Learning morphological rules across development and disorder

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Background. Learning a language's morphology entails learning both productive patterns that can be extended to novel items (e.g., adding *-s* to form noun plurals) and a set of item-specific exceptions (e.g., *child–children*). Research on natural and artificial language learning indicates that children can readily acquire productive rules, even under inconsistent input conditions [1, 2]. In contrast, adult learners tend to reproduce the relative frequencies of the patterns in the input. The extent and sources of these developmental differences remain debated [3], and even less is known about how rule learning operates in atypical language profiles such as developmental language disorder (DLD). To address these gaps, we examined how children and adults learn and generalise plural suffixes in an artificial language. We manipulated the type frequency distribution of plural markers so that it favoured or disfavoured rule abstraction [4]. We predicted reduced rule learning in adults and children with DLD relative to typically-developing (TD) children, due to maturational changes in mechanisms supporting rule abstraction in adults, and selective impairments affecting those mechanisms in DLD [5].

Method. Participants were 216 native speakers of European Portuguese: 72 TD children (aged 5–10 years), 72 children with DLD (age-matched), and 72 adults (aged 22–44 years). Participants were trained on a miniature artificial language and learned 10 singular–plural pseudoword pairs paired with pictures. In a training phase, participants saw a singular object and heard an auditory prompt consisting of an introductory frame followed by a noun (e.g., tikɐ zɔmu, "this is [noun]"). They then saw the plural display and heard its corresponding form (e.g., tikɐ zɔmupɐ); visual referents provided number cues (see Fig. 1). In the rule-promoting condition, six stems shared a regular plural suffix and four stems took distinct suffixes (exceptions). In the rule-disfavouring condition, only four stems shared a regular suffix and six were exceptions. Token frequency was matched across conditions, with regular and irregular tokens being presented an equal number of times, according to a Zipfian distribution. In a generalisation phase, participants were presented with 24 novel items and prompted to apply the plural suffix to a novel name. Responses were analysed using mixed-effects logistic regression, which modelled the probability of producing a regular versus an exception suffix.

Results. We obtained significant interactions between group and input condition (see Fig. 2). Model estimates showed that in the rule-promoting condition TD children produced significantly more regular suffixes (96%) than adults (59%) and children with DLD (51%). In the rule-disfavouring condition, regular suffix generalisation did not significantly differ across groups (TD: 49%; DLD: 62%; adults: 44%). TD children showed a significant difference between conditions, producing more regular suffixes in the rule-promoting than in the rule-disfavouring condition.

Discussion. Only TD children extended the regular suffix beyond its input frequency, and only when the distribution of types supported rule abstraction. In contrast, adults and children with DLD did not extend the regular suffix beyond its input probabilities. These findings suggest that mechanisms supporting productive morphological generalisation are most available in typical childhood, but diminish with maturation and can be selectively compromised in DLD. More broadly, the results highlight how learner profile and input structure jointly constrain the balance between rule-based generalisation and probabilistic learning in language acquisition.

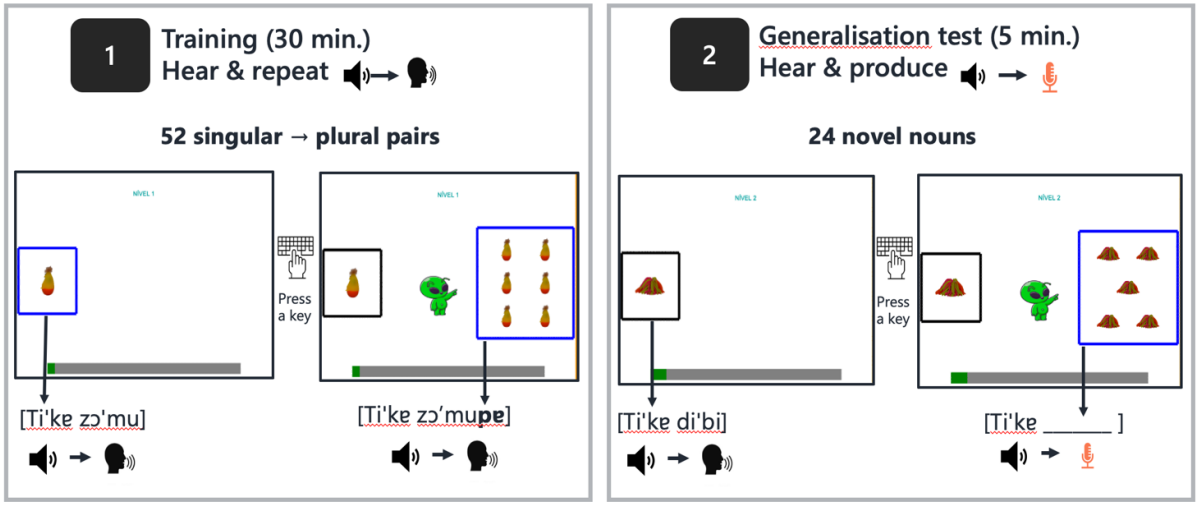

Figure 1: Training and generalisation phases in the artificial language learning task.

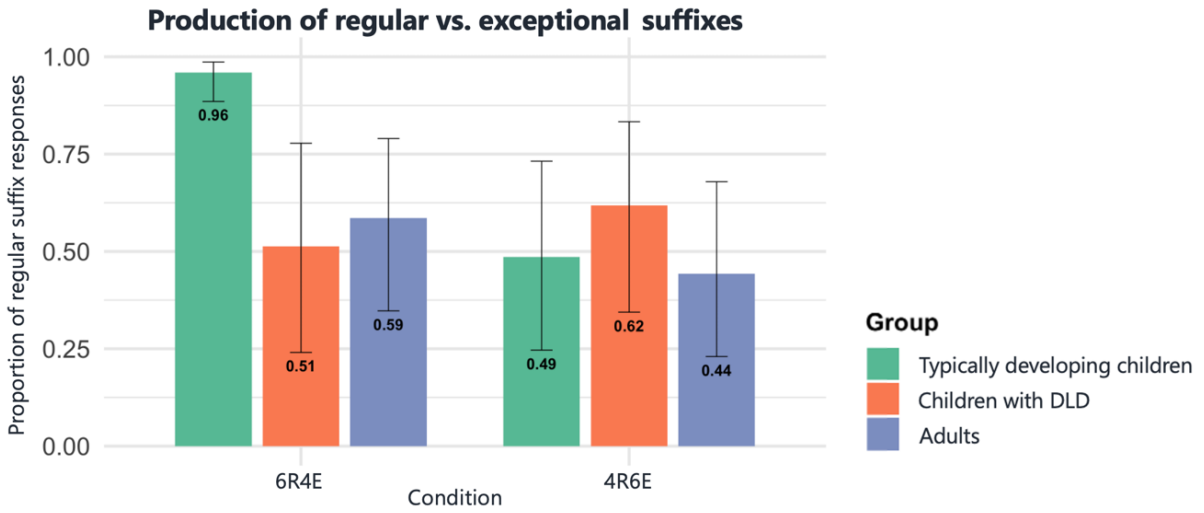

Figure 2: Model-estimated probabilities of producing a regular (vs. exceptional) suffix, by group and input condition. Error bars show 95% Cis.

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