Infants with and without a familial risk of dyslexia differ in visuospatial sequential learning

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Introduction

Infants employ sequential learning, the implicit statistical analysis over sequences of perceived elements, in various domains, e.g.

- the language domain [1]
- the visual domain [2] and
- the visuospatial domain [3]

Indications of a sequential-learning deficit are found in individuals with dyslexia [4] and should be observable at a very young age. Both typically developing (TD) and infants at familial risk of dyslexia (FR) were tested.

The present study investigates the visuospatial domain.

Research hypothesis:

Sequential learning is hampered in developmental dyslexia.

Methods

Subjects

26 typically developing (TD) infants: 17 female; 9 male

18 infants at familial risk of dyslexia (FR): 10 female; 8 male

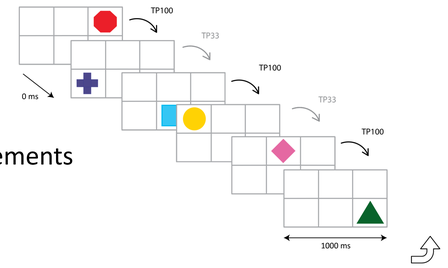
Mean age 8 months 7 days (range 7m14d – 9m8d)

Equipment

Tobii 1750 eye-tracker

Familiarization

Sequence of three pairs of elements (shape–colour–location)



Familiarization

Transitional probability (TP) = probability of Y following X.

Within pair: TP100, e.g. ● then always ✚

Between pairs: TP33, e.g. ✚ then ■ , ◆ or ●

Variable number of elements until infant became disinterested.

Blocks of 36 elements each (between-pair TP converges to TP33 at end of each block).

Dependent variable: dwell latency (time between element onset and start dwell of eye in element).

Test

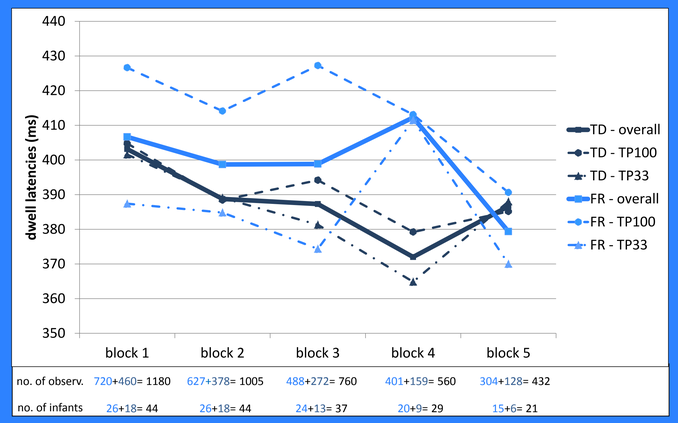
Six test trials alternating between

- novel sequences (same sequence of colour–shapes, but different locations)
- familiar sequences (as during familiarization)

Dependent variable: looking times.

Results

Familiarization



	block 1	block 2	block 3	block 4	block 5
no. of observ.	720+460= 1180	627+378= 1005	488+272= 760	401+159= 560	304+128= 432
no. of infants	26+18= 44	26+18= 44	24+13= 37	20+9= 29	15+6= 21

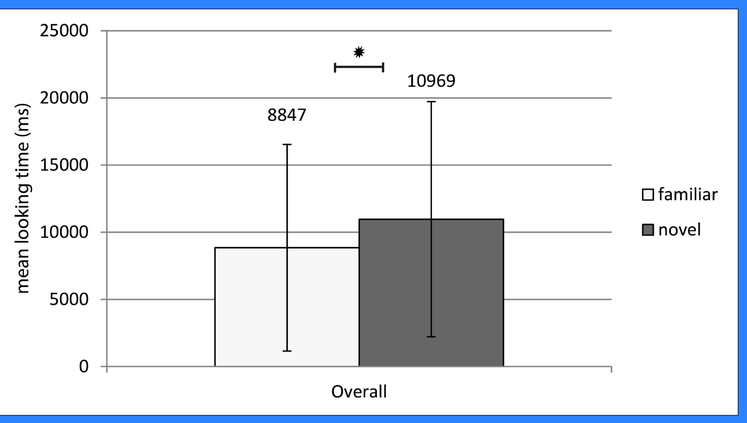
Mixed-effect model:

(i) Decreasing dwell latencies over blocks (p = .001)
Post-hoc: Block 1 higher dwell latencies than block 4 (p = .001) and block 5 (p = .038)

(ii) Shorter dwell latencies for TP33 than for TP100 transitions (p = .013)
Opposite to findings by Kirkham et al. (2007)

(iii) *Group*TP* interaction: effect of *TP* only present for the FR group (p = .003)

Test



Mixed-effect model:

Longer looking times to novel test trials than to familiar test trials (p = .020)

32/44 (73%) infants show (numerical) novelty effect (21/26 (81%) TD and 11/18 (61%) FR infants)

No main effect of *Group*
No interaction *Group*Trial type*

Discussion

- Both TD and FR infants show successful sequential learning
  - during familiarization, by decreasing dwell latencies over blocks
  - in test phase, by difference in looking times to novel test trials
- Novelty effect test phase supports results of Kirkham et al. (2007)
  - even with a slightly different sequence
  - with familiarization rather than habituation
- During familiarization, only FR infants show difference in dwell latencies between different TPs

i. Why TP33 < TP100 (which is opposite to Kirkham et al. 2007)?

Perhaps because

- sequence structure is different from Kirkham et al. 2007;
- TP33 offers 'a good target for an information-seeking infant with limited resources' [5]

ii. Why do only FR infants show *TP* effect?

This could be an indication of delayed sequential learning, but it could also be an indication of higher sensitivity to statistical information, but no evidence for either possibility was found in the literature.

References: [1] Saffran et al. (1996). *Science, 274,* 1926–1928; [2] Kirkham et al. (2002). *Cognition, 83,* B35–B42; [3] Kirkham et al. (2007). *Child Dev., 78,* 1559–1571; [4] Lum et al. (2013). *Res. Dev. Disabilities, 34,* 3460–3476; [5] Tummeltshammer and Kirkham (2013). *Dev. Sci., 16,* 760–771.

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