4

USAGE-BASED APPROACHES TO L2 ACQUISITION

Nick C. Ellis and Stefanie Wulff

The Theory and Its Constructs

Various approaches to second language acquisition (L2 acquisition) can be labeled as "usage based." What unites these approaches is their commitment to two working hypotheses:

(1) Language learning is primarily based on learners' exposure to their second language (L2) in use, that is, their communicative experience using the L2.
(2) Learners induce the rules of their L2 from this experience by employing cognitive mechanisms that are not exclusive to language learning, but that are general cognitive mechanisms at work in any kind of learning, including language learning.

We will look at the following major constructs of usage-based approaches to L2 acquisition in more detail:

- Constructions: language learning is the learning of constructions, pairings of form, and meaning or function. Constructions range from simple morphemes like *-ing* to complex and abstract syntactic frames such as Subject-Verb-Object-Object (as in *Nick made Steffi a sandwich*).
- Associative language learning: learning constructions means learning the association between form and meaning or function. The more reliable the association between a form and its meaning or function, the easier it is to learn. For example, the sound sequence /ˈsæn(d)wɪtʃ/ is reliably associated with a particular meaning ("slices of meat and/or cheese between two slices of bread"). The form *-ing,* in contrast, has different meaning/functions in different contexts, making it comparatively harder to learn.

- Rational cognitive processing: language learning is rational such that a learner's knowledge of a given form-meaning pair at any point in their language development is a reflection of how often and in what specific contexts the learner has encountered that form-meaning pair.
- Exemplar-based learning: language learning is in large parts implicit in the sense of taking place without the learner being consciously aware of it. The learner's brain engages simple learning mechanisms in distributional analyses of the exemplars of a given form-meaning pair that take various characteristics of the exemplar into consideration, including how frequent it is, what kind of words and phrases and larger contexts it occurs with, and so on.
- Emergent relations and patterns: language learning is a gradual process in which language emerges as a complex and adaptive (in the sense of continuously fine-tuning) system from the interaction of simple cognitive learning mechanisms with the input (and in interaction with other speakers in various social settings).

Constructions

The basic units of language representation are **constructions**. Constructions are pairings of form and meaning or function. By that definition, we know that words like, say, *squirrel,* must be constructions: a form—that is, a particular sequence of letters or sounds—is conventionally associated with a meaning (in the case of *squirrel,* something like "agile, bushy-tailed, tree-dwelling rodent that feeds on nuts and seeds"). In Construction Grammar, constructions are not restricted to the level of words (Goldberg, 2006; Trousdale & Hoffman, 2013). Instead, these form-function pairings are assumed to pervade all layers of language. Morphemes such as *-licious* (roughly meaning "delightful or extremely attractive") are constructions. Idiomatic expressions such as *I can't wrap my head around this* (meaning "I do not fully comprehend this") are constructions. Even abstract syntactic frames are constructions: sentences like *Nick gave the squirrel a nut, Steffi gave Nick a hug,* or *Bill baked Jessica a cake* all have a particular form (Subject-Verb-Object-Object) that, regardless of the specific words that realize its form, share at least one stable aspect of meaning: something is being transferred (nuts, hugs, and cakes). Some constructions do not have a meaning in the traditional sense but serve more functional purposes; passive constructions, for example, serve to shift what is in attentional focus by defocusing the agent of the action (compare an active sentence such as *Bill baked Jessica a cake* with its passive counterpart *A cake was baked for Jessica*).

Constructions can be simultaneously represented and stored in multiple forms and at various levels of abstraction: *table + s = tables;* [Noun] + (morpheme *-s*) = "plural things"). Ultimately, constructions blur the traditional distinction between lexicon and grammar. A sentence is not viewed as

the application of grammatical rules to put a number of words obtained from the lexicon in the right order; a sentence is instead seen as a combination of constructions, some of which are simple and concrete while others are quite complex and abstract. For example, *What did Nick give the squirrel?* comprises the following constructions:

• *Nick, squirrel, give, what, do* constructions
• VP, NP constructions
• Subject–Verb–Object–Object construction
• Subject–Auxiliary inversion construction

We can therefore see the language knowledge of an adult as a huge warehouse of constructions. Constructions vary in their degree of complexity and abstraction. Some of them can be combined with one another while others cannot; their combinability largely depends on whether their meanings/functions are compatible, or can at least be coerced into compatibility, given the specific context and situation in which a speaker may want to use them together. The more often a speaker encounters a particular construction, or combination of constructions, in the input, the more entrenched the (arrangement of) constructions becomes.

Associative Learning Theory

Constructions that are frequent in the input are processed more easily than rare constructions are. This empirical fact is compatible with the idea that we learn language from usage through associative learning (Ellis, 2002). Let's stick to words for now, though the same is true for letters, morphemes, syntactic patterns, and all other types of constructions. Through experience, a learner's perceptual system becomes tuned to expect constructions according to their probability of occurrence in the input, with words like *one* or *won* occurring more frequently than words like *seventeen* or *synecdoche*.

When a learner notices a word in the input for the first time, a memory is formed that binds its features into a unitary representation, such as the phonological sequence /wʌn/ or the orthographic sequence *one*. Alongside this representation, a so-called detector unit is added to the learner's perceptual system. The job of the detector unit is to signal the word's presence whenever its features are present in the input. Every detector unit has a set resting level of activation and some threshold level which, when exceeded, will cause the detector to fire. When the component features are present in the environment, they send activation to the detector that adds to its resting level, increasing it; if this increase is sufficient to bring the level above threshold, the detector fires. With each firing of the detector, the new resting level is slightly higher than the previous one—the detector is primed. This means it will need less activation from

the environment in order to reach threshold and fire the next time. Priming events sum to lifespan-practice effects: features that occur frequently acquire chronically high resting levels. Their resting level of activation is heightened by the memory of repeated prior activations. Thus, our pattern-recognition units for higher-frequency words require less evidence from the sensory data before they reach the threshold necessary for firing.

The same is true for the strength of the mappings from form to interpretation. Each time /wʌn/ is properly interpreted as *one,* the strength of this connection is incremented. Each time /wʌn/ signals *won,* this is tallied too, as are the less frequent occasions when it forewarns of *wonderland.* Thus, the strengths of form-meaning associations are summed over experience. The resultant network of associations, a semantic network comprising the structured inventory of a speaker's knowledge of language, is tuned such that the spread of activation upon hearing the formal cue /wʌn/ reflects prior probabilities of its different interpretations.

Many additional factors qualify this simple picture. First, the relationship between frequency of usage and activation threshold is not linear but follows a curvilinear "power law of practice" whereby the effects of practice are greatest at early stages of learning, but eventually reach asymptote (see De Keyser, this volume). Second, the amount of learning induced from an experience of a construction depends upon the salience of the form (i.e., how much it stands out relative to its context) and the importance of understanding it correctly (Ellis, 2017; Wulff & Ellis, 2018). Third, the learning of a construction is interfered with if the learner already knows another form that cues that interpretation, or, conversely, if the learner knows another interpretation for that form. Fourth, a construction may provide a partial specification of the structure of an utterance, and hence an utterance's structure is specified by a number of distinct constructions which must be collectively interpreted. Some cues are much more reliable signals of an interpretation than others, and it is not just first-order probabilities that are important—sequential probabilities matter a great deal as well, because context qualifies interpretation. For example, the interpretation of /wʌn/ in the context *Alice in wun …* is already clear after the learner has heard *Alice in …;* in other words, *Alice in* and /wʌn/ are highly reliably associated with each other. If a sentence starts out with *I /wʌn/ …,* in contrast, several competing interpretations are co-activated (*I wonder …, I won …, I once …,* etc.) because the first person pronoun *I* is a much less reliable cue for the interpretation of /wʌn/ than *Alice.*

Rational Language Processing

These associative underpinnings allow language users to be rational in the sense of having a mental model of their language that is custom-fit to their linguistic experience at any given time (Ellis, 2002, 2006a). The words that

they are likely to hear next, the most likely senses of these words, the linguistic constructions they are most likely to utter next, the syllables they are likely to hear next, the graphemes they are likely to read next, the interpretations that are most relevant, and the rest of what's coming …? (next) across all levels of language representation, are made readily available to them by their language processing systems. Their unconscious language representation systems are adaptively tuned to predict the linguistic constructions that are most likely to be relevant in the ongoing discourse context, optimally preparing them for comprehension and production. As a field of research, the **rational analysis of cognition** is guided by the principle that human psychology 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 the cue-interpretation mappings it must solve (Anderson, 1989).

Exemplar-Based Learning

Much of our language use is formulaic, that is, we recycle phrasal constructions that we have memorized from prior use (Wulff, 2008; Wulff & Ellis, 2018). However, we are obviously not limited to these constructions in our language processing. Some constructions are a little more open in scope, like the slot-and-frame greeting pattern [*Good* + (time-of-day)] which generates examples like *Good morning* and *Good afternoon*. Others still are abstract, broad-ranging, and generative, such as the schemata that represent more complex morphological (e.g., [NounStem-PL]), syntactic (e.g., [Adj Noun]), and rhetorical (e.g., the iterative listing structure, [*the* (), *the* (), *the* (), …, *together they* …]) patterns. Usage-based theories investigate how the acquisition of these productive patterns, generative schema, and other rule-like regularities of language is based on **exemplars**. Every time the language learner encounters an exemplar of a construction, the language system compares this exemplar with memories of previous encounters of either the same or a sufficiently similar exemplar to retrieve the correct interpretation. According to exemplar theory, constructions such as *Good* + (time of day), [Adj Noun], or [NounStem-PL] all gradually emerge over time as the learner's language system, processing exemplar after exemplar, identifies the regularities that exemplars share and makes the corresponding abstractions.

The Associative Bases of Abstraction

Prototypes, the exemplars that are most typical of their categories, are those that are similar to many members of their category but not similar to members of other categories. People more quickly classify sparrows as birds (or other average sized, average colored, average beaked, average featured specimens) than

they do birds with less common features or feature combinations, like geese or albatrosses. They do so on the basis of an unconscious frequency analysis of the birds they have known (their usage history) with the prototype that reflects the central tendencies of the distributions of the relevant features of these memorized exemplars. We don't walk around consciously counting these features, but yet we have very accurate knowledge of the underlying distributions and their most usual settings.

We are really good at this. Research in cognitive psychology demonstrates that such implicit tallying is the raw basis of human pattern recognition, categorization, and rational cognition. As the world is classified, so language is classified. As for the birds, so for their plural forms. In fact, world and language categorization go hand in hand: Psycholinguistic research demonstrates that people are faster at generating plurals for the prototype or default case that is exemplified by many types and are slower and less accurate at generating "irregular" plurals, the ones that go against the central tendency and that are exemplified by fewer types, such as [plural + "NounStem *s*" = "NounStem*s*-*es*"] or, worse still, [plural + *moose* =?], [plural + *noose* =?], [plural + *goose* =?].

These examples make it clear that there are no 1:1 mapping between cues and their outcome interpretations. Associative learning theory demonstrates that the more reliable the mapping between a cue and its outcome, the more readily it is learned. Consider an ESL learner trying to learn from naturalistic input what *-s* at the ends of words might signify. This particular form has several potential interpretations: It could be the plural (*squirrels*), it could indicate possession (*Nick's hat*), it could mark third person singular present (*Steffi sleeps*), and so on. Therefore, if we evaluate *-s* as a cue for any one of these outcomes, it is clear that the cue will be abundantly frequent in learners' input, yet the cue is not reliably associated with their interpretation or outcome. A similar picture emerges when we reverse the directionality of our thinking: plural *-s,* third person singular present *-s,* and possessive *-s* all have variant expression as the allomorphs [*s*], [*z*], and [ɪ*z*]. Thus, if we evaluate just one of these, say, [ɪ*z*], as a cue for one particular outcome, say, plurality, then it is clear that there are many instances of that outcome in the absence of the cue. Such **contingency** analysis of the reliabilities of the cue–interpretation associations suggests that they will not be readily learnable. High-frequency grammatical functors are often highly ambiguous in their interpretations (Goldschneider & DeKeyser, 2001).

Connectionism is one strand of research in L2 acquisition that seeks to investigate how simple associative learning mechanisms such as the kind of contingency analysis mentioned earlier meets the complex language evidence available to a learner in their input and output. The term "connectionist" reflects the idea that mental and behavioral models are in essence interconnected networks of simple units. Connectionist models are typically run as computer simulations. The simulations are data-rich and process-light: Massively

parallel systems of artificial neurons use simple learning processes to statistically generalize over masses of input data. It is important that the input data is representative of learners' usage history, which is why connectionist and other input-influenced research rests heavily on large-scale, maximally representative digital collections of authentic language (these are often called databanks or **corpora**). Connectionist simulations show how prototypes emerge as the prominent underlying structural regularity in the whole problem space, and how minority subpatterns of inflection regularity, such as the English plural subpatterns discussed earlier (or the much richer varieties of the German plural system, for example), also emerge as smaller, less powerful attractors. Connectionism provides the computational framework for testing usage-based theories as simulations, for investigating how patterns appear from the interactions of many language parts.

Emergent Relations and Patterns

Complex systems are those that involve the interactions of many different parts, such as ecosystems, economies, and societies. All complex systems share the key aspect that many of their systematicities are **emergent**: They develop over time in complex, sometimes surprising, dynamic, and adaptive ways. Complexity arises from the interactions of learners and problems too. Consider the path of an ant making its homeward journey on a pebbled beach. The path seems complicated as the ant probes, doubles back, circumnavigates, and zigzags. But these actions are not deep and mysterious manifestations of intellectual power. Instead, the control decisions are simple and few in number. An environment-driven problem solver often produces behavior that is complex because it relates to a complex environment.

Language is a complex adaptive system (Beckner et al., 2009; Ellis & Larsen-Freeman, 2009; see also Larsen-Freeman, this volume). It comprises the 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, constructions, interactions, and discourses), different human conglomerations (individuals, social groups, networks, and cultures), and different timescales (evolutionary, epigenetic, ontogenetic, interactional, neurosynchronic, diachronic) (MacWhinney & O'Grady, 2015).

> 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, p. 657)*

Two Languages and Language Transfer

Our neural apparatus is highly plastic in its initial state. It is not entirely an empty slate, since there are broad genetic constraints on the usual networks of system-level connections and on the broad timetable of maturation. Nevertheless, the cortex of the brain can represent any type of information equally well (Elman et al., 1996). From this starting point, the brain quickly responds to the input patterns it receives, and through associative learning, it optimizes its representations to model the particular world of an individual's experience. The term "neural plasticity" summarizes the fact that the brain is tuned by experience. Our neural endowment provides a general-purpose cognitive apparatus that, constrained by the makeup of our human bodies, filters and determines our experiences. In the first few years of life, the human learning mechanism optimizes its representations of the first language (L1) being learned. Thousands of hours of L1 processing tunes the system to the cues of the L1 and automatizes its recognition and production. It is impressive how rapidly we start tuning into our ambient language and disregarding cues that are not relevant to them (Kuhl, 2004). One result of this process is that the initial state for L2 acquisition is no longer a plastic system; it is one that is already tuned and committed to the L1. Our later experience is shaded by prior associations; it is perceived through the memories of what has gone before. Since the optimal representations for the L2 do not match those of the L1, L2 acquisition is impacted by various types of L1 interference. Transfer phenomena pervade L2 acquisition (Flege, 2002; Jarvis & Pavlenko, 2008; Lado, 1957; MacWhinney, 1997; Odlin, 1989; Weinreich, 1953).

Associative Aspects of Transfer: Learned Attention and Interference

Associative learning provides the rational mechanisms for L1 acquisition from linguistic usage and its analysis — allowing just about every human being to acquire fluency in their native tongue. Yet although L2 learners too are surrounded by language, not all of it "goes in," and L2 acquisition is typically limited in success. This is Corder's distinction between input, the available target language, and intake, that subset of input that actually gets in and that the learner utilizes in some way (Corder, 1967). Does this mean that L2 acquisition cannot be understood according to the general principles of associative learning? If L1 acquisition is rational, is L2 acquisition fundamentally irrational? No. Paradoxically perhaps, it is the very achievements of L1 acquisition that limit the input analysis of the L2. Associative learning theory explains these limitations too, because associative learning in animals and humans alike is affected by what is called **learned attention**.

We can consider just one example of learned attention here. Many grammatical form-meaning relationships are both low in salience and redundant in the understanding of the meaning of an utterance. It is often unnecessary, for

instance, to interpret inflections that mark grammatical meanings such as tense because they are usually accompanied by adverbs that indicate the temporal reference: "if the learner knows the French word for 'yesterday,' then in the utterance *Hier nous sommes allés au cinéma* (Yesterday we went to the movies) both the auxiliary and past participle are redundant past markers" (Terrell, 1991, p. 59). This redundancy is much more influential in L2 acquisition than L1 acquisition. Children learning their native language only acquire the meanings of temporal adverbs quite late in development. But L2 learners already know about adverbs from their L1 experience, and adverbs are both salient and reliable in their communicative functions, while tense markers are neither (Ellis, 2017, see also VanPatten, this volume). Thus, the L2 expression of temporal reference begins with a phase where reference is established by adverbials alone, and the grammatical expression of tense and aspect thereafter emerges only slowly if at all (Bardovi-Harlig, 2000; see also Bardovi-Harlig, this volume).

This is an example of the associative learning phenomenon of "blocking," where redundant cues are overshadowed because the learners' L1 experience leads them to look elsewhere for the cues to interpretation (Ellis, 2006b; Wulff & Ellis, 2018). Under normal L1 circumstances, usage optimally tunes the language system to the input; under these circumstances of low salience of L2 form and blocking, however, all the extra input in the world can sum to nothing, with interlanguage sometimes being described as having "fossilized" (Han & Odlin, 2006). Untutored adult associative L2 learning from naturalistic usage can thus stabilize at a "Basic Variety" of inter-language 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 or not present at all (Klein, 1998).

The usual social-interactional or pedagogical reactions to such nonnative-like utterances involve an interaction partner (Long, 1983; Mackey, Abbuhl, & Gass, 2011) or instructor (Doughty & Williams, 1998) who intentionally brings additional evidence to the learner's attention by some means of attentional focus that helps the learner to "notice" the cue (Schmidt, 2001). This way, L2 acquisition can be freed from the bounds of L1-induced selective attention: a focus on form is provided in social interaction (Tarone, 1997; see also Lantolf, Thorne & Poehner, this volume) that recruits the learner's explicit conscious **processing**. We might say that the input to the associative network is "socially gated" (Cadierno & Eskildsen, 2015; Ellis, 2015, 2019; Hulstijn et al., 2014).

What Counts as Evidence?

Like other enterprises in cognitive science and cognitive neuroscience, usage-based approaches are not restricted to one specific research methodology or evidential source. Indeed, different approaches require different methods,

and often a combination of different qualitative and quantitative methods. As mentioned earlier, many usage-based analyses employ data from large digitized collections of language, so-called corpora; computational modeling is at the heart of rational cognition analysis, exemplar theory, and emergentist analyses alike. Other relevant research methods include classroom field research, psycholinguistic studies of processing, and dense longitudinal recording (that is, recordings that capture learners' development at dense intervals over a prolonged period of time).

Corpus-based analysis constitutes a particularly growing trend across usage-based paradigms (McEnery & Hardie, 2012; Sinclair, 1991). If language learning is in the social-cognitive linguistic moment of usage, we need to capture all these moments so that we can objectively study them. We need large, dense, longitudinal corpora of language use, with audio, video, transcriptions, and multiple layers of annotation, for data sharing in open archives. We need recordings between short time intervals so that we can chart learners' usage history and their development (Tomasello & Stahl, 2004). We need them in sufficient detail that we can engage in detailed analyses of the processes of interaction (Kasper & Wagner, 2011). MacWhinney (2000) has long been working toward these ends with CHILDES, a corpus of L1 acquisition data, and later with Talkbank, a corpus that also covers language data from L2 learners. Alongside these and other corpora, a growing number of computer tools are becoming available that assist the researcher in analyzing corpus data. These corpus tools can help researchers interested in the most diverse areas of L2 acquisition by covering the full range from qualitative data analysis, such as a fine-grained conversation analysis of individual corpus files (say, a transcribed conversation between a student and an ESL teacher), to semi-quantitative analysis of a representative sample of attestations of a particular phenomenon (such as the use of the -*ing* morpheme by English language learners), to large-scale quantitative analysis of distributional patterns (e.g., the association strength between verbs and the larger constructions they occur in; see the exemplary study in this chapter or Gries & Wulff, 2005, 2009, for examples).

What Are Some Common Misunderstandings about the Theory?

Broad frameworks, particularly those that revive elements of no-longer-fashionable theories such as behaviorism or structuralist approaches to linguistics, open the potential for misunderstanding. Common misconceptions include that connectionism is the new behaviorism, that connectionist models cannot explain creativity and have no regard for internal representation, and that cognitive approaches deny influence of social factors, motivational aspects, and other individual differences between learners. At the heart of most of these misunderstandings is the idea that usage-based analyses only do number-crunching,

with too much of a focus on the effects that the frequency of constructions and other cues play in the learning process. While it is true that most usage-based approaches will discuss frequency as one of several factors, no usage-based theorist would claim that frequency is the only factor impacting L2 acquisition. In fact, there is a lively debate among usage-based theorists about the exact role frequency effects play in what is conceived of as a complex network of factors that can mute and amplify each other in complex ways (Ellis & Larsen-Freeman, 2006). At an even more fundamental level, what constitutes a frequency effect in the first place is a question we are far from having answered. Without going into too much detail here, there is ample empirical evidence, for instance, that we cannot always define a frequency effect by the rule "the more frequent, the more salient/important/relevant"—by that rationale, English articles and prepositions, which are the most frequent words in the English language, should not pose such an obstinate challenge to the average language learner! Instead, it seems that frequency effects come in different kinds (as absolute frequencies, ratios, association strengths, and other distributional patterns), and they will have differently weighted impacts depending on the target structure under examination, and, crucially, depending on the state of the learner's language development (Ellis, 2017; Wulff & Ellis, 2018). An emergentist/complex systems approach views L2 acquisition as a dynamic process in which regularities and systems emerge from many of the processes covered in this volume—from the interaction of people, brains, selves, societies, and cultures using languages in the world (Beckner et al., 2009; Ellis, 2008, 2019)—while at the same time investigating component processes in a rigorous fashion.

An Exemplary Study: Ellis, O'Donnell, and Römer (2014a)

Research Questions

While previous studies were able to demonstrate that frequency, prototypicality, and contingency are factors that impact L2 learners' constructional knowledge, most of these studies have considered only one of these factors at a time. This study wanted to determine whether and how these factors jointly affect L2 learners' constructional knowledge. The specific kind of constructions this study focused on are so-called verb-argument constructions (VACs). VACs are semi-abstract patterns that comprise verbs and the arguments they occur with, such as 'V *across* N' or "V *of* N"; in this study, the authors examined VACs that another team of researchers previously identified using corpus analysis (Francis, Hunston, & Manning, 1996).

Methods

One hundred thirty-one German, 131 Spanish, and 131 Czech advanced L2 learners of English as well as 131 native speakers of English were engaged in a

free association task: They were shown 40 VAC frames such as "V *across* N" or "*it* V *of the* N" and asked to fill in the verb slot with the first word that came to mind. The learners' responses were compared with results obtained from two native speaker databases. To get an impression of the frequencies with which different verbs occur in the VACs examined, and to calculate how strongly each verb is associated with the individual VACs, the authors consulted the British National Corpus (BNC). The BNC is a 100-million-word corpus of British English that strives to be representative of language use across different registers and genres. To obtain the verb type frequencies, one can simply run a search for the VACs in the BNC and count how often each verb type occurs. To calculate the association strength between each verb type and each VAC, the authors used a specific association measure called DeltaP (for more information on how DeltaP works, see Ellis, 2006a). To see how prototypical the verbs selected by the participants would be for each VAC, the authors consulted a second data-base called WordNet (Miller, 2009). WordNet is a lexical database, so unlike the BNC, it is not a collection of cohesive and complete texts and dialogues but rather a thesaurus-like database that groups words together based on their meanings. Using sophisticated computational techniques, the authors used this information to generate semantic networks for each of the VACs examined. For the "V *across* N" VAC, for instance, the verbs in the center of the network are *go, move, run,* and *travel,* while verbs like *shout, splash,* and *echo* constitute less prototypical verbs in that VAC.

Main Findings

A multifactorial analysis (i.e., a statistic that can gauge the impact of more than one factor on a specific outcome at a time; in our example, it measured the potential impact of frequency, prototypicality, and contingency on speakers' associations) revealed that for all of the VACs examined, each factor made an independent contribution to learners' and native speakers' associations:

1. The more frequently a particular verb occurred in a specific VAC in the native speaker corpus data, the more likely it was elicited as a response for that VAC in the word association experiment.
2. The more strongly a verb and a VAC were associated with each other as expressed in their DeltaP association scores, the more likely that verb was elicited as a response for that VAC in the word association experiment.
3. The more prototypical a verb was for the VAC as indicated by its position in the semantic networks the authors generated for each VAC, the more likely it was elicited as a response for that VAC in the word association experiment.

Theoretical Implications

Based on the statistical analyses, the authors concluded that advanced L2 learn-ers' knowledge of VACs involves rich associations that are very similar in kind and strength to those of native speakers (Ellis, O'Donnell, & Römer, 2014a, 2014b). The word associations generated in the experiment testified to learn-ers having rich associations for VACs that are tuned by verb frequency, verb prototypicality, and verb–VAC contingency alike—factors that, in combina-tion, interface across syntax and semantics.

Why/How This Theory Provides an Adequate Explanation of Observable Phenomena in L2 Acquisition

Observation 1: Exposure to input is necessary for L2 acquisition. Usage-based ap-proaches are input driven, emphasizing the associative learning of constructions from input. As with other statistical estimations, a large and representative sam-ple of language is required for the learner to abstract a rational model that is a good fit to the language data. Usage is necessary, and it is sufficient for successful L1 acquisition though not for L2 acquisition. This is because the initial state for L2 acquisition is knowledge of an L1, and the learner's representations, process-ing routines, and attention to language are tuned and committed to the L1.

    Observation 2: A good deal of L2 acquisition happens incidentally. The majority of language learning is implicit. Implicit tallying is the raw basis of human pattern recognition, categorization, and rational cognition. All of the counting that underpins the setting of thresholds and the tuning of the system to the proba-bilities of the input evidence is unconscious, as is the emergence of structural regularities, prototypes, attractors, and other system regularities. At any one point we are conscious of one particular communicative meaning, yet mean-while the cognitive operations involved in each of these usages are tuning the system without us being aware of it (Ellis, 2002). We know (or can be shown to be sensitive to in our processing) far too many linguistic regularities for us to have explicitly learned them. Usage-based approaches maintain that incidental associative learning provides the rational mechanisms and is sufficient for L1 ac-quisition from input analysis and usage, allowing just about every human being to acquire fluency in their native tongue. They do not suffice for L2 acquisition because of learned attention.

    Observation 3: Learners come to know more than what they have been exposed to in the input. The study of implicit human cognition shows us to know far more about the world than we have been exposed to or have been explicitly taught. Prototype effects are one clear and ubiquitous example of this: learn-ers who have never been exposed to the prototype of a category nevertheless classify it faster and more accurately than examples further from the central

tendency, and name it with the category label with great facility. The same is true for language, where learners go beyond the input in producing **U-shaped learning**, with novel errors (like *goed* instead of *went*) and other systematicities of stages of interlanguage development in L2 acquisition, for example, of negation or question formation. These creations demonstrate that the learners' language system is constantly engaged in making generalizations and finding abstractions of systematicities.

Observation 4: Learners' output (speech) often follows predictable paths with predictable stages in the acquisition of a given structure. As in L1 acquisition, L2 acquisition is characterized not by complete idiosyncrasy or variability but rather by predictable errors and stages during the course of development: interlanguage is systematic. Usage-based approaches hold that these systematicities arise from regularities in the input: For example, constructions that are much more frequent, that are consistent in their mappings and exhibit high contingency, that have many friends (constructions that behave in a similar way) of like-type, and that are salient are likely to be acquired earlier than those that do not have these features (Ellis, 2007).

Observation 6: Second language learning is variable across linguistic subsystems. The learners' mental lexicon is diverse in its contents, spanning lexical, morphological, syntactic, phonological, pragmatic, and sociolinguistic knowledge. Within any of these areas of language, learners may master some structures before they acquire others. Such variability is a natural consequence of input factors such as exemplar type and token frequency, recency, context, salience, contingency, regularity, and reliability, along with the various other associative learning factors that affect the emergence of attractors in the problem space. Some aspects of these problem spaces are simpler than others. Second language learning is a piecemeal development from a database of exemplars with patterns of regularity emerging dynamically.

Observation 7: There are limits on the effects of frequency on L2 acquisition. This is explicitly addressed above under Associative aspects of transfer: learned attention and interference.

Observation 8: There are limits on the effect of a learner's first language on L2 acquisition. The effect of a learner's L1 is no longer considered the exclusive determinant of L2 acquisition as proposed in the Contrastive Analysis Hypothesis. Usage-based accounts see the major driving force of language acquisition to be the constructions of the target language and the learner's experience of these constructions. However, the significance of transfer from L1 in the L2 learning process is uncontroversial. As we explain earlier under "Two Languages and Language Transfer," at every level of language, there is L1 influence, both negative and positive. The various cross-linguistic phenomena of learned selective attention, overshadowing and blocking, latent inhibition, perceptual learning, interference, and other effects of salience, transfer, and inhibition all filter and color the perception of the L2. So, usage-based accounts of L2 acquisition look at the effects of both L1 and L2 usage upon L2 acquisition (Robinson & Ellis, 2008).

Observation 9: There are limits on the effects of instruction on L2 acquisition. L1- tuned learned attention limits the amount of intake from L2 input, thus restricting the endstate of *L2 acquisition.* Attention to language form is sometimes necessary to allow learners to notice some blocked, overshadowed, or otherwise nonsalient aspect of the language form. Reviews of the empirical studies of instruction demonstrate that social recruitment of learners' conscious, explicit learning processes can be effective.

However, instruction is not always effective. Any classroom teacher can provide anecdotal evidence that what is taught is not always learned. But this observation can be made for all aspects of the curriculum, not just language. Explicit knowledge about language is of a different stuff from that of the implicit representational systems, and it need not impact upon acquisition for a large variety of reasons. Explicit instruction can be ill-timed and out of synchrony with development (Pienemann, 1998; see also Pienemann & Lenzing, this volume); it can be confusing; it can be easily forgotten; it can be dissociated from usage, lacking in transfer-appropriateness and thus never brought to bear so as to tune attention to the relevant input features during usage; it can be unmotivating; it can fail in so many ways.

The Explicit/Implicit Debate

Learning a new symbol, for example, the French word *étoile* for a ★*,* initially involves explicit learning: you are consciously aware of the fact that you did not know the French word for "star" before, and that now you do (Ellis, 1994). Some facts about how to use *étoile* properly you may not know yet, such as its proper pronunciation, its grammatical gender, synonymous forms, words, phrases, and idioms that *étoile* is associated with. Some of these facts you will learn by making a conscious effort, that is, via explicit learning; other facts you will not consciously figure out but rather learn implicitly. Without you being aware of it, your language system is hard at work, upon each subsequent encounter of *étoile,* to fill in these knowledge gaps and fine-tune the mental representation you have for this construction.

Despite the fact that many of us go to great lengths to engage in explicit language learning, the bulk of language acquisition is implicit learning from usage. Most knowledge is tacit knowledge; most learning is implicit; the vast majority of our cognitive processing is unconscious. Implicit learning supplies a distributional analysis of the problem space: our language system implicitly figures out how likely a given construction is in particular contexts, how often they instantiate one sense or another, how these senses are in turn associated with different features of the context, and so on. To the extent that these distributional analyses are confirmed time and again through continuous exposure to more input, generalizations and abstractions are formed that are also largely implicit.

Implicit learning would not do the job alone. Some aspects of an L2 are unlearnable—or at best are acquired very slowly—from implicit processes alone. In cases where linguistic form lacks perceptual salience and so goes unnoticed by learners, or where the L2 semantic/pragmatic concepts to be mapped onto the L2 forms are unfamiliar, additional attention is necessary in order for the relevant associations to be learned. To counteract the L1 attentional biases to allow implicit estimation procedures to optimize induction, all of the L2 input needs to be made to count (as it does in L1 acquisition), not just the restricted sample typical of the biased intake of L2 acquisition.

Ellis (2005) reviews the instructional, psychological, social, and neurological dynamics of the interface by which explicit knowledge of form-meaning associations impacts upon implicit language learning:

> The interface is dynamic: It happens transiently during conscious processing, but the influence upon implicit cognition endures thereafter. Explicit memories can also guide the conscious building of novel linguistic utterances through processes of analogy. Patterned practice and declarative pedagogical grammar rules both contribute to the conscious creation of utterances whose subsequent usage promotes implicit learning and proceduralization. Flawed output can prompt focused feedback by way of recasts that present learners with psycholinguistic data ready for explicit analysis.
>
> *(p. 305)*

Once a construction has been represented in this way, its use in subsequent implicit processing can update the statistical tallying of its frequency of usage and probabilities of form-function mapping.

So, we believe that learners' language systematicity emerges from their history of interactions of implicit and explicit language learning, from the statistical abstraction of patterns latent within and across form and function in language usage. The complex adaptive system of interactions within and across form and function is far richer than that emergent from implicit or explicit learning alone (Ellis, 2014).

Conclusion

In the terms of Chapter 1, the usage-based approaches touched upon here are too broad and far-ranging to qualify as a theory. Instead, they are a framework for understanding many of the complex agents that underlie language learning. No single factor alone is a sufficient cause of L2 acquisition. Language is a complex adaptive system. It comprises the interactions of many players: people who want to communicate and a world to be talked about. It operates across many different levels, different human configurations, and different timescales (Douglas Fir Group, 2016; Ellis, 2019). Take out any one of these levels and a

different pattern emerges, a different conclusion is reached. But nevertheless, like other complex dynamic systems, there are many systematicities that, like Observations 1–10, emerge to form the things a theory should explain.

Discussion Questions

1. One critique of the type of approach Ellis and Wulff take has been that it is an updated version of behaviorism. Do you agree with this criticism? How do the authors of the chapter handle this criticism?
2. Explain the difference between rule-based and rule-like behavior.
3. How do usage-based approaches address explicit and implicit learning and the nature of their interface?
4. Consider the case of the acquisition order of the present perfect and the pluperfect from Bardovi-Harlig (this volume). The functionalist approach offers one explanation for the order of emergence. How would usage-based approaches account for the order? What evidence might distinguish the two interpretations?
5. As we saw in White (this volume), the principal foundation of the approach White takes is the *poverty of the stimulus* (POS) situation or the *logical problem of language acquisition*. How do usage-based approaches view the POS? (You might want to review the examples in White's chapter before answering.)
6. Read the exemplary study presented in this chapter and prepare a discussion for class in which you describe how you would conduct a replication study. Be sure to explain any changes you would make and what motivates such changes.

Suggested Further Reading

Ellis, N. C. (2019). Essentials of a theory of language cognition. *Modern Language Journal, 103*, 39–60.
  A state-of-the art overview of language cognition.
Ellis, N. C., Römer, U., & O'Donnell, M. B. (2016). *Usage-based approaches to language acquisition and processing: Cognitive and corpus investigations of construction grammar.* Language Learning Monograph Series. Wiley-Blackwell.
  Recent investigations into usage-based L2 acquisition.
Ellis, N. C. (Ed.). (1994). *Implicit and explicit learning of languages*. San Diego, CA: Academic Press.
  An edited collection focusing upon the explicit/implicit debate.
Rebuschat, P. (Ed.). (2014). *Implicit and explicit learning of language*. Amsterdam, Netherlands: John Benjamins.
  A reprise summarizing explicit/implicit research 20 years on.
Ellis, N. C., & Larsen-Freeman, D. (Eds.). (2009). Language as a complex adaptive system [Special issue]. *Language Learning, 59* (Suppl. 1), 93–128.
  A special issue gathering experts from various language domains who share the CAS perspective.

Robinson, P., & Ellis, N. C. (Eds.). (2008). *Handbook of cognitive linguistics and second language acquisition*. London, England: Routledge.
> The first collection focusing upon usage-based approaches to L2 acquisition.

Tomasello, M. (2003). *Constructing a language*. Boston, MA: Harvard University Press.
> A thorough usage-based account of child language.

Tyler, A. (2012). *Cognitive linguistics and second language learning*. New York, NY: Routledge.
> L2 acquisition from a cognitive-linguistic perspective, referencing many usage-based studies and research into pedagogical applications of a usage-based L2 acquisition.

References

Anderson, J. R. (1989). A rational analysis of human memory. In H. L. I. Roediger & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 195–210). Hillsdale, NJ: Lawrence Erlbaum.

Bardovi-Harlig, K. (2000). *Tense and aspect in second language acquisition: Form, meaning, and use*. Oxford, England: Blackwell.

Beckner, C., Blythe, R., Bybee, J., Christiansen, M. H., Croft, W., Ellis, N. C., & Schoenemann, T. (2009). Language is a complex adaptive system. *Language Learning*, *59* (Suppl. 1), 1–26.

Cadierno, T., & Eskildsen, S. W. (Eds.). (2015). *Usage-based perspectives on second language learning*. Berlin, Germany: De Gruyter Mouton.

Corder, S. P. (1967). The significance of learners' errors. *International Review of Applied Linguistics, 5*, 161–169.

Doughty, C., & Williams, J. (Eds.). (1998). *Focus on form in classroom second language acquisition*. New York, NY: Cambridge University Press.

Douglas Fir Group (Atkinson, D., Byrnes, H., Doran, M., Duff, P., Ellis, N., Hall, J. K., … Tarone, E.) (2016). A transdisciplinary framework for SLA in a multilingual world. *Modern Language Journal, 100*, 19–47.

Ellis, N. C. (1994). Vocabulary acquisition: The implicit ins and outs of explicit cognitive mediation. In N. C. Ellis (Ed.), *Implicit and explicit learning of languages* (pp. 211–282). San Diego, CA: Academic Press.

Ellis, N. C. (1998). Emergentism, connectionism and language learning. *Language Learning, 48*, 631–664.

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*, 143–188.

Ellis, N. C. (2005). At the interface: Dynamic interactions of explicit and implicit language knowledge. *Studies in Second Language Acquisition, 27*, 305–352.

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

Ellis, N. C. (2006b). Selective attention and transfer phenomena in SLA: Contingency, cue competition, salience, interference, overshadowing, blocking, and perceptual learning. *Applied Linguistics, 27*, 1–31.

Ellis, N. C. (2007). Dynamic systems and SLA: The wood and the trees. *Bilingualism: Language & Cognition, 10*, 23–25.

Ellis, N. C. (2008). The dynamics of second language emergence: Cycles of language use, language change, and language acquisition. *Modern Language Journal, 41*, 232–249.

Ellis, N. C. (2014). Implicit AND explicit learning of language. In P. Rebuschat (Ed.), *Implicit and explicit learning of language* (pp. 3–23). Amsterdam, Netherlands: John Benjamins.

Ellis, N. C. (2015). Cognitive and social aspects of learning from usage. In T. Cadierno & S. Eskildsen (Eds.), *Usage-based perspectives on second language learning* (pp. 49–73). Berlin, Germany: DeGruyter Mouton.

Ellis, N. C. (2017). Salience in usage-based SLA. In S. Gass, P. Spinner, & J. Behney. (Eds.), *Saliency in second language acquisition* (pp. 39–58). New York, NY: Routledge.

Ellis, N. C. (2019). Essentials of a theory of language cognition. *Modern Language Journal, 103*, 39–60.

Ellis, N. C., & Larsen-Freeman, D. (2006). Language emergence: Implications for applied linguistics. *Applied Linguistics, 27*, 558–589.

Ellis, N. C., & Larsen-Freeman, D. (Eds.). (2009). *Language as a complex adaptive system*. Boston, MA: Wiley-Blackwell.

Ellis, N. C., O'Donnell, M. B., & Römer, U. (2014a). Second language verb-argument constructions are sensitive to form, function, frequency, contingency, and prototypicality. *Linguistic Approaches to Bilingualism, 4,* 405–431.

Ellis, N. C., O'Donnell, M. B., & Römer, U. (2014b). The processing of verb-argument constructions is sensitive to form, function, frequency, contingency, and prototypicality. *Cognitive Linguistics, 25*, 55–98.

Elman, J. L., Bates, E. A., Johnson, M. H., Karmiloff-Smith, A., Parisi, D., & Plunkett, K. (1996). *Rethinking innateness: A connectionist perspective on development*. Cambridge, MA: MIT Press.

Flege, J. (2002). Interactions between the native and second-language phonetic systems. In P. Burmeister, T. Piske, & A. Rohde (Eds.), *An integrated view of language development: Papers in honor of Henning Wode* (pp. 217–244). Trier, Germany: Wissenschaftlicher Verlag Trier.

Francis, G., Hunston, S., & Manning, E. (Eds.). (1996). *Grammar patterns 1: Verbs. The COBUILD Series*. London, England: HarperCollins.

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

Goldschneider, J. M., & DeKeyser, R. (2001). Explaining the "natural order of L2 morpheme acquisition" in English: A meta-analysis of multiple determinants. *Language Learning, 51*, 1–50.

Gries, S. T., & Wulff, S. (2005). Do foreign language learners also have constructions? Evidence from priming, sorting, and corpora. *Annual Review of Cognitive Linguistics, 3*, 182–200.

Gries, S. T., & Wulff, S. (2009). Psycholinguistic and corpus-linguistic evidence for L2 constructions. *Annual Review of Cognitive Linguistics, 7*, 164–187.

Han, Z. H., & Odlin, T. (Eds.). (2006). *Studies of fossilization in second language acquisition*. Clevedon, England: Multilingual Matters.

Hulstijn, J. H., Young, R. F., Ortega, L., Bigelow, M., DeKeyser, R., Ellis, N. C., … Talmy, S. (2014). Bridging the gap: Cognitive and social approaches to research in second language learning and teaching. *Studies in Second Language Acquisition, 36*(3), 361–421.

Jarvis, S., & Pavlenko, A. (2008). *Crosslinguistic influence in language and cognition*. New York, NY: Routledge.

Kasper, G., & Wagner, J. (2011). A conversation-analytic approach to second language acquisition. In D. Atkinson (Ed.), *Alternative approaches to second language acquisition* (pp. 117–142.). New York, NY: Routledge.

Klein, W. (1998). The contribution of second language acquisition research. *Language Learning, 48*, 527–550.

Kuhl, P. K. (2004). Early language acquisition: Cracking the speech code. *Nature Reviews Neuroscience, 5*, 831–843.

Lado, R. (1957). *Linguistics across cultures: Applied linguistics for language teachers*. Ann Arbor, MI: University of Michigan Press.

Long, M. H. (1983). Linguistic and conversational adjustments to non-native speakers. *Studies in Second Language Acquisition, 5*, 177–193.

Mackey, A., Abbuhl, R., & Gass, S. (2011). Interactionist approach. In S. Gass & A. Mackey (Eds.), *The Routledge handbook of second language acquisition* (pp. 7–23). New York, NY: Routledge.

MacWhinney, B. (1997). Second language acquisition and the Competition Model. In A. M. B. De Groot & J. F. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 113–142). Mahwah, NJ: Lawrence Erlbaum.

MacWhinney, B. (2000). *The CHILDES project: Tools for analyzing talk 3rd edition*. Mahwah, NJ: Lawrence Erlbaum Associates.

MacWhinney, B., & O'Grady, W. (Eds.). (2015). *The handbook of language emergence*. Oxford, England: Wiley-Blackwell.

McEnery, T., & Hardie, A. (2012). *Corpus linguistics*. Cambridge, England: Cambridge University Press.

Miller, G. A. (2009). *WordNet—About us*. Retrieved from http://wordnet.princeton.edu

Odlin, T. (1989). *Language transfer*. New York, NY: Cambridge University Press.

Pienemann, M. (1998). *Language processing and second language development: Processability theory*. Amsterdam, Netherlands: John Benjamins.

Schmidt, R. (2001). Attention. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 3–32). Cambridge, England: Cambridge University Press.

Sinclair, J. (1991). *Corpus, concordance, collocation*. Oxford, England: Oxford University Press.

Tarone, E. (1997). Analyzing IL in natural settings: A sociolinguistic perspective of second-language acquisition. *Communication and Cognition, 30*, 137–150.

Terrell, T. (1991). The role of grammar instruction in a communicative approach. *The Modern Language Journal, 75*, 52–63.

Tomasello, M., & Stahl, D. (2004). Sampling children's spontaneous speech: How much is enough? *Journal of Child Language, 31*, 101–121.

Trousdale, G., & Hoffmann, T. (Eds.). (2013). *Oxford handbook of construction grammar*. Oxford, England: Oxford University Press.

Weinreich, U. (1953). *Languages in contact*. The Hague, Netherlands: Mouton de Gruyter.

Wulff, S. (2008). *Rethinking idiomaticity: A usage-based approach*. London, England: Continuum.

Wulff, S., & Ellis, N. C. (2018). Usage-based approaches to SLA. In D. Miller, F. Bayram, J. Rothman, & L. Serratrice (Eds.), *Bilingual cognition and language: The state of the science across its subfields* (pp. 37–56). Amsterdam, Netherlands: John Benjamins.