Implicit Artificial Grammar Learning in Adults and Children

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Introduction

Implicit structure learning is often defined as a process that occurs without any intention to learn and without complete awareness of the acquired knowledge. In addition, Reber (1993) hypothesized that implicit learning is an evolutionarily old process, which is robust with respect to disorders and varies little with IQ and age. In accordance with the latter claim, several developmental studies have provided evidence that implicit learning is available to young children (e.g. Gomez & Gerken, 1999) and that children's performance is equal to that of adults (e.g. Meulemans, Van der Linden & Perruchet, 1998).

If implicit learning is indeed invariant with age, its central characteristics should be observed in children as well as in adults. In previous experiments we found that implicit learning does not occur inevitably. Our results indicated that adult participants learn a structure implicitly when knowledge of the structure is useful to perform their task, but not when knowledge of the structure is useless. We predicted that implicit learning in children would also depend on the structure's usefulness to their current task and tested this prediction in the following experiment.

Methods

Twenty-eight students (18-34) and 30 children (10-11) participated in a computerized artificial grammar learning experiment. They were told that they were new ice-cream sellers on another planet with an unfamiliar language. All participants were shown the same 15 strings of non-words (2x), each accompanied by three ice-creams. Their task was to guess which ice-cream the string referred to. The non-word strings had been generated by an artificial grammar.

There were two conditions in this induction phase. In the structure-useless condition all five non-words referred to flavors. Discovering the individual word meanings was sufficient to identify the right ice-cream. In the structure-useful condition, two of the five non-words (meaning 'extra large' and 'with sprinkles') modified the others. To identify the right ice-cream, both word meaning and the position of these words had to be taken into account.

In the test phase, participants were informed that not all ice-creams were for sale on the planet. They were asked to judge for 40 new strings whether the ice-cream would be for sale (similar to the previously presented strings) or not.

Results

An analysis of variance with Condition (Structure-useful, Structure-useless) and Group (Adults, Children) as independent variables and proportion correct grammaticality judgments as dependent variable showed a main effect of Condition ($F(1,54) = 11.048$, $p = .002$) and a main effect of Group ($F(1,54) = 5.686$, $p = .021$), but no interaction ($F(1,54) = 1.194$, $p = .279$). The proportion correct was higher in the Structure-useful than in the Structure-useless condition and higher for adults than for children. In the Structure-useful condition, performance was significantly above chance (Adults: $M = .58$, $p < .001$; Children: $M = .53$, $p = .036$). In the Structure-useless condition, it was not (Adults: $M = .52$, $p = .21$; Children: $M = .50$, $p = .88$).

Discussion

In the present experiment adults showed more artificial grammar learning than children. Possibly they acquired additional explicit knowledge, while children did not. However, Thomas et al. (2004) demonstrated improvement of implicit learning with age in the absence of explicit knowledge. They suggested that implicit learning in children requires more exposure to the structure. Insufficient exposure might also underlie the children's inferior performance in the present study, as only 30 strings were presented and performance on the induction task was slightly worse for children than for adults.

Nevertheless, as predicted, children and adults showed implicit learning when knowledge of the structure was useful in performing their task, but not when it was useless. This suggests that usefulness of the structure may be a general requirement for the occurrence of implicit learning.

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