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The Forum

L2 Development from a CDST Perspective and the Issue of Generalizability

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From a complex dynamic systems (CDST) perspective, language is understood as a dynamic system comprised of subsystems that change and develop over time in response to learner-internal and -external factors (Verspoor et al., 2008). Accordingly, language development is seen as a process responsive to the dynamic interaction between the learner and her context over time. While CDST prefers a process over product approach to analyzing language and its development, extant research on language learning has traditionally taken a more static and rigid perspective on acquisition, generally operating under the assumption that development can be understood (more or less) by drawing a straight line between individual variables or conditions and changes in the interlanguage. Findings from traditional research are often presented in "before and after" terms, framing language outcomes as a product of treatments, rather than characterizing developments as an ongoing and variable process.

Though L2 acquisition studies have certainly been able to produce broader findings on the contributing factors to language development, viewing language as a complex and dynamic system complicates researchers' ability to make generalizations about the influence of specific variables at both the group and individual levels. While this linear view of learning is common in traditional research, systems approaches to studying language recognizes that different factors will not necessarily interact the same way over time for different individuals. As such, researchers must be cautious about interpreting the meaningfulness of group findings (even when statistically significant) to individual learners (Lowie & Verspoor, 2015).

The problem of generalizability and meaningfulness of findings arises, first, because of misguided assumptions around the implication of homogeneity for the larger population. As Lowie and Verspoor (2015) explain, the thinking is that because individuals are highly similar (e.g., beginner learners of English who share the same L1), researchers are able to generalize to the entire population they represent; Lowie and Verspoor go on to say that this assumption is invalid, however, as the network of complex variables affecting an individual's development trajectory "cannot be equated with interindividual variation at one moment in time" (p. 69). That is, the assumption that group uniformity corresponds to uniformity of development is unwarranted; while mixed-model designs can account for differences between participants at the group level, they cannot account for intraindividual changes across time in the same way (Lowie & Verspoor, 2015).

Chan, Verspoor, and Vahtrick, in their 2015 study, illustrate this point clearly. The researchers investigated a set of Taiwanese identical twins who were beginner learners of English, and tracked their spoken and written English sentence complexity over the course of eight months. These learners demonstrated similar levels of English proficiency, and were exposed to the same home environment, schooling, and levels of English exposure prior to and throughout the study. Chan and her colleagues showed that, despite their being very similar, the

participants ultimately displayed vastly different developmental trajectories and patterns of intraindividual variation. Chan et al.'s research demonstrates that even in cases where participants are (seemingly) identical and are learning in the same context over the same period of time, the learning process may be realized very differently across individuals.

In a practical sense, this finding means that researchers have a more difficult job in making a connection between what group-level research says about the impact of variables or conditions on development, and understanding how the individual will be affected by those same variables. The basis for this inability to generalize results across study types has not just to do with the nature of language as a dynamic system but also where it meets ergodic theory. Broadly, ergodic theory speaks to researchers' ability to apply ensemble statistics to the individual or, alternately, to generalize individual statistics to a larger population. When it comes to research on L2 acquisition, however, this ability is often quite limited; developmental processes are almost by definition nonergodic (Molenaar et al., 2009). Molenaar et al. (2009) explain that under classical ergodic theory, there are two conditions which must be met for an ensemble to be ergodic: first, that the process must be stationary, or homogenous, in time; and second, that the population must be homogenous, such that "each person in the population must obey the same dynamics" (p. 261). In L2 acquisition research, the condition of stationarity tends to be the greatest obstacle to ergodicity, and by extension, to the question of generalizability. Molenaar and his colleagues clarify this point in this way: "Because *development* generally implies that some kind of growth or decline occurs, developmental processes are almost always nonstationary and are, therefore, nonergodic" (p. 261, emphasis in original). This means that, even in cases where the subjects in a population are homogeneous—or even identical, as with Chan et al. (2015), above—because the process almost inevitably results in a change in the statistical properties of the ensemble over time, the researcher cannot use ensemble statistics to make inferences about individuals (Tarko, 2005). In short, ergodic theory provides a statistical argument for why we are very seldom able to generalize between findings on inter- and intraindividual variation (Yu & Lowie, 2020).

Why, then, does this matter? A broader implication of this inability to translate findings across group and individual levels is that it can be difficult to find congruence between the results of group studies and individual studies. While group studies can provide insight into how different factors (such as those of individual differences, or contextual or instructional factors) might differentially affect L2 development—allowing researchers to understand the weight of different factors on development—their findings "may not be representative for a longer period of time and cannot predict much about any individual's behavior at any point in time" (Lowie & Verspoor, 2019, p. 203). This also holds true in the reverse: while longitudinal case studies can provide information on development by describing changes in individual performance and the variable impact of factors over time, these findings may not generalize beyond the individuals under investigation.

In practical terms, this points to the importance of undertaking different types of research; while CDST studies have largely adopted a process-oriented approach to researching language development, choosing to focus on intraindividual variation and change, *both* process- and product-oriented research provide necessary and complementary contributions to our understanding of language development. It is by employing both types of studies that the issue of generalizability observed in prior research can be accounted for.

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