IMPLICIT CONCURRENT LEARNING OF ADJACENT AND NONADJACENT DEPENDENCIES IN CHILDREN

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Our environment is permeated with statistical regularities, occurring among adjacent elements (e.g., the syllable /pre/ is more likely to be followed by /ti/ than /on/) and nonadjacent elements (e.g., the morphosyntactic rule *is* X-*ing* where the intervened X is a verb). Importantly, both adjacent and nonadjacent dependencies occur simultaneously in language and other domains. Previous research has investigated how humans acquire these adjacent and nonadjacent dependencies (e.g., Newport & Aslin, 2004). Concurrent learning of both dependencies has recently been shown in adults in extended and multiple learning sessions using auditory stimuli (e.g., Creel, Newport, & Aslin, 2004). This study extends this line of research by testing the hypothesis that concurrent learning rapidly occurs in children without extensive exposure to visual stimuli.

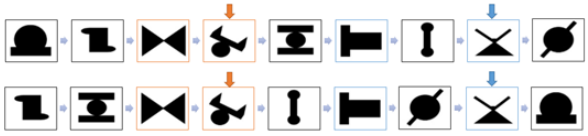

Fig. 1: Examples of adjacent (orange) and nonadjacent (blue) dependencies for trainings blocks 1–6.

Sixty-two children aged 10 to 11 years (M = 131 months, SD = 3.3) were tested first in a serial reaction time (SRT) task in which they were trained on materials comprising equally probable adjacent and nonadjacent dependencies by pressing keys that corresponded to each stimuli shown on screen as quickly and accurately as possible for 6–8 minutes. Fig. 1 illustrates two sequences of the SRT task: stimuli were shown one by one on screen in sequences over 6 blocks. Each sequence involved both adjacent and nonadjacent dependency. Examples of adjacent dependency are marked by orange boxes whereas examples of nonadjacent dependency are marked by blue boxes. These dependencies were violated in block 7 to test implicit learning. In a subsequent explicit judgement task, children were then required to discriminate between trained and untrained dependencies.

The results obtained from the SRT task (see Fig. 2) showed a speed-up from block 1 to 2 and subsequent blocks which indicates learning of key-image associations for adjacent/nonadjacent dependencies and other items that are not part of dependencies; slow-down from block 6 to 7 for adjacent and nonadjacent items but not the remaining items indicates that children learned and noticed the violation of learned dependencies (in block 7). Therefore, the reaction-time data show that children quickly developed sensitivity to both types of dependencies. This sensitivity was not found in the data from the explicit judgement task.

These findings suggest that implicit concurrent learning of both types of dependencies occurs rapidly in school-aged children. This shows that children rely on implicit mechanisms that allow them to simultaneously extract adjacent and nonadjacent regularities from their environment. However, children are not consciously aware of these regularities as suggested by the explicit judgement data.

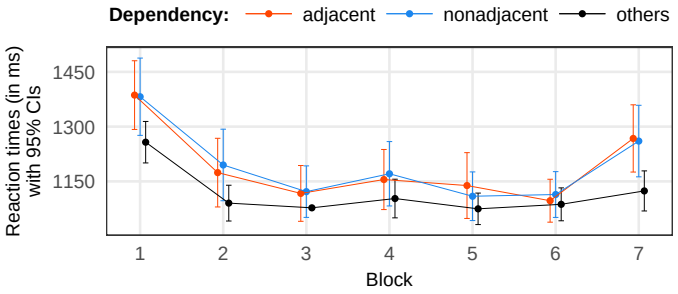

Fig. 2: Summary of SRT task data across blocks.

While learning statistical structures from exposure may first be implicit, it might become explicit over time and development. These conclusions are consistent with Daltrozzo and Conway's (2014) statistical-sequential learning model and Cleeremans' (2006) model of unconscious cognition.