistic environments.

In the second article, Meara demonstrates how phenomena that occur in multilingual speakers are explainable in terms of emergent properties of *lexical networks*. Modeling lexicons in Boolean network terms, Meara addresses one of the main puzzles in bilingual research, namely, how bilinguals manage to keep their languages apart. He hypothesizes the existence of a 'language switch,' which involves the rapid acquisition of one language and deactivation of another. The language switch is thought to be an emergent property of simple lexical networks rather than a built-in design feature. In addition, he points to interesting patterns of interference between L2 and L3 that appear in the model, which may explain why real speakers often report that they can retrieve an L3 word when they are searching for an L2 word.

In the third article, Mellow proposes an emergentist solution to the ‘poverty of stimulus’ puzzle. An emergentist approach would not expect instantaneous acquisition, and although its constructs are complex, they are learnable. After collecting and examining a longitudinal corpus of a Spanish-speaking English language learner, Mellow suggests that the learning of a complex syntactic structure, such as a relative clause, is initially item-based, in which a small number of tokens of a particular construction are assimilated. The initial use of such a *complex syntactic structure* is facilitated by the prior acquisition of the components of the construction. From these constructions, learners gradually develop linguistic abilities that can be described as grammaticized, generalized linguistic constructs.

In the fourth paper in this issue, Cameron and Deignan challenge an exclusively cognitive view of metaphor. Arguing for the existence of a dynamic, recursive relationship between language and thinking, they incorporate an affective and a socio-cultural dimension as well. Demonstrating the value of the emergentist belief in linking different levels of explanation, they examine both local contexts of use and a large language corpus, and they show how metaphors emerge in the complex dynamics of *discourse*. On a micro-timescale, discourse participants converge on particular systems of framing metaphors; on a macro timescale, metaphors develop into non-predictable, but stable forms, which they call ‘metaphoremes.’ They observe that metaphoremes are not discrete entities, but rather a bundle of relatively stable patterns of language use, with some variation.

In the final article in this special issue, Ke and Holland report on their agent-based model, which simulates how word order could have emerged in the process of *language origin*. They contend that an emergentist perspective provides a new conceptual framework to replace the traditional opposition between nativism and empiricism. Modeling approaches, such as theirs, also hold the promise of realizing the emergentist goal of connecting phylogenetic development at the macro-level and ontogenic development at the micro-level.

DUALISM AND THE COMPLEMENTARY NATURE

When considering interface (Case 8), we alluded to Descartes’ Dualism, the separation of ‘res cogitans’ (God and the human soul) and ‘res extensa’ (the corporeal world). Dualism pervades scientific thinking. Humans divide their world into contraries and perceive and interpret these as mutually exclusive. Applied Linguistics too is driven by such either/or dichotomies—Figure 1 illustrates but a few, beginning as we did here, with the property theory/transition theory antinomy. But these contraries too are emergent attractor states. We accept that meteorological phenomena involve local physical interactions of heat, molecules of water, gaseous air, and planetary spin, and from these emerge high pressure and low pressure systems, warm and cold fronts; thus it makes sense to summarize at this

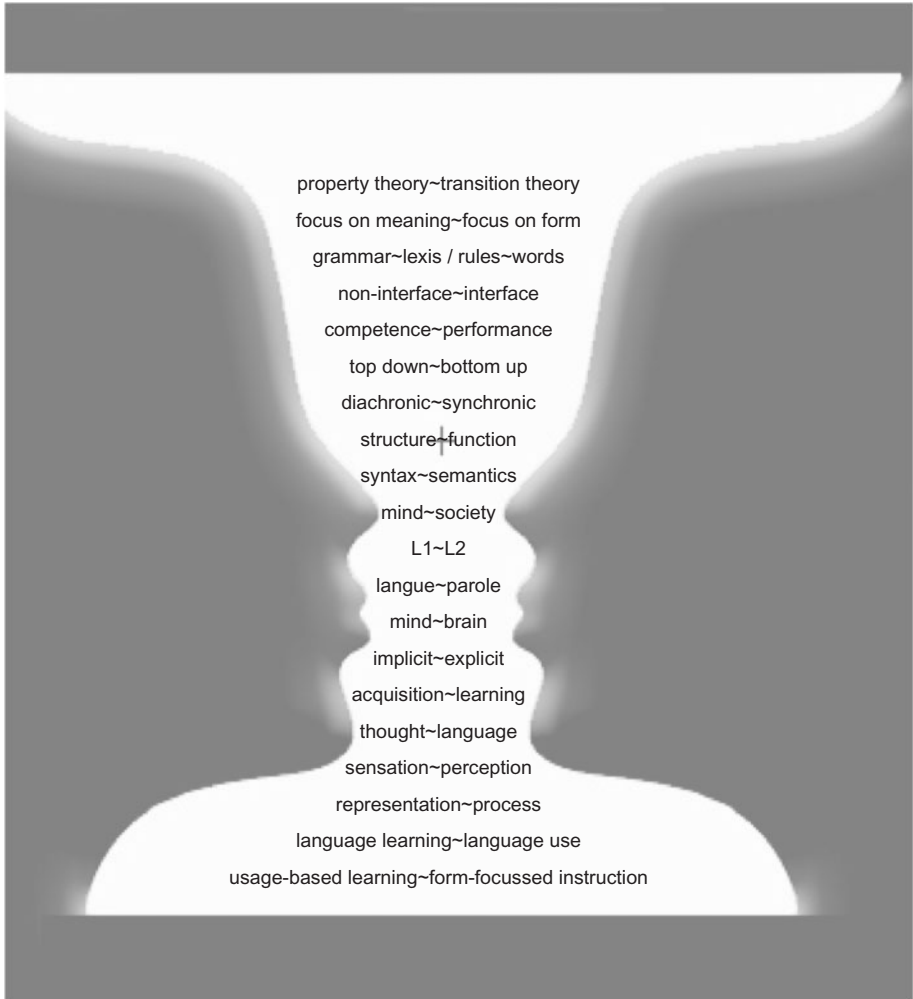


Figure 1: Complementary pairs in Applied Linguistics

level and to talk in such terms when forecasting the weather. Human thinking, like nature, appears to partition things, events, and ideas into pairs. But these pairs are emergent, and they are complementary, more mutually dependent than mutually exclusive. They drive change, with the ‘action’ taking place in between in complex coordination dynamics (Scott Kelso 1997; Scott Kelso and Engstrøm 2006).

Throughout history, many have recognized that truth may well lie in between such polar opposites. In fact, one feature of dynamic systems theory is superposition, which means that a phenomenon is characterized

by two (apparently) incompatible properties at the same time (van Geert and Steenbeek 2005). Failure to accept this perspective leads to researchers picking sides in debates such as whether it is genes or the environment which can be used to explain development. Superposition, in fact, suggests that genes and environment are locked in a complex chain of steps over time and that they cannot be conceived of as variables that make mutually independent contributions to development. Heraclitus summarized the dynamic nature of learning: 'All things come into being through opposition, and all are in flux like a river'. The philosophical analysis of dialectics has a rich tradition, flowing from Plato, Socrates, Hegel, Kant, Vygotsky, and Wertsch into applied linguistics in the work of Lantolf, Kramsch and others (Kramsch 2002; Lantolf 2006; Lantolf and Thorne 2006). The science of complex systems (Holland 1998; Kauffman 1995), dynamic systems (Thelen and Smith 1994), connectionism (Elman *et al.* 1996), chaos-complexity theory (Cooper 1999; Larsen-Freeman 2002; Waldrop 1992), and emergentism (Bates and MacWhinney 1987; MacWhinney 1999, Discussant this issue), is somewhat younger. The confluence of these philosophical and scientific streams, we believe, provides new ways to understand complementary pairs such as those in Figure 1, and the ways that language, the shared focus of our inquiries, might be better understood as an emergent system.

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