

# Cognitive abilities underlying the early stages of L2 acquisition: An artificial language study

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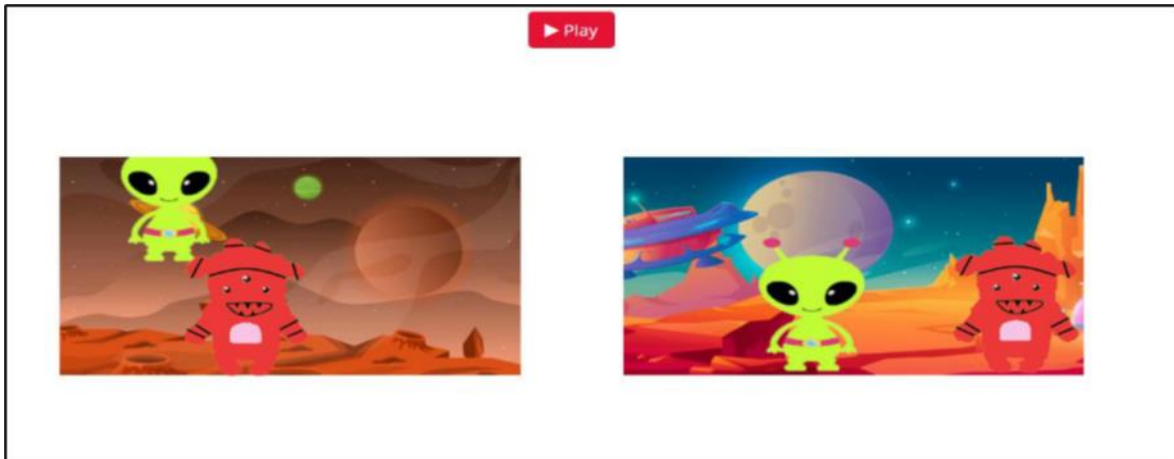
**Keywords:** implicit statistical learning, explicit learning, individual differences, second language learning, grammatical processing

While late second language (L2) acquisition is largely explicit, there is some evidence that adults are able to acquire the vocabulary and the grammar of novel languages under incidental learning conditions (Rebuschat et al., 2021; Ruiz et al., 2018). However, it remains unclear which aspects of language can be/are learned implicitly and under what conditions. Here, we revisit the question of whether adults can learn grammar incidentally and investigate whether word order and morphology are susceptible to implicit learning to the same degree. Additionally, we ask what cognitive abilities support early L2 learning and whether their roles change as a function of time.

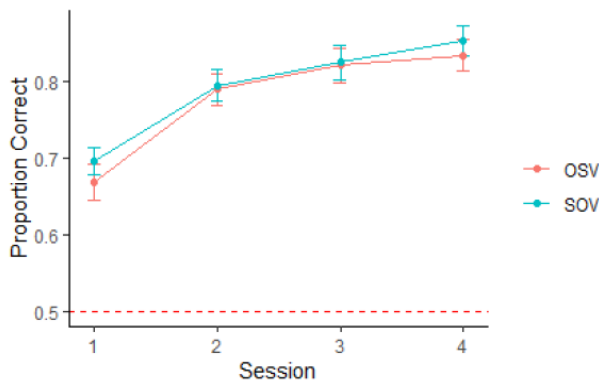
Forty-one English monolinguals, aged 18-35, were exposed to Kupidalo (1), an artificial language that had case marking and variable word order (SOV and OSV). The study included five online sessions. First, participants were explicitly trained on the nouns of the language. This was followed by a two-alternative forced-choice task (2AFCT) consisting of two blocks. In block 1 (270 trials), participants received vocabulary training, while being implicitly exposed to grammar. Two videos, each showing two aliens performing an action, were presented whilst a sentence was played (**Fig 1**). The videos differed in 1) one of the aliens, or 2) the color of one alien or, 3) the action performed. Participants had to select the video that matched the sentence and were given feedback on their responses. Block 2 served as a grammatical comprehension test. Here, the two videos differed in that the agent/patient roles were reversed. Participants completed 90 trials without any feedback. The 2AFCT was repeated in the first four sessions. In session 5, a grammaticality judgment task (GJT) including both word order and case marking violations assessed participants' grammatical knowledge. During the study, participants completed a series of cognitive abilities tasks testing explicit learning (EL), implicit statistical learning (ISL), sustained attention, grammatical sensitivity and speed of automatization.

We found that, although performance on vocabulary increased significantly across sessions (**Fig 2**), grammatical comprehension showed little improvement over time and improvement was limited to SOV sentences only (**Fig 3**). Moreover, in the GJT, participants performed better on grammatical than ungrammatical sentences and were better at detecting word order violations than case marking errors. Vocabulary and grammar learning as well as accuracy in the GJT were found to be modulated by EL. Sustained attention and accuracy in the initial noun training additionally predicted vocabulary learning, while, in the GJT, the positive EL effect appeared to be stronger for participants with higher sustained attention scores. Interestingly, for both grammar and vocabulary learning, the ISL effects were most pronounced early on, whereas the EL effects increased with time. However, the interaction between session and ISL was statistically significant only for vocabulary learning. Taken together, our results underscore the role of EL and ISL in early L2 acquisition. Furthermore, learners' difficulty with case marking confirms the presence of a threshold in incidental L2 acquisition which is tightly linked to the first language experience (Ellis, 2006; MacWhinney, 2005).

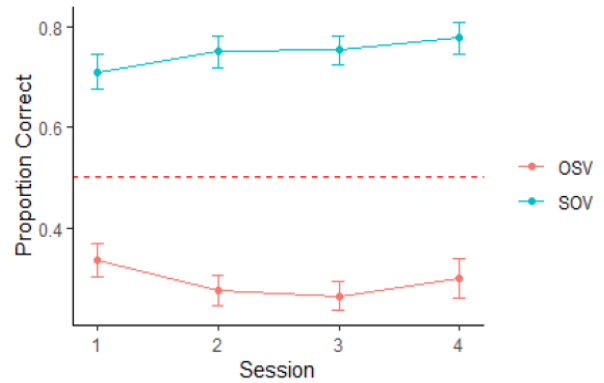
(1) Velg-a pog-a prad-o kov-o varek  
velg-NOM green-NOM prad-ACC red-ACC jump-over  
the green velg jumps over the red prad



**Fig 1.** Screenshot of a training trial in the vocabulary training block (Left scene: the (green) velg is jumping over the (red) prad, Right scene: the (green) velg is approaching the (red) prad).



**Fig 2.** Performance on the 'vocabulary training' blocks for each word order. The red dashed line indicates chance level.



**Fig 3.** Performance on the 'Grammatical comprehension test' blocks for each word order. The red dashed line indicates chance level.

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