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OPEN PEER COMMENTARY

In Search of Variables Explaining Individual Differences in Second Language Learning and Processing: A Commentary on "The Neurocognitive Underpinnings of Second Language Processing: Knowledge Gains From the Past and Future Outlook"

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In her review article "The Neurocognitive Underpinnings of Second Language Processing: Knowledge Gains from the Past and Future Outlook," Distinguished Professor Janet van Hell presented a rigorous review of the most prominent electrophysiological and neuroimaging research on second language (L2) learning and processing and various promising future directions.

We would like to focus on one of them: investigating individual variability in neural correlates of language learning and processing. As thoroughly described in the review, there are several key variables for L2 learning and processing beyond age of acquisition and proficiency. These include language use, amount of exposure, environmental context, language switching habits, but also general cognitive parameters such as cognitive functions, language learning aptitude, and motivation. As van Hell pointed out, individual variability is not limited to the L2 but may be present in the first language (L1). In the following, we would like to raise awareness of four important variables likely related to L2 variability that have received little attention thus far: auditory processing precision, language background, input type, and variability in L1 processing. We then discuss methodological considerations in exploring individual variability.

Auditory processing precision refers to lower-order abilities in perceiving domain-general acoustic information, that is, pitch, formants, duration, and intensity. Language input is often provided auditorily, which means that complex auditory analyses take place during language learning. Auditory processing precision is not limited to learning novel sound contrasts but is also important to identifying word and phrase boundaries, syntactic structures, and morphosyntactic markers. Auditory processing may be associated with success in L2 speech learning, explaining up to 50% of the variance (Saito, 2023). Assessing learners' auditory processing ability is therefore an important step toward understanding individual differences in L2 processing, and there are open-source tools available for this purpose (Mora-Plaza et al., 2022).

The language background of research participants should be thoroughly considered. Although studies of L2 learners might exclude participants for whom the target language is a third language (L3; e.g., a study on L1-English learners of L2-Spanish may exclude English-Portuguese bilingual learners of Spanish), such studies may not exclude people who speak a L3 in addition to the target L2 (e.g., L1-English learners of L2-Spanish with L3-Portuguese). Current research has shown that this may be problematic as several languages can influence each other in multidirectional ways even resulting in a later-acquired, less proficient language influencing an earlier-acquired, more proficient language (Cabrelli Amaro, 2017; de Bruin et al., 2023). Consequently, L2-Spanish speakers with L3-Portuguese may find an ungrammatical construction like *Lorenzo me parece adorar a Irene* "Lorenzo seems to me to adore Irene" more acceptable than L2-Spanish speakers without knowledge of Portuguese because it is grammatical in Portuguese (Cabrelli Amaro, 2017).

Language input may often be confounded with proficiency measures: Higher proficiency is often related to immersion experience that in turn is associated with exposure to native input. This is in contrast to learning a foreign language in the L1 environment where the input often comes from nonnative classmates and teachers. Frequent exposure to foreign-accented input is associated with nonnative phonetic properties in bilingual children's production (Stoehr et al., 2019). If the language input includes ungrammatical constructions, this may affect language processing in the brain. In this case, the bilingual brain may not react to grammatical violations simply because of differences in the input it has received.

Considerations of individual variability are generally limited to L2 processing. As van Hell discussed, researchers have recently started acknowledging variability in L1 processing even within typical young speakers/readers, and such variability should be further investigated (Vaughn et al., 2019). We argue that the fields of both L1 and L2 processing would gain major advancements by deeply exploring individual variability in L1 processing (Freunberger et al., 2022). Research correlating L1 and L2 processing may reveal that L2 processing variability is at least partially explained by L1 processing variability.

The importance of exploring individual variability in L2 processing and its relationship with L1 variability has led us to several methodological considerations:

- It is important to conduct within-participant designs whenever possible, in which individual difference variables are incorporated as continuous variables. As van Hell argued, such designs would lead to better consideration of individual variability and differences in the L2 but also in the L1 (Bice & Kroll, 2021). Correlation analyses of L1 with L2 processing would then be possible and certainly highly informative. Within-participants designs also render comparisons with L1 speakers less needed, which would help move away from considering monolinguals as the gold standard (see Freunberger et al., 2022).
- Within-participant designs are not always possible, for example, when researchers explore grammatical rules in the L2 that are absent in the L1. When L1 speaker comparisons are necessary, mirror-image bilinguals rather than monolinguals (who hardly exist anyway) may provide the most reasonable baseline, for instance, by comparing the Spanish of L1-English–L2-Spanish and L1-Spanish–L2-English speakers. Such a comparison would at least compare people with similar linguistic repertoires.

- If the field is moving toward a deeper consideration of individual variables influencing L2 processing, the recent trend of internet-based studies is a methodological advancement that can be combined with neurocognitive studies. The most prominent advantage of internet-based studies is that large and diverse samples can be accessed easily to measure the association of these variables with perception/comprehension and production. Large samples are needed to reliably identify variables explaining individual differences, and increasing linguistic diversity is an important step forward in any discipline concerned with bilingualism.

To conclude, we fully concur with Janet van Hell that the research field on the neurocognition of L2 learning and processing has advanced impressively over the last decades, but that it is time to take different angles to continue progressing. Major advances in methodological tools and statistical analyses, such as individual-level analyses of electroencephalography and event-related potentials data using mixed-effect models, will allow the field to move forward by investigating the role of individual differences in several linguistic and non-linguistic parameters in L1 and L2 processing as well as the relation between individual differences in L1 and L2 processing.

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References

Bice, K., & Kroll, J. F. (2021). Grammatical processing in two languages: How individual differences in language experience and cognitive abilities shape comprehension in heritage bilinguals. *Journal of Neurolinguistics*, *58*, Article 100963. https://doi.org/10.1016/j.jneuroling.2020.100963

Cabrelli Amaro, J. (2017). L3 morphosyntactic effects on L1 vs. L2 systems: The Differential Stability Hypothesis. In T. Angelovska & A. Hahn (Eds.), *L3 syntactic transfer* (pp. 173–194). Benjamins. https://doi.org/10.1075/bpa.5.09ama

de Bruin, A., Hoversten, L., & Martin, C. D. (2023). Interference between non-native languages during trilingual language production. *Journal of Memory and Language*, *128*, Article 104386. https://doi.org/10.1016/j.jml.2022.104386

Freunberger, D., Bylund, E., & Abrahamsson, N. (2022). Is it time to reconsider the 'gold standard' for nativelikeness in ERP studies on grammatical processing in a second language? A critical assessment based on qualitative individual differences. *Applied Linguistics*, *43*(3), 433–452. https://doi.org/10.1093/applin/amab058

Mora-Plaza, I., Saito, K., Suzukida, Y., Dewaele, J-M., & Tierney, A. (2022). Tools for second language speech research and teaching. SLA Speech Tools. http://sla-speech-tools.com

Saito, K. (2023). How does having a good ear promote successful second language speech acquisition in adulthood? Introducing Auditory Precision Hypothesis-L2. *Language Teaching*, 1−17. Advance online publication. https://doi.org/10.1017/S0261444822000453

Stoehr, A., Benders, T., van Hell, J., & Fikkert, P. (2019). Bilingual preschoolers' speech is associated with non-native maternal language input. *Language Learning and Development*, *15*(1), 75−100. https://doi.org/10.1080/15475441.2018.1533473

Vaughn, C. R., Baese-Berk, M. M., & Idemaru, K. (2019). Re-examining phonetic variability in native and non-native speech. *Phonetica*, *7*(5), 327–358. https://doi.org/10.1159/000487269