



## Chasing the butterfly effect: Informal language learning online as a complex system

*Robert Godwin-Jones, Virginia Commonwealth University*

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### Introduction

Evidence is accumulating that a major shift is underway in the ways that second language (L2) development is taking place. Increasingly, especially among young people, that process is occurring outside of institutional settings, predominately through the use of online networks and media. That phenomenon has been particularly noticed for learners of English, as shown in recent studies of fully autonomous learners in Brazil (Cole & Vanderplank, 2016) and predominantly recreational L2 users in Europe (Kusyk, 2017; Sundqvist & Sylvén, 2016). One of the hallmarks of this kind of language development is the great variety of approaches and materials used (i.e., social media, online participation in affinity spaces, watching videos, listening to music, engaging in online learning communities). The availability of immense quantities of spoken and written content in open (or inexpensively available) online channels, most also accessible on mobile devices, opens up countless opportunities for users to mix and match as never before tools, services, media, and group participation in ways that accommodate individual L2 needs and preferences.

Understanding the dynamics at work in this development, as compared to classroom-based learning, is no easy task. L2 learners and users have a rich variety of choices in online resources and have various motives and goals in accessing L2 materials and in interacting with L2 communities. In fact, they may not be focused on language learning at all, but rather may be seeking entertainment or simply socializing (Sockett, 2014). An approach that is designed to deal with phenomena consisting of multiple, interconnected variables is *complexity theory* (CT) or complex systems theory. CT has been in use for some time in applied linguistics, dating back to the seminal work of Larsen-Freeman (1997) on chaos theory and second language acquisition (SLA). I argue here that the concept of complex systems can be especially useful in exploring informal language learning in digital environments. CT helps illuminate the dynamic processes at play; it can untangle sets of nested systems, as is the case here, with language and learners themselves being complex systems within a dynamic framework of L2 development (see Beckner et al., 2009; Ortega & Han, 2017).

Given the emphasis on uncovering differing patterns of development within complex systems, CT aligns well with qualitative analyses that track individual L2 development paths. This keeps with recent calls for a more *person-centered* approach to research in SLA (Benson, 2017; Larsen-Freeman, 2018). This is not a suggestion to revert back to a purely cognitively-oriented focus on individual skills development in isolation, but rather to apply a socio-cultural lens in considering the individual learner in situated contexts. This connects CT to ecological and constructivist approaches in SLA, which emphasize consideration of the social and political environment in which L2 development occurs (e.g., Kramsch, 2003; van Lier, 2004; Warner & Dupuy, 2018).

### Language Online: Superdiversity and Multimodality

Language, as used in digital environments, is complex. Language on the Internet has been described as a “genuine new medium” (Blyth, 2008, p. 48), using terms such as “netspeak” (Crystal, 2001, p. 41) or “oralized written text” (Yus, 2011, p. 11) to describe the dynamic mix of written and spoken modes online (see Barton & Lee, 2013). Today, language online is characterized increasingly by multimodality and

multilingualism. Digital tools and services, from text messaging and Twitter to Flickr and Facebook allow and encourage users to integrate text with images, audio, and video. Multimodal content has become widely accepted—and often expected—in digital communication. At the same time, online environments are seeing an ever-increasing mix of languages. The term *linguistic superdiversity* has been coined to describe the multilingual environment of the Internet today (Blommaert & Rampton, 2011). Blommaert (2013) associates superdiversity with three characteristics: mobility, complexity, and unpredictability. A number of studies have shown how translingual practices manifest those characteristics. These include case studies of the remixing of Japanese manga in Sweden (Jonsson & Muhonen, 2014) or the linguistic complexity of Dutch-Chinese young people (Li & Juffermans, 2011). Fanfiction studies have shown that kind of linguistic diversity as well (Sauro, 2017). A particularly emblematic case is that of a hip-hop singer in rural China who raps in a combination of local dialect, Mandarin, and English, and posts work on the Internet (Wang, 2012). The concept of *translanguaging* (García & Wei, 2014) characterizes this dynamic mix of modes and languages:

Humans make meaning by assembling linguistic signs but also by pooling language (and all their languages) together with whatever other bits of semiotic repertoire they have, to the point that meaning making is always multisensory, multimodal, and always involving much more than language. (Ortega, 2017, pp. 290–291)

Language online reflects the “complex realities of our globalized multilingual society” (Ushioda, 2011, p. 200). Lee (2017) provides many concrete examples from a variety of online environments, services and tools.

Online communities bring to the fore this rich assortment of languages and modalities. Lee (2016) summarizes this current dynamic mix of language online by asserting that “interacting or doing things with more than one language becomes an important resource for all web users (including those who are considered ‘monolinguals’ in the offline world) in a superdiverse world” (p. 119). Translanguaging practices are especially evident in social media contexts, such as in Facebook posts. Ortega (2017) reinforces Lee’s (2016) comment on the need for monolinguals to adapt to the multilingual online world:

The digital wilds are so pervasively multilingual in many cases (e.g., when we see large translocal groups of friends on Facebook with different linguistic repertoires and language ideologies) that so-called monolingual members in those affinity spaces learn to cope, let it pass, or even enjoy and celebrate multiple languages and translanguaging. They can do this by ignoring messages in languages they do not understand, by contenting themselves with only partial comprehension of those messages, or by using the automated translation function if the application has one. (Ortega, 2017, p. 296)

The linguistic complexity of Facebook extends beyond language mixing to the different contexts of language use. Sockett (2014) has shown how the many synchronous and asynchronous functions in Facebook provide a variety of user interactions and language use situations, such as online chat, posting texts or images, and commenting on others’ posts:

In order to make choices within such a complex environment, the learner needs to engage in a number of cognitive processes, including attributing a status to an item (considering it to be important, urgent, unimportant, worthy of response, etc.) and transforming information (writing about a picture or a video clip, for example). (p. 38)

Language use in Facebook involves more than transactional language and breaks from the typical speaker–listener dyad common in language learning environments. Warner and Chen (2017) have shown the potential linguistic complexity and sophistication involved in participation in Facebook interactions, such as recognizing citations, detecting irony or sarcasm, or untangling code-switching. Other recent studies of language use in Facebook examine the increasing linguistic complexity of that environment (Jonsson & Muhonen, 2014; Kulavuz-Onal & Vásquez, 2018).

Studies of online gaming have shown the richness and complexity of language use in that environment as well. Players in massive multiplayer games such as World of Warcraft (WoW) are “exposed to huge amounts of text” (Scholz & Schulze, 2017, p. 108). Communication and collaboration are central components of gameplay and provide exposure to diverse types of language. Bytheway (2015) describes that complexity:

The WoW interfaces provide a wealth of linguistic resources, including written instructions and storylines, optional pop-up tips, accessible manuals, animated film clips with spoken audio and captions, as well as access to synchronous and asynchronous (typed) chat messaging, real-time phone-like conversations with VoIP software (voice over internet protocol), and interactive wikis. Players can simultaneously discuss multiple topics using spoken and written communication tools (Blizzard Entertainment, 2012). Players can also use a variety of languages and translation tools. (p. 510)

Online gaming typically involves participants in a wide range of ancillary reading and writing activities, including visiting fan or game developers’ sites, engaging in discussion forums, or consulting help pages. There is extensive multimodality involved as well, as players make use of multiple non-verbal means to communicate, such as avatars: “In WoW, a player’s embodiment is via an avatar, who can typically gesture, emote, speak, and move about an expansive virtual space” (Newgarden & Zheng, 2016, p. 276). Informal activities online thus offer a rich supplement to the language of the classroom: “Technology-mediated environments are a worthwhile source for natural, authentic interaction which provides linguistic resources not easily available in all language classrooms” (González-Lloret, 2015, p. 58). That includes pragmatic and informal forms, in line with the priority online of communicative effectiveness over grammatical correctness (see Kramsch, 2014).

Many of the studies of language use in social media and online gaming use qualitative approaches that draw on methods borrowed from online ethnography (Androutsopoulos, 2008). These approaches have been used to reveal other interesting aspects of language use online, such as how commercial websites position English in contrast to other languages (Kelly-Holmes, 2013; for more examples, see also Lee, 2017). Androutsopoulos (2008) uses what he terms “discourse-oriented online ethnography” to investigate online language use, combining systematic observation of online sites with “direct contact with its social actors” (p. 2). His approach uses ethnographic methods to illuminate log data through triangulation, in this instance, combining conversation analysis with insights from interviews. The systematic observation of a given site or community forum provides an opportunity to examine samples of genre and user discourse that can be revealing in terms of language use in context:

Identifying controversial discussion issues in a forum can be the basis for selecting discussion threads in order to examine the identity constructions these controversies prompt. If one is interested in multilingualism, identifying discussion topics that favour the use of a minority language can be the basis for selecting threads and posts for detailed analysis of code-switching. (Androutsopoulos, 2008, p. 7)

Androutsopoulos (2008) demonstrates in his own ethnographic study of the use of hip-hop inspired language by young Germans how complex and varied such language use is—in this case, a mix of standard German, dialect, and a mishmash of English hip-hop expressions converted into pseudo-German. Clearly, phenomena such as translanguaging have the potential to disrupt the traditionally monolingual L2 development process. Warner and Chen (2017) point out that learners (and teachers) may be confronted with a potentially disorienting situation: “When asked to participate in online communities of languages other than English, learners may at first be confronted with the fact that purely monolingual spaces of, for example, German speakers, are hard to find” (p. 129). Language use online may in that way be quite different from students’ everyday offline lives (Lee, 2017).

## L2 Development Online: Navigating, Noticing, Negotiating

The term *L2 development*, rather than *language learning* or *language acquisition*, has been increasingly used to indicate that this is an on-going process and not an end point (Larsen-Freeman, 2015). *Development* also acknowledges a wider range of learning opportunities, particularly appropriate in the context of informal language learning. The understanding of the process of language development is guided by underlying theories about the nature of language, whether that be “language as grammar, language as skill or habit, language as creative activity, language as a social tool, [or] language as communication” (Kibler & Valdes, 2016, p. 97; see also Lightbown & Spada, 2013). The current view of language has been shaped by research based on corpus linguistics, discourse analysis, and related fields, which see language above all as a set of patterns and conventional word groupings. Studies examining real language exchanges show that language use is characterized by repetition, reuse, and re-purposing of chunks of language (Ellis, 2017). This has given rise to usage-based linguistics and phraseology—the study of fixed expressions and typical word combinations (Howarth, 1998). From this perspective, grammar and lexis cannot be considered independently of one another: “Corpus linguistics demonstrates that language usage is pervaded by collocations and phraseological patterns, that every word has its own local grammar, and that particular language forms communicate particular functions: Lexis, syntax, and semantics are inseparable” (Ellis, 2017, pp. 40–41). This perspective on language naturally leads to a focus in L2 development on learning conventionalized units such as formulaic sequences and frequent word groupings, or what Verspoor (2017) calls “form-use-meaning-mappings” (p. 146).

This construction-based view of language means that it is essential for the learner to have access to a sufficient volume of language in different contexts to be able to identify patterns, as well as to gain insight into how usage can vary according to formality or other contexts. The need is for exposure to real language in real and meaningful contexts. That, in fact, is the big advantage of informal language learning online: being able to engage in substantial communicative activities in authentic and meaningful contexts, supplying both more volume and more variety than is the case in instructed language learning. In this way, language is learned through meaningful experiences, and language structures emerge from repeated use:

Rather than conceptualizing language as rule based, language can be thought of as a collection of patterns that are observed through repeated use. In this sense, learners of the language notice these patterns and replicate them, as opposed to learning a concrete set of grammatical rules from a textbook. (Scholz, 2017, p. 45)

In practice, this involves on the learner’s part encountering, identifying, and re-using chunks of language, through processes such as categorization, pattern finding, and entrenchment (Kusyk, 2017). This requires repeated contact with language patterns, as well as the act of noticing these patterns (Schmidt, 1990). Research on extensive, extramural viewing of L2 videos (Sockett, 2014) as well as on multiplayer gaming (Scholz & Schulze, 2017) has shown how that is indeed possible in those environments.

Kibler and Valdes (2016) suggest that given the “proliferation of theoretical approaches to SLA and multilingualism ... [and] the increasing complexity of language use in a global society” (p. 110), there are no simple answers to the question of how to learn and teach language. It is clear, however, that the answer is not a set sequence of learning activities that acts “like a dictate regarding which specific elements or skills or functions should be learned, acquired, or developed” (Kibler & Valdes, 2016, p. 97). This is in contrast to the traditional view of language development as a “development ladder” (Larsen-Freeman, 2018, p. 62), following a “natural order of acquisition” (Krashen, 1982, p. 15). That this is still the traditional view of language learning in wide swaths of the language teaching community (at least in the United States) is evident from examining the most commonly used language textbooks (see Verspoor, 2017).

One way forward, that embraces the multiplicity of socially oriented SLA theories, is proposed by a consensus-building group of researchers (Douglas Fir Group, 2016), who envision language development as learning how to “negotiate social and linguistic action in the face of minimal common ground and maximal semiotic demands” (p. 23). For Ortega (2017), this formula encapsulates new understanding from

advances in usage-based linguistics and critical sociolinguistics:

It emphasizes language as a practice rather than a system (“social and linguistic action”), it recognizes unpredictability as a feature of all human communication (“minimal common ground”), and it underscores that meaning making is not just a matter of language signs, but of attendant multimodal semiotic resources (“maximal semiotic demands”). (p. 290)

This view underscores the complexity of the L2 learner’s task. Drawing on semiotic resources (in multiple languages) from the learner’s own repertoires and repurposing those received, language emerges dynamically, particularly as “frequently occurring and perceptually salient patterns in regular, recurring contexts of use are noticed and adapted by learners to the present situation, often a process of bricolage” (Larsen-Freeman, 2018, p. 58). As Larsen-Freeman (2018) points out, this kind of sociocognitive approach tends to blur the boundary between language use and language development. This is, in fact, even more the case when looking at language development through informal means online.

### **The Informal Learner’s Role: Assembling Resources and Enacting Identities**

If we view language as co-constructed through interactions, as patterns that emerge from repeated encounters with language in context, it means that language acquisition is very much an individualized process, with unique outcomes, specific to a learner’s experiences and goals. From this perspective, the learner’s task is not to aspire toward the model of being a native-like speaker:

The learner is not building towards an ideal version of the language which exists in abstract. Rather, the learner is building on and out of his perception of the usage of the language heard in the mouths of other language users and this construction process in the life of every language user is the only meaningful definition of what the language is. (Sockett, 2014, p. 29).

Learning informally is thus not guided by traditional perspectives of rule-based grammar, but rather in this model, structure is determined from usage. In an inductive process, learners take and re-use examples and apply them to other contexts. Indeed, in both earlier cited video watching and gaming studies, learners showed L2 development not only in recognition and understanding, but also in production, measured either through learner diaries and testing (Sockett, 2014) or through analysis of language use in in-person conversations in the target language and in recorded logs (Scholz & Schulze, 2017).

Access to resources and meta-knowledge about language and language learning are of themselves not sufficient for L2 development. The learner needs to be sufficiently motivated to invest time and energy in the process. Recent studies of “recreational language learning” (Chik & Ho, 2017) demonstrate how leisure time activities, such as watching TV series or YouTube videos, listening to popular music, and participating in social media, can be highly motivating. The motivation for engaging in such activities online is personal, not academic or institutional, driven by the “wish to be entertained, to be able to communicate with acquaintances” (Kusyk, 2017, p. 92). This phenomenon is enabled in part by the greater availability worldwide of popular forms of entertainment, such as movies, available soon after release dates through services such as Netflix, often with multiple subtitling options. This also enables L2 users to bypass national broadcasting systems that often dub movies. A similar phenomenon is underway for music through popular streaming services such as Spotify. Sockett’s study (2014) found that the frequency of accessing English language media correlated with English language development, particularly in the areas of vocabulary and idiomatic language.

Recent research into learner motivation as well as into language learning and identity has shown there is also an important affective factor at work, namely the desire and willingness to forge a L2 identity. Optimally, L2 learners will not just work to “speak another language,” but to add a new dimension to their perspective on the world: “It is paramount to understand that becoming a L2 speaker is not just mastery of a language, it is about building one’s biography and the person that is seen by others in one’s lifeworld” (Wagner, 2015, p. 90). That new dimension to one’s identity, as one participates in online L2 communities,

will optimally shift the individual from L2 learner to L2 user, as learners gain both proficiency and confidence. Learning and identity are bound to one another, so that identity becomes constituted on the go as “particular forms of semiotic potential, organized in repertoires” (Blommaert, 2005, p. 207). L2 identities may be connected with future participation in imagined communities (Norton, 2001). This plays an important role in informal language learning online, particularly for learners of English, impelled by personal aspirations, connected with popular culture or upward social mobility. Unfortunately, in the classroom, these aspirations are sometimes stifled as “language learning activities that posit the native speaker as an ideal model are often in danger of creating dis-identificatory moments of non-participation and marginalization” (Murphey, Chen, & Chen, 2005, p. 95).

A useful concept in considering learner motivation is that of *transportable identities* (Van De Mieroop & Clifton, 2012):

Transportable or “categorical” identities reflect visible or culturally claimable characteristics of the learner, such as nationality, first or primary language(s), presented gender, age, and ethnicity, that can possibly be invoked or oriented to during interaction, but may otherwise remain latent or implicit. (Thorne, Sauro, & Smith, 2015, p. 219)

Different transportable identities are instantiated as linguistic repertoires when needed or evoked in particular contexts. These repertoires are comprised of not only language skills, including vocabulary and grammar, but also include pragmatic and strategic competencies, including knowledge of the cultures of use within a given online community (Thorne, 2003). The degree to which a L2 learner fully participates in online L2 activities or communities may vary depending on knowledge and skills (both linguistic and cultural), but also on the rules and regulations, conventions, or attitudes applicable to newcomers.

Motivation is contextual and varies with the situation. If users are motivated to create new, enabling identities, they become invested in community participation: “The construct of investment seeks to make a meaningful connection between a learner’s desire and commitment to learn a language, and the language practices of the classroom or community” (Norton & Toohey, 2011, p. 415). This view contrasts with the traditional static model of motivation and stresses motivational changes based on context:

The notion of investment recognizes that learners often have variable desires to engage in the range of social interactions and community practices in which they are situated. Previous work on motivation frequently conceived of individuals as having unitary, fixed, internalized and ahistorical ‘personalities’. Investment, on the other hand, sees language learners as having complex identities, which change across time and space, and which are constructed on the basis of the socially given, and the individually struggled-for. (Norton & Toohey, 2011, p. 420)

Such an “invested” identity tends not to develop in classroom settings, but “is far more likely to emerge from critical experiences of using the language outside the classroom in situations that destabilize identity” (Reinders & Benson, 2017, p. 567). Those might be critical events that happen in the context of navigating in-person situations in a foreign culture, but could occur online as well. Critical incident analysis could be used in either context (Reinders & Benson, 2017). Reflection on such incidents can lead to intercultural insights (see McConachy, 2017).

What complicates language development is not just the complexity of language or of the language development process, but also the complexity of the individual learner (see Dörnyei, 2017). These subsystems constitute together a dynamic, interconnected system in which, “identity, practices, and resources are inextricably linked and mutually constituted” (Norton & Toohey, 2011, p. 414). One of the complexities is that starting points for informal language learning are varied. That includes individual differences among L2 learner or users: age, aptitude, motivation, willingness to communicate, learner anxiety, emotion, beliefs, learning strategies (Larsen-Freeman, 2018). In online environments, additional factors come into play, including aptitude or comfort level in using digital communication tools and services, newbie or habitué status in online communities, ability to cope with multilingualism, mode of access (mobile, voice commands), context of access (standing in line at the grocery store versus relaxing at home),

and associated degree of focus or interest. These individual differences contribute to a variety of possible identity enactments: “global identities (age, ethnicity, language affiliation, etc.), local community-assigned identities, and, finally, temporary identities, which can arise from a particular exchange” (Klimanova & Dembovskaia, 2013, p. 71). These identity formations are dynamic and are shaped by learner attributes that “display a considerable amount of variation from time to time and from situation to situation” (Dörnyei, 2009, p. 232). Many researchers will likely agree with Dörnyei’s contention that the “traditional notion of individual difference factors, conceived as stable and monolithic learner characteristics, is outdated” (2009, p. 243). Changing and adaptive learner characteristics make L2 development online complex and unpredictable.

## Complexity Theory and Applied Linguistics

CT studies how complex systems are affected over time by changes in one or more of a variety of interconnected variables (Cameron & Larsen-Freeman, 2007). Because of their interconnectedness, even minor changes in one variable can have major and unpredictable effects on other variables, thus changing the dynamics of the system as a whole and influencing outcomes. As applied to language learning, CT (or the variants, *complex adaptive systems* and *complex dynamic systems*) emphasizes the importance of considering both cognitive and environmental factors, posits nonlinear trajectories in language learning, and stresses the importance of considering L2 development over time.

Although CT originally was used in mathematics and the natural sciences, the complexity of human language use and development in today’s world justifies its use in SLA and computer-assisted language learning (CALL; see Schulze & Scholz, 2016). What characterizes above all the complex systems approach is the “focus on change and development” (De Bot, 2011, p. 123). In the CT paradigm, change and development occur within the nested subsystems of language, language development, and L2 online use. The systems themselves, along with the variables within them, are interconnected, so that changes in one system or variable can affect other variables and guide outcomes in different directions. Hiver and Al-Hoorie (2016) point out that the usefulness of CT has been shown in a diverse set of domains related to language research, from L2 anxiety to willingness to communicate. A 2017 survey by Larsen-Freeman lists over 30 different areas within the fields of SLA and CALL in which CT is used (pp. 24–25). Dörnyei (2014) provides an introduction to CT with practical research strategies, while the monograph by Verspoor, Lowie, van Geert, van Dijk, and Schmid (2011) offers an informative how-to section on conducting language research using complex systems theory. Hiver and Al-Hoorie (2016) provide an insightful introduction to the use of CT in SLA through the analysis of one particular study (Spoelman & Verspoor, 2010) that investigated a Dutch adult learner of Finnish using CT. A recent monograph on CT and language development (Ortega & Han, 2017) offers a variety of perspectives, including a chapter on the integration of CT-derived insights into classroom teaching (Verspoor, 2017).

A crucial aspect of CT is the inseparability of learner characteristics or variables and learner contexts, viewed dynamically as mutually linked and evolving. If we add to the already complex nature of L2 identity formation the great variety of possible online situations in which the L2 may be used, we can see that the intricacy of the relationship of L2 users and learner to the environment “requires a more holistic, ecological, and relational systems account” (Larsen-Freeman, 2018, p. 59). De Bot, Lowie, and Verspoor (2007) outline how that might look using a CT approach:

A language learner is regarded as a dynamic subsystem within a social system with a great number of interacting internal dynamic sub-sub systems, which function within a multitude of other external dynamic systems. The learner has his/her own cognitive ecosystem consisting of intentionality, cognition, intelligence, motivation, aptitude, L1, L2, and so on. The cognitive ecosystem in turn is related to the degree of exposure to language, maturity, level of education, and so on, which in turn is related to the SOCIAL ECOSYSTEM, consisting of the environment with which the individual interacts. (p. 14)

CT insists that development be viewed holistically within nested systems, looking at emerging patterns, rather than isolating variables. CT-based studies move away from simple causal exclamations, instead focusing on description and interpretation:

Explanation of development is notoriously difficult: Many variables may have an impact on the learning of a foreign language, the variables are likely to interact over time, and some variables may be effective during one stage of development but not during another stage (De Bot, 2011, p. 124).

In this way, CT offers an alternative to much of research in CALL, which tends to focus on how one particular approach or application affects L2 development. CT emphasizes the interconnectedness of the “complex constellation” of learner characteristics (Dörnyei, 2014, p. 84) with the complexity of language development.

Studies using CT may be quantitative or qualitative, or (ideally) use a mixed-methods approach, such as in the *idiodynamic approach* in MacIntyre and Legatto (2010). Indeed, one of the advantages of a CT approach is the inherent logic of combining quantitative and qualitative methods (see Dörnyei, MacIntyre, & Henry, 2015). Often, collecting quantitative data is a starting point for CT-oriented qualitative studies. Quantitative studies find ways to visualize language development, using modeling approaches that, when necessary, quantify general conceptual notions. Modeling has a built-in constraint that “inevitably implies a limitation on the number of variables we want to look at, which is a form of reductionism that a dynamic kind of thinking opposes” (De Bot, 2011, p. 126). Qualitative research with CT tends to use case studies and a narrative approach. In either case, to study L2 development from a CT perspective, researchers need sufficient individualized data collected over time:

If we really want to know how an individual (or group) develops over time, we need data that is dense (i.e., collected at many regular measurement points), longitudinal (i.e., collected over a longer period of time), and individual (i.e., for one person at a time and not averaged out). (Van Dijk, Verspoor, & Lowie, 2011, p. 62)

The emphasis on measuring L2 development at different points is a crucial aspect of CT in that the focus is on development as a whole over time. There are often exhortations in CALL research for more longer-term studies, but for understandable practical reasons, that happens infrequently.

The emphasis on the diversity of individual development paths in CT studies poses a research difficulty in CALL and SLA generally, in that the typical procedure is to examine variables in relative isolation and to seek cause-and-effect relationships between isolated factors (see Dörnyei, 2014). The use of group averages, as is the general practice in quantitative studies (and sometimes in qualitative studies as well), has limited relevance for CT research. Dörnyei (2014) points out that in a study of Chinese learners of English, Larsen-Freeman (2006) “identified a composite developmental trajectory of this group, but when she disaggregated the group data, she found unique and different developmental paths, none of which coincided with the group results” (p. 83). This illustrates that general tendencies observed in a group may not yield useful information in terms of individual outcomes. Indeed, Dörnyei remarks that quantitative research “irons out idiosyncratic details that are at the heart of understanding development in dynamic systems” (2014, p. 83). That is demonstrated in a recent study on listening comprehension, in which a traditional L2 study was reconceptualized using a CT approach, yielding more informative results (Becker & Sturm, 2018). The focus in CT studies is both on individual learners and on patterns of successful L2 development, often best accomplished with a mixed-methods approach, in which general tendencies are identified statistically and individual learner development is examined using narrative methods.

Murray and Lamb (2018) offer the following recommendations for principles guiding research from a complex systems perspective, based on Larsen-Freeman and Cameron (2008):

View the context as part of the system being studied, examine dynamic processes and changing relationships, look for reciprocal relationships rather than cause and effect sequences, and move



beyond thinking in terms of binary opposites ... researchers might consider case study methodology, action research, ethnography, or narrative enquiry. (Murray & Lamb, 2018, p. 258)

Murray and Lamb (2018) suggest that CT is particularly suited for research in the area of learner autonomy. Indeed, in the contributions to the monograph on autonomy they edit, the researchers state that there is a “leitmotif, which threads its way through of most of them—a stream of references and allusions running just beneath the surface. This theme is complexity ... the authors frequently incorporate constructs and notions prevalent in this approach” (Murray & Lamb, 2018, pp. 249–250). This reflects the comment by Hiver and Al-Hoorie (2016) that CT principles have reached a “critical mass” (p. 743) in the field of SLA research.

Insights from CT that highlight the interdependence of learner and context, while striving to identify individual learning trajectories, reflect and complement other SLA theories. Activity theory argues against treating students as “processing devices,” and for understanding them “as people, which in turn means we need to appreciate their human agency” (Lantolf & Pavlenko, 2001, p. 145). Positioning theory (Davies & Harré, 1999) highlights the individual learner, stressing the centrality of position or status in “how it is that people do being a person” (p. 7) and examining how language shapes identity and thus influences learning (for a study that combines positioning theory with CT, see Wu, in this issue). Actor network theory (Latour, 2005) stresses the role of agents, extending that concept from the learner as agent to include tools and artifacts—in our context, technologies and curriculum materials—and learning settings (Little & Thorne, 2017). Socio-cultural theory (Lantolf & Thorne, 2006) stresses L2 development as a process of social mediation and thus shares with CT a greater emphasis on the active and dynamic role of environmental contexts (see Lantolf, 2006). CT evinces a number of similarities to ecological approaches (Kramsch, 2003; van Lier, 2004), which also look at L2 learning from a wider perspective.

## **Informal L2 learning as a Complex System: Nonlinear, Self-Organizing, Emergent**

Informal language learning lends itself particularly well to study from a CT standpoint, as seen in recent CT-oriented studies on English learners in Brazil and Europe (Cole & Vanderplank, 2016; Kusyk, 2017; Sockett, 2014), on online gaming (Scholz, 2017; Scholz & Schulze 2017), and on corpus-based learning (Ellis, O’Donnell, & Römer, 2013). I argue that there are three characteristics of informal language learning that mesh well with a CT approach, namely the *nonlinear development path* (especially as compared to typical instructed language learning), its *self-organizational character* (L2 users and the Internet combine to create a unique, ever-evolving set of resources), and the *focus on emergent outcomes* (widely variable and unpredictable learning, often incidental in nature). We will look at each in turn.

### **Nonlinear Development: The Butterfly Flaps Its Wings**

One of the central characteristics of dynamic systems is the “sensitive dependence on initial conditions” (De Bot et al., 2007, p. 15). This references the unpredictability in the development of complex systems and has been popularized in the image of the butterfly effect: “Does the flap of a butterfly’s wings in Brazil set off a tornado in Texas?” (De Bot et al., 2007, p. 15). The idea is that minor variations in initial conditions may have an unpredictable and disproportionate impact on outcomes. De Bot et al. (2007) maintain that there is “a growing body of evidence that suggests that initial conditions are precursors of the development of a second language” (p. 15). They cite, as an example, studies that have shown the importance of phonological awareness as a predictor of reading acquisition in the native language, with a subsequent influence on the development of other language skills. In turn, native language literacy is seen as a crucial component for successful L2 acquisition as “phonological awareness and word recognition skills in the L1 affect word recognition in L2” (De Bot et al., 2007, p. 15). They conclude the following:

From this evidence, it can be tentatively inferred that very subtle and overt problems in early childhood, like a middle-ear infection, may have a long lasting effect at all levels of second language acquisition. ... Difficulties in SLA are at least partly due to initial conditions butterflying their way throughout the process of second language acquisition. (De Bot et al., 2007, p. 15)

One should note the tentativeness here in cause–effect attribution, typical in a CT approach, which looks for emerging patterns, rather than explanations or predictions.

If we consider the “initial conditions” for informal language learning, it is evident that there will be substantial variations among users or learners. Those may include access and technology issues, L2 background, the level of personal needs or interests, knowledge of other languages, and previous online experiences. For the Brazilian “fully autonomous self-instructed learners” in Cole and Vanderplank (2016, p. 34), interviews with the participants revealed the following starting points:

- Their acquisition had begun as a by-product of committed engagement with informal sources of English such as television and music, which they accessed online.
- They enjoyed using English in their spare time and participated in activities in which English was the shared language, especially in online environments (p. 34).

The different motivations, L2 uses, and varied time and place settings of informal learners contrast with traditional instructed language learning environments, where, as Sockett points out, initial conditions tend to be “extremely uniform, with classes of children learning the same items from the same textbooks at the same time” (2014, p. 22). For most L2 users and learners today, there may be a similar initial situated identity, determined by an institutional language-learning environment: “L2 learners are often ascribed defined roles based on their physical characteristics, history of classroom interactions, and institutional positioning that ostensibly correlates with language ability” (Thorne et al., 2015, p. 229). Becoming L2 users online enables creation and then enactment of transportable identities, providing multiple opportunities to participate in online L2 activities and communities. Studies in fanfiction (Black, 2006; Lam, 2000, 2006; Sauro, 2017) have demonstrated how the transformation from institutional (and sometimes poorly performing) L2 learner to confident and capable L2 user can happen.

The aforementioned transformation process does not follow a predetermined path, but is likely to be unpredictable in its development. There are likely to be multiple interconnected variables at play, such as “habits and activities in the L2, motivation, aptitude, and working memory capacity” (Kusyk, 2017). In their study of L2 development through gameplay, Scholz and Schulze list four collective variables as clusters of initial conditions: “rationale for studying German, previous language-learning experience, gaming proficiency, and computer proficiency” (2017, p. 105). It is not just the starting points that vary in L2 development. The process itself, as any L2 learner can testify, is not a straightforward progression with steady and consistent improvement. Instead, the learner typically makes advances and reaches plateaus, but also experiences setbacks and frustrations. This is likely to be even more evident in informal learning environments that lack the supportive structure of institutional language learning.

An additional factor in participation in activities such as fan communities or online gaming is the degree of individual motivation to participate. Studies in L2 motivation have shown its complexity as it “emerges and dynamically ebbs and flows” (Sampson, 2015, p. 11). The open environment of the Internet can be a personally empowering factor in L2 development: “Online use environments can lead to a lower affective filter by giving users unprecedented control, both in terms of choosing input relevant to their interests and in the ability to manipulate the speed of their interaction with that input” (Cole & Vanderplank, 2016, p. 33). A recent edited volume examines learner motivation from the perspective of CT (Dörnyei, Henry, & MacIntyre, 2015). It is clear that being highly motivated is one of the salient initial conditions for recreational L2 users and learners.

### **Self-Organization: Life at the Edge of Chaos**

While motivation and the affordances or constraints of individual resources will shape the experience of individuals engaged in informal language learning, the dynamics of the system itself (i.e., the combination of learner, learning process, and learner contexts, specifically the online environment) are at play as well. Larsen-Freeman (1997) points out that “languages go through periods of chaos and order as do other living systems. Furthermore, their creative growth occurs at the border between these two” (p. 158). This border between chaos and order, seen as “the edge of chaos” (Finch, 2010, p. 423), demonstrates “the capacity for

learning that complex adaptive systems have when they are neither settled nor chaotic” (p. 424). Complex systems are considered to have a capacity for self-organization that “aims to increase the orderly nature of the initially transient, fluid, and nonlinear system behavior” (Dörnyei, 2014, p. 84). Typically, self-organization occurs through a series of stages, as the system moves through different states of equilibrium and change, eventually reaching a new and different configuration.

From a CT perspective, all the elements of the system are subject to continuous change. However, CT also recognizes stable states in system behavior:

Dynamic systems are known to self-organise, as a result of which they can settle into preferred states—referred to as attractor states—during their development. Interestingly, some behavioural outcomes of the system’s self-organisation process are so stable that they seem to be programmed or hardwired; an example is that most children learn to walk and speak a language up to an advanced level. (Waninge, Dörnyei, & De Bot, 2014, p. 706)

The states of stability and L2 development might be mastery of certain structural elements, such as being able to use correctly all 15 cases in Finnish (Hiver & Al-Hoorie, 2016). This enables a new stage of development, a “phase transition” (Larsen-Freeman, 2017, p. 16). There may be “stable attractors” which provide a continuous, structuring component to user actions, as Sockett (2013) describes in connection with French online learners of English: “Stable attractors, such as on-going relationships or the on-going narratives of favourite television series, play an important role in driving the continued interactions which allow second language development to take place” (p. 60).

Using the concept of *attractor basin* to describe the range and strength of an attractive state, Sockett (2014) gives the example of the use of subtitling in extramural video watching:

There is a demonstrable evolution over time of choices related to subtitle use. ... There is a movement from foreign language subtitles to English subtitles as language proficiency increases. To use the idiom of DST [Dynamic Systems Theory], foreign language subtitling here plays the role of a basin attractor state. Evolution of the system is initially helped by the presence of foreign language subtitles as it enters the initial downslope into the basin. As the system continues to evolve in time and language proficiency increases, it reaches the upslope of the basin and foreign language subtitling becomes a hindrance to comprehension. (p. 53)

Attractor states could be related as well to social relationships, developed through online L2 use, such as friendships reaching a particular level of comfort and trust, enabling the relationship to rise to a higher level of intimacy.

A related concept in CT is co-adaptation, through which system elements (agents, environment) adapt in response to each other. In CT, context is not seen just as a background factor, but as dynamically engaged within the system (i.e., subject to change). This is a phenomenon familiar to classroom instructors, in which the environment (e.g., the activities of in the language classroom) adapts to agents (e.g., students needing more explanation or more practice than anticipated). In online language learning, the resources made available by the environment (the Internet) shift depending on user actions (i.e., showing subtitles or not). Sockett (2014) gives the example of students listening to popular music as a way to learn English but seeking out lyrics available online to read while listening:

This concurrent use of two sources is interesting in that it illustrates how learners can subconsciously create learning systems for themselves and unique combinations. This may be seen as a system level phenomenon, since neither the lyrics site nor the audio file can individually facilitate learning to the extent that they can combination. (p. 46)

In other instances, L2 users may make adaptations to the environment in order to move out of a *repeller state* (i.e., an undesirable point of stability). Chik and Ho (2017) give the example of using YouTube videos for learning Spanish, only to find an episode is missing:

After watching four episodes of *La Mappa Misteriosa* (BBC), Alice was prepared to continue with the series, only to discover that the remaining episodes were not available on YouTube. This sudden change created a level of anxiety and uncertainty as she felt her ‘established’ learning pattern was being disrupted. (p. 167)

In this case, the student’s frustration results in moving on to a different resource, namely participating in a commercial language learning service, thus co-adapting the system to her needs.

The dynamic co-adaptive character of informal language learning online is particularly evident in participatory, Web 2.0 activities. Reading and writing while participating in online communities can be a major contributor to L2 development. In this way, resources are developed over time, so that instead of remaining static, web sites, services such as social network sites, discussion forums, or other affinity sites grow and change. Users change the environment as they themselves change and develop in response. Neither learner nor environment are static: “Learning is a social process in which culturally and historically situated participants engage in culturally-valued activities, using cultural tools. They thus develop the sorts of behaviors required for participation, and in so doing, change the activities and the tools” (Norton & Toohey, 2011, p. 419). Of course, the digital environment is changing and self-organizing today as well through automatic processes, such as sensors, tracking devices, and public cameras. In the process, profiles are being constructed in a self-assembly process, often without our approval or even knowledge. The ever-growing ubiquity of mobile devices, along with the increased presence of connected wearable devices and objects (*Internet of things*), will only further build and complicate our interactions with the digital world.

### **Emergent Outcomes: The Dance Goes on**

The nonlinearity of complex systems means that outcomes are unpredictable. De Bot et al. (2007) use the image of dancers to describe the process:

The dance metaphor is particularly well chosen to explain some of the basics of the CT approach. Based on very simple procedures (steps) carried out in coordinated fashion in dyads, complex patterns emerge from the interaction between the two dancers, and even increasingly more complex and unpredictable patterns will emerge over time when one pair of dancers interacts with other pairs on the dance floor. (p. 9)

*Emergence* is understood as the “spontaneous occurrence of something new” (Larsen-Freeman, 2017, p. 15)—in this example, the eventual configuration of the dance and dancers. Changes in sub-system components (the addition of more dancing couples) leads to new configurations. The dance becomes more intricate when we consider the many additional potential “partners” that can be found online. Larsen-Freeman points out that due to the availability of “augmented reality, game based learning, and other innovative uses of mobile services ... learners will be more able to pursue differentiated language goals” (2018, p. 65). The outcomes of their online L2 activities will be shaped by those goals and by the unique mix of resources used.

The dynamics of complex systems—the continual flux and inter-connectedness of variables—make it impossible to specify cause and effect. Indeed, that is a hallmark of the CT approach:

In a dynamic approach, the goal is not to list possible causes for change and development but to describe the process of change and development itself by means of tracing the iterative change over time: Which components in the system change from one moment to the other and how they influence each other over time. In a dynamic approach, the multitude of influences is acknowledged and no claims about the unique contribution of single factors are made. (De Bot, 2011, p. 125)

One of the approaches that is used to describe development paths or trajectories is known as *retrodiction* (the opposite of prediction), that is, working backward from end states to examine stages of development and variables that (in individual cases) may have led to those outcomes (Larsen-Freeman & Cameron, 2008). The goal is to describe *signature dynamics*, namely the mechanisms in system development that contribute to particular outcomes (Dörnyei, 2014; Hiver & Al-Hoorie, 2016). Retrodictive methods enable researchers

to focus on successful learning histories, looking at what resources and approaches were used at different stages of the learning process. Scholz and Schulze (2017) used retrodiction to study the different paths taken by gamers in terms of language development, analyzing the unique combinations of user characteristics and actions at play: “We aim to understand exactly when and why certain linguistic constructions might have been developed, and how they had been further utilized both in-game and outside of game as the gameplay experience continues” (p. 109). They stress the importance in this methodology of having a sufficient volume of user data, as well as being able to follow development over time. This allowed them to identify likely patterns that contributed to L2 development, namely “time-in-game, willingness to communicate in game, reflection on in-game experiences” (p. 112).

Dörnyei (2014) describes in detail the process of *retrodictive qualitative modeling*. He points out that results from such studies are geared to individual users, and thus, generalization is problematic. However, although predicted outcomes are uncertain, such studies can point to possible, or even likely, results: “We CAN understand salient patterns—or essential underlying mechanisms—associated with typical system outcomes” (p. 89). As Dörnyei (2014) points out, this kind of qualified hypothesis is not unfamiliar to practicing language teachers:

They will have experienced on many occasions that something that works with one student or one class may not work with another, and a particular strategy may not even work with the same student or the same class on another occasion. (p. 89)

Indeed, the language classroom itself is another complex system, with uncertain and sometimes surprising outcomes.

## Conclusion: The Learner as a Person

Much of what characterizes L2 development from a CT perspective may seem common-sense or second nature to language teachers. As language teachers, we have all experienced the nonlinearity of language development, the interconnectedness of student performance and classroom dynamics, or the peaks and valleys of individual L2 development. However, CT-derived perspectives can provide helpful reminders of important aspects of language and language learning. Language is not fixed and static, but rather “a dynamic system that is constantly being transformed through use” (Larsen-Freeman, 2018, p. 58). This is not a rationale for abandoning the teaching of morphology or syntax, but rather a call for making students aware that rules are not absolute dictates, but rather frequent patterns:

Language is not an analytical system in which small parts make a whole, but a holistic system that is more than the sum of its parts; however, it may also contain regularities that have emerged through use and can be seen as entrenched patterns or ‘attractors’ in CDST terms [Complex Dynamic System Theory]. (Verspoor, 2017, pp. 145–146)

Verspoor (2017) offers concrete and illuminating suggestions for how to include insights from CT and usage-based linguistics into classroom-based communicative language learning (see also Rouse-Malpat & Verspoor, 2018).

CT also draws our attention to the fact that language learning, whether it be instructed or autonomous online, remains, in spite of all curricular plans and logical syllabi, nonlinear and unpredictable. It serves to remind us to use caution in assigning simplistic causal explanations for complex interactions. The emphasis on the variety of individual trajectories accords with developing views within SLA that, as Larsen-Freeman (2018) remarks, “emphasis must be placed on the individual learner/person, a noteworthy and perhaps ironic trend in these days of ‘big data’ across many different areas of inquiry” (p. 63). It may indeed seem ironic initially to focus on the individual at a time of big data, however if done in appropriate and ethically responsible ways, data (especially learner corpora) can be very helpful in identifying individual variation in L2 development, as well as to supply the learner models that make possible individualized learning environments (see Godwin-Jones, 2017a). Case studies provide information about unique learner

development, and together, they constitute a rich resource: “Ethnographic, narrative, and other forms of qualitative research ... have now produced a rich database of individual case studies that look much more like fully fleshed-out portraits of identifiable individual learners” (Benson, 2017, p. 7). These studies provide insight into different approaches to language development that may be effective, given particular initial conditions and on-going choices of resources.

Taking into consideration the many variables at play in informal language learning points to the importance of consideration of the language learning environment as a totality. That environment goes beyond the binarity of two spaces, formal and informal (Benson, 2017). Murray and Lamb (2018) and Reinders and Benson (2017) discuss the growing role of informal or semi-formal spaces for language learning, such as community centers hosting heritage language classes, language cafés in educational institutions, or self-study centers associated with institutional language programs. Magno e Silva proposes viewing learners and their learning as “language learning systems” (2018, p. 230). Such an ecological approach to language learning takes into consideration a host of factors:

The language learning system would encompass the learners comprised of their various nested systems (cognitive, biological, affective, etc.), their teachers, the materials, the spaces they move across, and the places for learning that emerge as they interact with and within these spaces. (Murray & Lamb, 2018, p. 258)

Murray and Lamb (2018) point out that adopting a learning systems perspective would allow teachers to view what happens in the classroom as only one mode in a learner’s personal learning system.

Through a focus on individual learner paths, we are coming to see L2 learners as people, helping students use language “to accomplish the ways of ‘being-in-the-world’ ... that they desire” (Kibler & Valdes, 2016, p. 111). Increasingly, it has been recognized that the social and political realities of learners play a crucial role in their language development: “If FL [foreign language] education is to take learners seriously as legitimate users of the language, scholars and instructors must consider the different ways in which their students could imagine engaging with the world beyond the context of classroom” (Warner & Dupuy, 2018, p. 124). On the one hand, that might involve, as Warner and Dupuy (2018) write, engaging in critical literary pedagogy or peace education:

Being an active designer of social futures involves developing a sense of agency and expression on one’s own behalf. At the same time, it calls on a recognition on the part of learners and educators that the particular texts, contexts, and discourses with which we make meaning have an ethical dimension vis-à-vis others. (p. 124)

On the other hand, it can mean focusing on vulnerable groups of individuals, such as “marginalized multilinguals” (Ortega, 2017, p. 293) or refugees (Duff, 2014). Individualized case studies can be helpful in that regard (Duff, 2014), as in the studies of a single Turkish immigrant (Polat & Kim, 2014), of Chinese migrants to the Netherlands (Juffermans, Blommaert, Kroon, & Li, 2014), of immigrant children (Vandommele, Van den Branden, Van Gorp, & De Maeyer, 2017), or of inner-city youth (Smith, Pacheco, & de Almeida, 2017). The validation of multilingualism is an important step in that process (see Kramsch, 2014; Ortega, 2017).

An awareness of these issues in classroom instruction is important. That means taking the difficult step of refraining from putting the native speaker forward as a model and goal of language instruction. That entails moving from treating L2 learners as “double monolinguals” to instead leading them to be “emergent multilinguals” (Ortega, 2017, p. 304). Validating multilingualism is easier to do through online resources, hence the importance of recognizing and encouraging extramural language learning. From a CT perspective, the classroom is itself a complex system. But, it should also be seen as a subsystem in a larger L2 environment, incorporating online affinity spaces, diaspora communities, and local networks. Using mobile technology offers one avenue for building bridges across these different systems (Godwin-Jones, 2017b). Allowing mobile devices to be part of the classroom learning experience acknowledges the reality of today’s integrated, complex L2 development environment (Godwin-Jones, 2018).

Raising awareness of L2 development dynamics entails integrating into instructed language learning rich and regular opportunities for individual reflection and group discussions using learner diaries, class blogs, or Facebook groups. Developing critical reflexivity and multilingual awareness might involve actions such as examining local settings as linguistic landscapes or inviting students to engage in ethnographic studies (online or face-to-face). Students might be asked to write their own language learning histories. Such activities may lead students to critical thinking about the role of language in society, as well as their own social responsibilities. Murphey et al. point to how having students write language learning histories may lead to reflection on “crucial experiences” happening outside the classroom, which “can create great investments in learning” (2005, p. 104). Reinders and Benson (2017) advocate the use of critical incident analysis, through reflective writing or stimulated recall to help learners focus. Encouraging students to express openly their feelings should be part of that reflective process (see Busch, 2015; Klimanova & Dembovskaya, 2013; Murray & Lamb, 2018).

Viewing students as engaged and authentic members of society—not just as L2 learners—makes the language experience potentially more meaningful to their personal lives and may lead them to see their L2 as an integral part of who they are. This perspective on the learner’s context further extends the L2 learning complex, from subsystems of language and language learning to engaged citizenship in the world (Byram, Golubeva, Hui, & Wagner, 2017). For language teachers, this calls for a recognition of classroom learning as one variable (and a complex one itself) within a larger endeavor. It also means looking for new ways to assess and validate learner activities from a wider perspective, entailing possibly development of teachers’ “own indicators of learning” (Kibler & Valdes, 2016, p. 111; see also Ortega, 2017). They should consider what role factors such as multilingual and global awareness should play in their L2 learning goals. In the process, it may be that instructors will need to supplement existing curriculum materials, or even, as Warner and Dupuy (2018) suggest, “subvert existing textbooks” (p. 122).

## References

- Androutsopoulos, J. (2008). Potentials and limitations of discourse-centred online ethnography. *Language@Internet*, 5(9), article 8. Retrieved from <http://www.languageatinternet.org/articles/2008/1610/androutsopoulos.pdf>
- Barton, D., & Lee, C. (2013). *Language online: Investigating digital texts and practices*. London, UK: Routledge.
- Becker, S. R., & Sturm, J. L. (2018). Using metacognitive strategies to induce phase shifts. In A. Tyler, L. Ortega, M. Uno, & H. Park (Eds.), *Usage-inspired L2 Instruction: Researched pedagogy* (pp. 165–185). Amsterdam, Netherlands: John Benjamins.
- Beckner, C., Blythe, R., Bybee, J., Christiansen, M. H., Croft, W., Ellis, N. C., ... , Schoenemann, T. (2009). Language is a complex adaptive system: Position paper. *Language Learning*, 59(S1), 1–26.
- Benson, P. (2017). Language learning beyond the classroom: Access all areas. *Studies in Self-Access Learning Journal*, 8(2), 135–146.
- Black, R. W. (2006). Language, culture, and identity in online fanfiction. *E-learning and Digital Media*, 3(2), 170–184.
- Blizzard Entertainment (Producer). (2012). *World of Warcraft*.
- Blommaert, J. (2005). *Discourse: A critical introduction*. Cambridge, UK: Cambridge University Press.
- Blommaert, J. (2013). *Ethnography, superdiversity, and linguistic landscapes: Chronicles of complexity*. Bristol, UK: Multilingual Matters.
- Blommaert, J., & Rampton, B. (2011). Language and superdiversity. *Diversities*, 13(2), 1–21.

- Blyth, C. (2008). Research perspectives on online discourse and foreign language learning. In S. S. Magnan (Ed.), *Mediating discourse online* (pp. 47–70). Amsterdam, Netherlands: John Benjamins.
- Busch, B. (2015). Expanding the notion of the linguistic repertoire: On the concept of *Spracherleben*—The lived experience of language. *Applied Linguistics*, 38(3), 340–358.
- Byram, M., Golubeva, I., Hui, H., & Wagner, M. (Eds.). (2017). *From principles to practice in education for intercultural citizenship*. Bristol, UK: Multilingual Matters.
- Bytheway, J. (2015). A taxonomy of vocabulary learning strategies used in massively multiplayer online role-playing games. *CALICO Journal*, 32(3), 508–527.
- Cameron, L., & Larsen-Freeman, D. (2007). Complex systems and applied linguistics. *International Journal of Applied Linguistics*, 17(2), 226–240.
- Chik, A., & Ho, J. (2017). Learn a language for free: Recreational learning among adults. *System*, 69, 162–171.
- Cole, J., & Vanderplank, R. (2016). Comparing autonomous and class-based learners in Brazil: Evidence for the present-day advantages of informal, out-of-class learning. *System*, 61, 31–42.
- Crystal, D. (2001). *Language and the Internet*. Cambridge, UK: Cambridge University Press.
- Davies, B., & Harré, R. (1999). Positioning and personhood. In R. Harré & L. van Langenhove (Eds.), *Positioning theory: Moral contexts of intentional action* (pp. 32–52). Oxford, UK: Blackwell.
- De Bot, K. (2011). Epilogue. In K. De Bot, W. Lowie, & M. Verspoor (Eds.), *A dynamic systems theory approach to second language acquisition: Methods and techniques* (pp. 123–127). Amsterdam, Netherlands: John Benjamins.
- De Bot, K., Lowie, W., & Verspoor, M. (2007). A dynamic systems theory approach to second language acquisition. *Bilingualism*, 10(1), 7–21.
- Dörnyei, Z. (2009). Individual differences: Interplay of learner characteristics and learning environment. *Language Learning*, 59(S1), 230–248.
- Dörnyei, Z. (2014). Researching complex dynamic systems: ‘Retrodictive qualitative modelling’ in the language classroom. *Language Teaching*, 47(1), 80–91.
- Dörnyei, Z. (2017). Conceptualizing learner characteristics in a complex, dynamic world. In L. Ortega & Z.-H. Han (Eds.), *Complexity theory and language development: In celebration of Diane Larsen-Freeman* (pp. 79–96). Amsterdam, Netherlands: John Benjamins.
- Dörnyei, Z., Henry, A., & MacIntyre, P. D. (Eds.). (2015). *Motivational dynamics in language learning*. Bristol, UK: Multilingual Matters.
- Dörnyei, Z., MacIntyre, P. D., & Henry, A. (2015). Introduction: Applying complex dynamic systems principles to empirical research on L2 motivation. In Z. Dörnyei, A. Henry, & P. D. MacIntyre (Eds.), *Motivational dynamics in language learning* (pp. 1–7). Bristol, UK: Multilingual Matters.
- Douglas Fir Group. (2016). A transdisciplinary framework for SLA in a multilingual world. *Modern Language Journal*, 100(S1), 19–47.
- Duff, P. A. (2014). Case study research on language learning and use. *Annual Review of Applied Linguistics*, 34, 233–255.
- Ellis, N. C. (2017). Cognition, corpora, and computing: Triangulating research in usage-based language learning. *Language Learning*, 67(S1), 40–65.
- Ellis, N. C., O’Donnell, M. B., & Römer, U. (2013). Usage-based language: Investigating the latent structures that underpin acquisition. *Language Learning*, 63(S1), 25–51.



- Finch, A. (2010). Critical incidents and language learning: Sensitivity to initial conditions. *System*, 38(3), 422–431.
- García, O., & Wei, L. (2014). Translanguaging and education. In O. García & L. Wei (Eds.), *Translanguaging: Language, bilingualism, and education* (pp. 63–77). London, UK: Palgrave.
- Godwin-Jones, R. (2017a). Scaling up and zooming in: Big data and personalization in language learning. *Language Learning & Technology*, 21(1), 4–15. <https://doi.org/10125/44592>
- Godwin-Jones, R. (2017b). Smartphones and language learning. *Language Learning & Technology*, 21(2), 3–17. <https://doi.org/10125/44607>
- Godwin-Jones, R. (2018). *Using mobile devices in the language classroom*. Cambridge Papers in ELT Series. Cambridge, UK: Cambridge University Press.
- González-Lloret, M. (2015). Conversation analysis in computer-assisted language learning. *CALICO Journal*, 32(3), 569–594.
- Hiver, P., & Al-Hoorie, A. H. (2016). A dynamic ensemble for second language research: Putting complexity theory into practice. *The Modern Language Journal*, 100(4), 741–756.
- Howarth, P. (1998). Phraseology and second language proficiency. *Applied Linguistics*, 19(1), 24–44.
- Jonsson, C., & Muhonen, A. (2014). Multilingual repertoires and the relocalization of manga in digital media. *Discourse, Context, & Media*, 4, 87–100.
- Juffermans, K., Blommaert, J., Kroon, S., & Li, J. (2014). Dutch–Chinese repertoires and language Ausbau in superdiversity: A view from digital media. *Discourse, Context, & Media*, 4, 48–61.
- Kelly-Holmes, H. (2013). ‘Choose your language!’ Categorisation and control in cyberspace. *Sociolinguistica*, 27, 132–145.
- Kibler, A. K., & Valdes, G. (2016). Conceptualizing language learners: Socioinstitutional mechanisms and their consequences. *The Modern Language Journal*, 100(S1), 96–116.
- Klimanova, L., & Dembovskaia, S. (2013). L2 identity, discourse, and social networking in Russian. *Language Learning & Technology*, 17(1), 69–88. <http://doi.org/10125/24510>
- Kramsch, C. (2003). *Language acquisition and language socialization: Ecological perspectives*. New York, NY: Bloomsbury.
- Kramsch, C. (2014). Teaching foreign languages in an era of globalization: Introduction. *The Modern Language Journal*, 98(1), 296–311.
- Krashen, S. (1982). *Principles and practice in second language acquisition*. Oxford, UK: Pergamon.
- Kulavuz-Onal, D., & Vásquez, C. (2018). “Thanks, shokran, gracias”: Translingual practices in a Facebook group. *Language Learning & Technology*, 22(1), 240–255. <https://doi.org/10125/44589>
- Kusyk, M. (2017). The development of complexity, accuracy, and fluency in L2 written production through informal participation in online activities. *CALICO Journal*, 34(1), 75–96.
- Lam, W. S. E. (2000). L2 literacy and the design of the self: A case study of a teenager writing on the Internet. *TESOL Quarterly*, 34(3), 457–482.
- Lam, W. S. E. (2006). Re-envisioning language, literacy, and the immigrant subject in new mediascapes. *Pedagogies*, 1(3), 171–195.
- Lantolf, J. P. (2006). Language emergence: Implications for applied linguistics—A sociocultural perspective. *Applied Linguistics*, 27(4), 717–728.

- Lantolf, J. P., & Pavlenko, A. (2001). (S)econd (L)anguage (A)ctivity theory: Understanding second language learners as people. In M. Breen (Ed.), *Learner contributions to language learning* (pp. 141–158). Harlow, UK: Longman-Pearson.
- Lantolf, J. P., & Thorne, S. L. (2006). *Sociocultural theory and the genesis of second language development*. Oxford, UK: Oxford University Press.
- Larsen-Freeman, D. (1997). Chaos/complexity and second language acquisition. *Applied Linguistics*, 18, 141–165.
- Larsen-Freeman, D. (2006). The emergence of complexity, fluency, and accuracy in the oral and written production of five Chinese learners of English. *Applied Linguistics*, 27(4), 590–619.
- Larsen-Freeman, D. (2015). Saying what we mean: Making the case for second language acquisition to become second language development. *Language Teaching*, 48, 491–505.
- Larsen-Freeman, D. (2017). Complexity theory: The lessons continue. In L. Ortega & Z. Han (Eds.), *Complexity theory and language development: In celebration of Diane Larsen-Freeman* (pp. 11–50). Amsterdam, Netherlands: John Benjamins.
- Larsen-Freeman, D. (2018). Looking ahead: Future directions in, and future research into, second language acquisition. *Foreign Language Annals*, 51, 55–72.
- Larsen-Freeman, D., & Cameron, L. (2008). *Complex systems and applied linguistics*. Oxford, UK: Oxford University Press.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford, UK: Oxford University Press.
- Lee, C. (2016). Multilingual resources and practices in digital communication. In A. Georgakopoulou & T. Spilioti (Eds.), *The Routledge handbook of language and digital communication* (pp. 118–132). London, UK: Routledge.
- Lee, C. (2017). *Multilingualism online*. New York, NY: Taylor & Francis.
- Li, J., & Juffermans, K. (2011). Multilingual Europe 2.0: Dutch–Chinese youth identities in the era of superdiversity. *Working Papers in Urban Language and Literacies*, 71. London, UK: King's College.
- Lightbown, P. M., & Spada, N. (2013). *How languages are learned (4th ed.): Oxford Handbooks for Language Teachers*. Oxford, UK: Oxford University Press.
- Little, D., & Thorne, S. L. (2017). From learner autonomy to rewilding: A discussion. In M. Cappellini, T. Lewis, & A. R. Mompean (Eds.), *Learner autonomy and Web 2.0* (pp. 12–35). London, UK: Equinox.
- MacIntyre, P. D., & Legatto, J. J. (2010). A dynamic system approach to willingness to communicate: Developing an idiodynamic method to capture rapidly changing affect. *Applied Linguistics*, 32(2), 149–171.
- Magno e Silva, W. (2018). Autonomous learning support base. In G. Murray & T. Lamb (Eds.), *Space, place, and autonomy in language learning* (pp. 219–232). London, UK: Routledge.
- McConachy, T. (2017). *Developing intercultural perspectives on language use: Exploring pragmatics and culture in foreign language learning*. Bristol, UK: Multilingual Matters.
- Murphey, T., Chen, J., & Chen, L. (2005). Learners' constructions of identities and imagined communities. In P. Benson & D. Nunan, (Eds.), *Learners' stories: Difference and diversity in language learning* (pp. 83–100). Cambridge, UK: Cambridge University Press.

- Murray, G., & Lamb, T. (2018). Space, place, autonomy and the road not yet taken. In G. Murray & T. Lamb (Eds.), *Space, place, and autonomy in language learning* (pp. 249–262). London, UK: Routledge.
- Newgarden, K., & Zheng, D. (2016). Recurrent languaging activities in World of Warcraft: Skilled linguistic action meets the Common European Framework of Reference. *ReCALL*, 28(3), 274–304.
- Norton, B. (2001). Non-participation, imagined communities, and the language classroom. In M. Breen (Ed.), *Learner contributions to language learning: New directions in research* (pp. 159–171). London, UK: Pearson.
- Norton, B., & Toohey, K. (2011). Identity, language learning, and social change. *Language Teaching*, 44(4), 412–446.
- Ortega, L. (2017). New CALL–SLA research interfaces for the 21st century: Towards equitable multilingualism. *CALICO Journal*, 34(3), 285–316.
- Ortega, L., & Han, Z.-H. (Eds.). (2017). *Complexity theory and language development: In honor of Diane Larsen-Freeman*. Amsterdam, Netherlands: John Benjamins.
- Polat, B., & Kim, Y. (2014). Dynamics of complexity and accuracy: A longitudinal case study of advanced untutored development. *Applied Linguistics*, 35(2), 184–207.
- Reinders, H., & Benson, P. (2017). Research agenda: Language learning beyond the classroom. *Language Teaching*, 50(4), 561–578.
- Rousse-Malpat, A., & Verspoor, M. (2018). Foreign language instruction from a dynamic usage-based (DUB) perspective. In A. Tyler, L. Ortega, M. Uno, & H. Park (Eds.), *Usage-inspired L2 Instruction: Researched pedagogy* (pp. 55–74). Amsterdam, Netherlands: John Benjamins.
- Sampson, R. J. (2015). Tracing motivational emergence in a classroom language learning project. *System*, 50, 10–20.
- Sauro, S. (2017). Fandom and online interest groups. In S. L. Thorne (Ed.), *Language, education, and technology* (pp. 1–12). Berlin, Germany: Springer.
- Schmidt, R. W. (1990). The role of consciousness in second language learning. *Applied linguistics*, 11(2), 129–158.
- Scholz, K. (2017). Encouraging free play: Extramural digital game-based language learning as a complex adaptive system. *Calico Journal*, 34(1), 39–57.
- Scholz, K., & Schulze, M. (2017). Digital-gaming trajectories and second language development. *Language Learning & Technology*, 21(1), 99–119.
- Schulze, M., & Scholz, K. (2016). “CALL theory: Complex adaptive systems.” In C. Caws & M.-J. Hamel (Eds.), *Language-learner computer interactions: Theory, methodology, and CALL applications* (pp. 65–87). Amsterdam, Netherlands: John Benjamins.
- Smith, B. E., Pacheco, M. B., & de Almeida, C. R. (2017). Multimodal codemeshing: Bilingual adolescents’ processes composing across modes and languages. *Journal of Second Language Writing*, 36, 6–22.
- Sockett, G. (2013). Understanding the online informal learning of English as a complex dynamic system: An emic approach. *ReCALL*, 25(1), 48–62.
- Sockett, G. (2014). *The online informal learning of English*. New York, NY: Palgrave Macmillan.
- Spoelman, M., & Verspoor, M. (2010). Dynamic patterns in development of accuracy and complexity: A longitudinal case study in the acquisition of Finnish. *Applied Linguistics*, 31, 532–553.

- Sundqvist, P., & Sylvén, L. K. (2016). *Extramural English in teaching and learning*. London, UK: Palgrave Macmillan.
- Thorne, S. L. (2003). Artifact and cultures-of-use in intercultural communication. *Language Learning & Technology*, 7(2), 38–67. <http://doi.org/10125/25200>
- Thorne, S. L., Sauro, S. & Smith, B. (2015). Technologies, identities, and expressive activity. *Annual Review of Applied Linguistics*, 35, 215–233.
- Ushioda, E. (2011). Language learning motivation, self, and identity: Current theoretical perspectives. *Computer Assisted Language Learning*, 24(3), 199–210.
- Van De Mierop, D., & Clifton, J. (2012). The interplay between professional identities and age, gender, and ethnicity; Introduction. *Pragmatics*, 22(2), 193–201.
- Van Dijk, M., Verspoor, M., & Lowie, W. (2011). Variability and DST. In K. De Bot, W. Lowie, & M. Verspoor (Eds.), *A dynamic systems theory approach to second language acquisition: Methods and techniques* (pp. 55–84). Amsterdam, Netherlands: John Benjamins.
- van Lier, L. (2004). The semiotics and ecology of language learning. *Utbildning & Demokrati*, 13(3), 79–103.
- Vandommele, G., Van den Branden, K., Van Gorp, K., & De Maeyer, S. (2017). In-school and out-of-school multimodal writing as an L2 writing resource for beginner learners of Dutch. *Journal of Second Language Writing*, 36, 23–36.
- Verspoor, M. (2017). Complex dynamic systems theory and l2 pedagogy. In L. Ortega & Z.-H. Han (Eds.), *Complexity theory and language development: In celebration of Diane Larsen-Freeman* (pp. 143–162). Amsterdam, Netherlands: John Benjamins.
- Verspoor, M., Lowie, W., van Geert, P., van Dijk, M., & Schmid, M. S. (2011). How to sections. In M. Verspoor, K. de Bot, & W. Lowie (Eds.), *A dynamic approach to second language development* (pp. 129–199). Amsterdam, Netherlands: John Benjamins.
- Wagner, J. (2015). Designing for language learning in the wild: Creating social infrastructures for second language learning. In T. Cadierno & S. Eskildsen (Eds.), *Usage-based perspectives on second language learning* (pp. 75–101). Berlin, Germany: Walter de Gruyter.
- Wang, X. (2012). ‘I am not a qualified dialect rapper’: Constructing hip-hop authenticity in China. *Sociolinguistic Studies*, 6(2), 333–372.
- Waninge, F., Dörnyei, Z., & De Bot, K. (2014). Motivational dynamics in language learning: Change, stability, and context. *The Modern Language Journal*, 98(3), 704–723.
- Warner, C., & Chen, H. (2017). Designing talk in social networks: What Facebook teaches about conversation. *Language Learning & Technology*, 21(2), 121–138. <https://doi.org/10125/44614>
- Warner, C., & Dupuy, B. (2018). Moving toward multiliteracies in foreign language teaching: Past and present perspectives... and beyond. *Foreign Language Annals*, 51, 116–128.
- Yus, F. (2011). *Cyberpragmatics: Internet-mediated communication in context*. Amsterdam, Netherlands: John Benjamins