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The systems framework dispels causal illusions and organizes multi-causal models

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Titone and Tiv (2022) describe recent research and new questions to illustrate the power of the systems framework of bilingualism. But this framework does more than suggest new questions. My purpose here is to present 3 examples of how multicausal frameworks can illuminate long-standing topics in bilingualism.

- A systems framework disrupts the illusion of causality that has obscured the relationship between age of immigration and L2 ultimate attainment.
- A systems framework can prevent missteps in language-policy, as in the case of profoundly deaf individuals growing up without an accessible language.
- A systems framework, and particularly network science, can organize myriad factors to facilitate agent-based modeling of the decision to invest resources in learning a new language vs. maintaining expertise in a known language.

Critical (or sensitive periods) for L2 acquisition: the illusion that age is causal

When humans learn of two associated events, the brain's meaning-making machinery rapidly activates existing causal schemas to explain the association. Consider graphs showing the reliable, strong decrease in ultimate L2 attainment as a function of age of acquisition (AoA) (e.g., Vanhove, 2013). One outcome is intuition that a brain-based sensitive period for L2 acquisition caused the decline.

Training students to be skeptical of causal illusions is common in psychology (Huck, 1979). Consider the statement that children exposed to the arts end up with higher math and science scores than students not exposed to the arts. My students will eventually think of third variables that are correlated with the X and Y, such as parental or school financial resources differing for students exposed vs. not exposed to the arts. Some complain: "But you never said other things could be different!" Indeed.

Two situations inhibit the cognitive-miser solution that everything else is the same, and therefore, Y was caused by X. Having a stake in a non-causal outcome compels decision makers to search for alternative explanations; an example is rejecting the genetic essentialism suggested by data that black children have lower IQ scores than white children (Flynn, 2008).

The other situation is having a wealth of knowledge about what other factors vary with the X and Y variables. Here is where the social infusion aspect of the systems framework of bilingualism mutes the inference that brain changes are the cause of AoA effects. Familiarity with the nested spheres of influence surrounding language learners (as in Figure 1 from Titone & Tiv, 2022) alert us to how children resist learning a second language if they are able to use their L1 to communicate; we connect with information that immigrant children encounter diverse support for L2 learning while adults typically do not; we know that the language directed at children is more comprehensible than language directed to adults (Caldwell-Harris & MacWhinney, under review). Nonetheless, Montrul wrote (2020, p. 16) "Actual language loss is rare in adults, but it is not in children exposed to the same environmental conditions…" Even experts can forget that age organizes language learning, and thus the environment for learning is not held constant for child and adult learners.

The systems framework prompts us to adopt a multi-causal approach. Brain changes may well be a part of the explanation for age effects, but language learning is a complex dynamical system, with myriad moving parts. All the embedded social spheres described by Titone and Tiv (2022) have their influence.

Deaf children's English reading abilities are superior if they don't use sign language

Antia, Lederberg, Easterbrooks, Schick, Branum-Martin, Connor, and Webb (2020) measured English reading ability in deaf children who were trained in only spoken English compared to those who learned only sign language. Graphs depicting this data (see Antia et al.'s 2020 supplementary files) visually convey a compelling conclusion: the best route for achieving English literacy is to promote spoken language learning and restrict or forbid using sign language. That inference has influenced policy for decades (Lane, 1992).

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Deaf children are never randomly assigned to sign-only vs. spoken-only language acquisition treatment. Instead, some deaf children have sufficient residual hearing or for somewhat mysterious reasons can succeed with lip reading. These children then succeed, at least to some degree, in acquiring spoken English as their first language. Children without that residual hearing or lip-reading abilities cannot easily extract language information from interacting with speech. They can have normal cognitive and social development when exposed to sign language from birth (Hoffmeister, 2000). Once in the public school system, these children learn English as a second language via print, a notoriously hard task (Caldwell-Harris, 2021).

Titone and Tiv (2022) mention political and economic interests as part of the nested spheres of influence; awareness of the role these have played in deaf education (Lane, 1992) can alter inferences drawn from simple correlational data concerning deaf children with different learning histories.

An organizational framework to facilitate agent-based modeling

The prior examples involved how a multicausal framework can disrupt single-factor reasoning. My next case involves how the nested spheres of social influence (Figure 1 in Titone & Tiv, 2022; and a related framework (Atkinson, Byrnes, Doran, Duff, Ellis, Hall, Johnson, Lantolf, Larsen–Freeman, Negueruela, Norton, Ortega, Schumann, Swain & Tarone, 2016) can organize complex computer modeling endeavors. An example is my own attempt to create an agent-based model of language learning following immigration (Caldwell-Harris, 2019).

No agent-based model exists of how multilinguals choose to invest in L1 vs. L2. Titone and Tiv (2022) discuss social features of language use, which fit with network models (Vitevitch, 2019), such as learning via social interaction and being influenced by other social actors. Agent based modeling has these and other characteristics, making it a good fit to agent-based modeling, such as diffusion/adoption effects (Bonabeau, 2002). Language learning involves positive and negative feedback loops, such that poor progress early in learning can spiral into negativity and avoidance, while early success can accelerate learning. An implemented model would provide simulations to test theories about why language learning is difficult for people occupying different linguistic ecosystems (Caldwell-Harris, 2019).

I argued for the relevance of pertinent factors, but organizing entities, state variables, scales to represent brains, learning, family, neighborhoods, and societal values proved too challenging to aim for an implemented model. I used the Overview, Design Concepts and Details protocol (ODD; Grimm, Berger, Bastiansen, Eliassen, Ginot, Giske, Goss-Custard, Grand, Heinz, Huse, Huth, Jepsen, Jørgensen, Mooij, Müller, Pe'er, Piou, Railsback, Robbins, Robbins, Rossmanith, Rüger, Strand, Souissi, Stillman, Vabø, Visser & Deangelis, 2006) to organize a narrative description. I identified outcome variables (frequency of use and fluency in the two languages), frequent actors, and defined rules for initiating/continuing conversation, and rules for agents to move to new locations. Titone and Tiv's (2022) framework suggests that an additional organizing feature would be to use the nested spheres of influence, and to draw on complex variables such as language entropy to organize both a description and implementation.

Summary

Titone and Tiv (2022) have been forward thinking in describing diverse new research and new questions that exemplify systems thinking about multilingual experiences. I make the case here that longstanding questions will also benefit from being incorporated into a multicausal, dynamic framework.

Conflict of interest. The author declares no conflict of interest.

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