Adult and Child Differences in the Production of Novel Language Input

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Introduction

The debate surrounding the effects of age at time of language learning has a long tradition in psycholinguistics, with many researchers arguing that young learners acquire language in a different manner than mature learners (e.g., Johnson & Newport, 1989; Newport, 1990; see Snow & Hoefnagel-Hohle, 1978 for an alternative view). In an attempt to identify the effects of age on the processing of language, Dufour, Newport, and Medin (1990) investigated how adults and children differ in their capacity to produce novel language input (i.e., signs from ASL). They found that adults were able to produce the input almost perfectly, while children (3- and 4-year-olds) could only produce part of the input. This suggests that the difference between children and adults is quantitative in nature, adults remember more of the input than children do. However, analyses of the errors made by the participants suggested that adults' and children's conception of an appropriate production was radically different. Adults' errors were predominantly *replacements* (e.g., producing the hand configuration from a previously seen sign) while children's errors were predominantly *omissions* (e.g., not producing the hand configuration of the sign) suggesting that the difference between children and adults is qualitative in nature; children remember the input differently than adults do. Dufour and his colleagues hypothesized that these differences may ultimately be advantageous for language acquisition during childhood.

PDP Models and Language

Connectionist models are frequently used to simulate the language acquisition process of children (e.g., Plunkett & Marchman, 1991, 1993). Elman (1990, 1993) demonstrated that recurrent networks can learn syntactic structure but that these models achieve their best performance under incremental training conditions; i.e., when the input to the network is presented in incremental steps instead of all at once. Elman (1993) concluded that when this pattern is implemented using a working memory span constraint, it is comparable to the language acquisition process of young children. One question we wish to address in this paper is: Can a single neural network architecture account for the performance of both adults and children on the production of novel language input?

Simulating Age Difference Effects

One of the specific goal of this research is to examine how the performance of three-year olds and adults can be simulated using only one neural network architecture. That is, how must the network be set (e.g., learning rate, size of the hidden layer, number of training epochs) in order to capture the capacity of both adults and children on this novel language input production task? Two experiments were conducted to investigate these questions. In Experiment 1, three-layer feedforward networks were trained on the signs used in the Dufour et al. study to examine whether the task could be simulated and the networks could reproduce the type of errors made by both age groups. In Experiment 2, three-layer feedforward networks were trained on the data for each of the three age groups studied by Dufour et al. The data for each age group was then tested on each of the other age group networks (e.g., the data from the 3-year-olds was presented to the trained 4-year-old and adult networks). The results indicate that (1) replacement and omission errors can be simulated within a single neural network architecture and (2) networks trained on age-specific data can generalize to the data from other age groups. This pattern of results suggest that although the difference between adults and children appear to be qualitative in nature, it may in fact be quantitative.

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