Commentary

Studying second language acquisition in the age of large language models: Unlocking the mysteries of language and learning. A commentary on “Age effects in second language acquisition: Expanding the emergentist account” by Catherine L. Caldwell-Harris and Brian MacWhinney

This is an exciting time for those who study language and language learning. Large Language Models, or LLMs, such as Open AI ChatGPT, Microsoft Bing, Google Bard, and a score of other recently-released artificial intelligence tools are upending much of what we thought we knew about language learning and language function. What makes LLMs especially interesting is that the artificial intelligence that is changing the world at an unprecedented rate is essentially a language learning model that follows rules that linguists, psychologists, computer scientists, and other cognitive scientists have been studying for decades. By relying on statistical probabilities to make predictions, LLMs are rapidly advancing from text autocomplete to providing logical answers to complex questions and generating new content.

Historically, the main theories of language advocated for an innate language learning mechanism, for universal grammar, for a critical period, and for a human factor that no other species possessed, one anchored in communicative intent, consciousness, and higher-order pragmatic and cognitive reasoning. These may still be defining characteristics, but they may also be challenged to the core as LLMs evolve. Already now, LLMs can do much more than anyone expected they would at this stage, and they are improving at a rapid pace. If statistical learning and prediction can accomplish so much so fast, how much more will LLMs be able to do as they evolve and build on the body of knowledge acquired over the course of humanity’s existence? Is probabilistic learning enough to learn language and become a competent language user? If no, why not, what else is needed? At what point in the evolution of LLMs may they acquire pragmatic skills and develop communicative intent, if at all? And from there on, where do the boundaries between consciousness and non-consciousness lie? These are just some of the questions philosophers of language grapple with, and consensus is elusive. For that matter, we don’t even agree on what language learning mechanism, for universal grammar, for a critical period, and for a human factor that no other species possessed, one anchored in communicative intent, consciousness, and higher-order pragmatic and cognitive reasoning. These may still be defining characteristics, but they may also be challenged to the core as LLMs evolve. Already now, LLMs can do much more than anyone expected they would at this stage, and they are improving at a rapid pace. If statistical learning and prediction can accomplish so much so fast, how much more will LLMs be able to do as they evolve and build on the body of language and become a competent language user? If no, why not, what else is needed? At what point in the evolution of LLMs may they acquire pragmatic skills and develop communicative intent, if at all? And from there on, where do the boundaries between consciousness and non-consciousness lie? These are just some of the questions philosophers of language grapple with, and consensus is elusive. For that matter, we don’t even agree on what language and thought do not believe that the two coincide, there is little arguing that they mutually influence each other, and that studying language gives us a unique window into the mind.

It is against this historic backdrop that Catherine Caldwell-Harris and Brian MacWhinney wrote their excellent keynote on age effects in SLA. I found it to be a very interesting and thorough analysis. The authors not only provide an up-to-date review of the literature on and adjacent to SLA, but also propose a framework that moves beyond maturational factors in thinking about what age effects in SLA mean and what they tell us about language and learning. As is characteristic of emergentist accounts of language, their discussion recognizes that language learning is a dynamic process that consists of the gradual emergence of linguistic knowledge through the interaction of multiple factors. Their expanded framework is grounded in empirical research and recognizes that there are multiple paths to language proficiency. I particularly appreciated the breadth of the approach, the attempt to structure existing knowledge into a cohesive three-legged theory, the many examples, and the parallels to phenomena outside language. The authors even draw on proteomics and discuss the four levels of protein folding to illustrate how emergentism operates on a different scale.

The proposed framework incorporates three groups of factors – environmental supports, cognitive abilities, and motivational forces. The authors propose that successful language acquisition is shaped by both protective and risk factors that vary across the developmental lifespan (infancy and early toddlerhood, early childhood, middle childhood, adolescence, and young adulthood, adulthood, older age) and across linguistic processes (speech perception and audition, articulation, lexicon, morphology, syntax, and conversation). The broad scope of the discussion, which also incorporates language competition within and across languages (Fernandez-Duque et al., 2023), as well as cognitive and motivational variables, is appealing in its non-reductiveness. The result is a more accurate understanding of age effects in SLA, one that challenges the overly simplistic maturational and biological accounts that have been traditionally considered responsible for these effects.

This means that SLA outcomes are not due to an open or closed sensitive period, but rather a result of an interconnected set of variables that work in concert, mutually influencing and building upon each
other. Recognizing this underscores the value of the field of SLA in explicating the mysteries of language and learning, with implications for both human and artificial intelligence (with some modifications, for example to the motivational component, at least for now and depending on how it is defined).

The authors make convincing arguments against the critical period hypothesis, the sensitive period hypothesis, and maturational accounts more generally. The critical and sensitive periods hypotheses have had a good run, but it is time to retire them in favor of a broader framework that considers interactions among multiple factors over the course of an organism's lifespan (and possibly beyond, as Caldwell-Harris and MacWhinney point to the potential role of epigenetic shaping of aptitude). Moving beyond the “closing of a sensitive period” is necessary not only when considering SLA, but also native language learning, and language and learning more broadly. You can teach old dogs new tricks, as the authors themselves allude to when they discuss that a return to plasticity IS possible in other animal models (cats, rats, etc.). Evidence confirms the ability to learn a second language to fluency at any age, subject to the interactive effects of environmental, cognitive, and motivational factors. It is increasingly clear that language learning is a life-long process and not a finite task that takes place within a constrained time window.

Multiple factors are discussed in support of an emergentist account and against maturational mechanisms. Even aspects that have traditionally been seen as supporting a maturational account could be challenged. For example, I am not convinced that the attrition of L1 in young adoptees is similar to the phenomenon of “catastrophic interference” demonstrated in neural nets when the training set switches to a new set of input-output pairs, nor that it is an example of a “complete loss.” Research employing the savings paradigm suggests that young adoptees who appear to have completely lost a language (and may not even know what language they once knew) learn the language they were once exposed to during infancy with greater ease than a language they were not exposed to, or than other people who were not exposed to that language in early development (Isurin, 2015; Piec et al., 2014). Regardless of whether “catastrophic interference” yields complete loss of previous input-output pairs in machine learning, the data suggest that in human learning, some knowledge is preserved even after decades and even without use, further challenging theories that L1 attrition and L2 success are tied to the same maturational mechanisms.

The downside to the flexible, inclusive, and multidisciplinary approach of emergentist theories of language is their under-specification and lack of clarity. There are many unknowns. We have yet to delineate how exactly the multitude of variables build upon each other in this integrated emergentist account to result in successful SLA (or language learning in general). To their credit, rather than hiding behind the complexity in a dismissive hand-wavy way, the authors make an honest attempt to enumerate and organize the many contributing variables into an integrated emergentist account to result in successful SLA (or language learning process through continued learning and their own emergentism).

To be sure, although LLMs can test theories much faster and can help us learn about SLA, they also differ from humans on many of the environmental, cognitive, and socio-motivational factors discussed by Caldwell-Harris and MacWhinney. LLMs may very well evolve in ways that stray from human thought, not just due to speed, but also size, physical differences, and lack of embodiment (for now, though development of carbon versions is in progress). Machine learning operates under different constraints than human learning (which is limited by the speed at which neurons fire in the brain, among other things), and while we can learn from these differences, caution is advised when considering similarities and differences between machine and human language learning and making extrapolations. For example, LLMs are still subject to the WEIRD bias due to the differences between the databases available for training across high-vs low-resource languages, whereas the “slow” cross-cultural human research has the merit of being able to capture sociocultural and ecological influences on language acquisition that may be lost in machine learning.

Modern LLMs reinforce emergentist theories about the dynamic nature of language and challenge nativist assumptions of universal grammar and critical periods. Whether the probabilistic nature of learning from large-scale corpora that is at the basis of LLMs will evolve to exhibit emergent abilities that had not been directly trained or expected was, until not long ago, an open question. Most recently, evidence points to the affirmative, with several documented instances of LLMs exhibiting emergent abilities (Ornes, 2023) and confirmed examples of LLMs spontaneously and unexpectedly performing arithmetic operations, generating executable computer code, summarizing passages, and deducing answers to questions. While some call the emergent abilities of LLMs a mirage (Schaefter et al., 2023), the breakneck speed at which LLMs advance gives us reasons to believe that emergentist accounts of language learning are on the right track and that analyses of age effects in SLA, like the ones presented by Caldwell-Harris and MacWhinney, are a prescient preview of things to come.

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