DEVELOPMENTAL DIFFERENCES IN CHILDREN'S STATISTICAL LEARNING ABILITIES

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Infants, children and adults are constantly exposed to repeating patterns in their environment, and manage to learn and generalize from them. This ability – often called statistical learning (SL) - is postulated to be one of the important mechanisms in language acquisition [1]. Research over the past twenty years has shown that SL is present already from early infancy and found in a variety of tasks and modalities [2,3]. Though SL is well established for infants and adults, only few studies examine the developmental trajectory of SL abilities across childhood [4]. Even less work has compared auditory and visual learning throughout development. Moreover, studies of SL focus on the group level: learning is demonstrated when participants (as a group) show performance that is significantly above chance (50%). Yet recent work suggests that only a subset of participants show significant learning when looking at individual performance [5]. These findings raise questions about individual differences in SL, and the ability to correlate performance on SL tasks with other linguistic measures. To address these issues, we conducted a large-scale developmental study of both auditory and visual SL across a wide age-range (4-14, N=238), with three questions in mind: (1) Does auditory and visual SL improve with age? (2) Are there differences in SL abilities between modalities? And (3) What is the pattern of individual performance in children?

Children were tested on either an auditory or a visual SL task. In the auditory task (ASL) children were exposed to a stream of "alien" language containing 5 tri-syllabic "words" (modeled on [2]). In the visual task (VSL) children saw a visual sequence of aliens containing 5 triplets (modeled on [4]). Children showed significant learning in both modalities at the group level (ASL mean=55.2%, N=125; VSL mean=59.4%, N=113, $p's$<.05). Children's performance on both tasks significantly improved through development (Fig 1): they became better with age in both tasks (N=238, β=0.01, p<.0001). Interestingly, despite similar input statistics and transitional probabilities in both tasks, children's learning was significantly better in the visual domain (β=0.31, p<.0001). However, there was no difference in the developmental trajectories of SL skills across modalities (no interaction between modality and age, β=0.0002, p=0.97). Like adults, individual analyses showed that only a subset of children (less than 30%) could be defined as 'significant learners' as individuals (with accuracy over 67%, according to the Bernoulli distribution, see [5]).These results suggest that SL is not a unitary, stable mechanism [6], but rather one affected by (a) modality: visual SL is superior to auditory SL during childhood, (b) development: SL abilities improve with age, unlike language learning, which tends to *deteriorate* with age, and (c) individual differences: children differed in their ability to learn. We discuss implications for models of SL, and its role in language acquisition.

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Mean Accuracy by Age and Task