

Why Do Children Differ in Their Development of Reading and Related Skills?

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- Why do children differ in their development of reading and related skills?
- Answers to this question have been predominantly environmental, including preschool language and print exposure, the quality and quantity of reading instruction in school, peer and family influences, socioeconomic status (SES), and learning to read in a second language.
- This environmental focus is understandable because reading is a learned skill that initially depends on formal instruction.
- A different perspective on the aetiology of individual differences in reading and related skills has been provided by behavioural genetic studies that compare similarities between large samples of identical (monozygotic or MZ) and fraternal (dizygotic or DZ) twins who share their home and school environment, yet differ in their additive genetic similarity (100% for MZ pairs, 50% of segregating genes for DZ pairs).

General qualifications and limitations of twin research

- They are assessments of the sources of variance between individuals in a sample, not mean performance of that sample.
- Estimates of genetic and environmental influence are specific to the behaviourally-relevant environmental range in the sampled population.
- Behavioural genetic studies only describe the average current balance of genetic and environmental influences

on individual differences within a sample; they do not specify the genetic and environmental aetiology for any individual in that sample.

- Estimates of genetic and environmental influences do not speak to the possibility of changing the average reading level in a population.
- Genes are expressed through environment.

The genetic and environmental aetiology of reading disability

- DeFries and Fulker (1985) recognised that the continuous normal distribution of reading ability in the population could be used to support a continuous regression method for assessing the average genetics and environmental aetiology of twins' reading disability, based on the similarity of the MZ and DZ co-twins' regression to the population mean.
- In behavioural genetic studies, additive genetic influence is labelled as A, shared environmental influence as C, and non-shared environmental influence as E.
- Here, only A and C percentages are used, because E simply equals $100\% - (A\% + C\%)$.
- For reading disability, $A \sim 60\%$ and $C \sim 30\%$; thus, the average influence of genes is approximately twice as strong as the shared environment.
- The genetic effect is higher in a high SES environment than a low SES environment.

The genetic and environmental aetiology of individual differences in reading

- While it is important to understand the aetiology of reading disabilities, it is also important to understand the aetiology of the full normally-distributed variation in reading and related skills in the population.
- There are low-to-moderate genetic correlations between

word decoding and oral language.

- For example, the genetic correlation (r_g) between word recognition and listening comprehension is modest ($r_g = .37$).
- This highlights the importance of partly independent genetic influences on paired associate learning between print and speech for the development of word recognition.
- When reading and related skills were modelled as latent traits in children aged 10 and 16 years, the latent-trait longitudinal correlations were $r = .98$ for word recognition, $r = 1.0$ for phonological awareness, $r = .93$ for phonological decoding, and $r = .95$ for spelling.
- This means that most children establish a very stable developmental trajectory for growth in reading and related skills by 10 years of age.
- At preschool, most individual differences on a print-knowledge latent trait (primarily based on letter name and sound knowledge) were due to differences in shared family environment ($A = 20\%-26\%$; $C = 62\%-74\%$).
- By the end of kindergarten, most children could read enough words and nonwords that the genetic and environmental effect could be estimated according to their individual differences.
- Considering regional results, those individual differences were mostly due to genes in Australia ($A = 84\%$; $C = 9\%$) and in Colorado ($A = 68\%$; $C = 25\%$); however, in Scandinavia they were mostly due to shared environment ($A = 33\%$; $C = 52\%$). This may be because reading is not formally taught in Scandinavia until the first grade.
- However, after all children had received a year of formal reading instruction, genetic influence was approximately as strong in Scandinavia ($A = 79\%$; $C = 7\%$) as it was in Australia ($A = 80\%$; $C = 2\%$) and in Colorado ($A = 83\%$; $C = 7\%$) at the end of first grade.

- The conclusion drawn from these findings is that after a year of formal reading instruction, individual differences in word reading, spelling, and reading comprehension are highly influenced by genes in these populations.
- It is recognised that environmental influences have a significant effect, as the level of reading in the population is affected by learning to read in classrooms and homes.
- When compared with the strong shared environmental influences on preschool print knowledge, it appears that formal reading instruction in schools considerably reduces the environmental variance of reading development in these populations.
- In part, schools aim to overcome the factors that produce significant differences among children before they attend school, particularly when those environmental influences are negative.

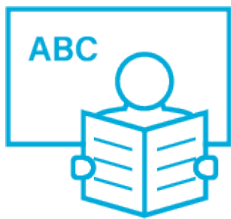


Summary

- In summary, the question, 'Why do children differ in their development of reading and related skills?' is answered by the evidence that suggests on average, after the first year of formal literacy instruction, genetic differences between children are mostly responsible.
- In principle, twin samples with greater reading-relevant environmental variance are likely to demonstrate lower average estimates for genetic influences and higher average estimates for environmental influences on individual differences or deficits in reading.
- It is important to consider that even when behavioural

genetic estimates of the average environmental influence within a sample are low, there can be extreme cases of poor reading within the sample that are entirely due to environmental influences (such as a particularly poor home, peer, or classroom environment for reading).

- The average classroom effect on individual differences in early grade reading has been consistently found to be small.
- It is recognised that extremely effective (or ineffective) teachers can have a very positive (or negative) influence that is not obvious from the very modest average influence of classroom differences on early reading development.



Implications

- The implication for education is that depending on the severity of reading difficulties, more reading practice (possibly involving computer or tutor support for decoding difficulties) may be required for children with genetically constrained learning rates for reading accuracy, fluency, and comprehension. This will support them attaining or more closely approaching the necessary 'grade-level' criterion (average performance).
- All children should have strong support for their reading development, including the opportunity for additional intensive instruction for those with learning difficulties in reading.
- The evidence for strong genetic influences on many reading difficulties (including reading fluency, which

appears most resistant to intervention) indicates that a much more nuanced approach is applied to reading ability expectations for children.

- There is evidence that some of the high genetic influence on reading ability is due to a gene-environment correlation for reading practice, further emphasising the importance of reading environment in reading development.
- Even if estimates of shared environmental variance are very low in a twin sample, this does not preclude changes in the environment for improving reading at the low end of the distribution in that sample, as well as across the whole sample.
- Thus, regardless of the levels of genetic and environmental influence in a population, there is always room for well-designed interventions (including extended reading practice) and research should continue to explore the most effective interventions for reading difficulty and for improving literacy in the population as a whole.