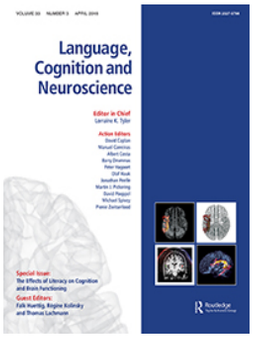

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PREFACE

The culturally co-opted brain: how literacy affects the human mind

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Reading and writing are activities that most people are engaged in every single day of their lives. Typically, people are not aware of what an amazing feat and extraordinary achievement this is. Reading and writing are astonishingly complex skills. It is for this reason that it takes years to acquire them. Reading and writing are multifaceted overlearned behaviours that require the fine-tuning of many perceptual and cognitive functions, including basic visual skills, phonological processes, oculomotor control, attentional mechanisms, executive control, long-term memory, working memory, etc. None of these functions however are specific to literacy, making effortless reading and writing an even more amazing accomplishment.

The mind has not evolved for this activity; reading and writing are human cultural inventions. The first writing systems are less than 6000 years old. This is just a tiny fraction of human existence on an evolutionary scale. In order to read therefore our brains have to make use of abilities that have evolved for different purposes. Pre-existing perceptual and cognitive skills must be recruited, modified and coordinated for the acquisition of the evolutionarily new cultural activity. Complex perceptual and cognitive procedures are overlearned and become automatised with extensive practice over years. This automatisation comes along with structural and functional changes in the brain: a "reading network" becomes functionally specialised. What are the consequences of this process for the human mind? How is information processing altered by learning to read and write? This special issue attempts to reflect on these questions by looking at normal and impaired literacy acquisition.

Learning to read requires that basic visual processes are adapted. Readers of the Latin alphabet, for instance, have to suppress or inhibit orientation invariance. In order to test the idea that literacy boosts mirror image discrimination, Fernandes, Coelho, Lima, and Castro (2018) conducted two experiments, contrasting on the one hand, preliterate children to age-matched beginning readers, and, on the other hand, three adult groups: illiterate participants, ex-illiterates (who have learned to read at adult age, without having attended school in childhood), and schooled literates. Their study demonstrates that an increase in mirror-image discrimination is not a function of general development but is primarily a specific effect of literacy acquisition. Furthermore, Fernandes et al. show that literacy acquisition specifically enhances the discrimination of reflections across the external vertical axis, whereas it does not affect the discrimination of reflections across the object principal axis. Finally, their study illustrates that mirror-image discrimination is easier when an object signals the use of one particular hand to grasp it. Thus, the ability to discriminate reflections across the external vertical axis is not driven by maturation or general cognitive development; the main underlying mechanism is literacy acquisition with a smaller but significant contribution of dorsal stream processes.

Malik-Moraleda, Orihuela, Carreiras, and Duñabeita (2018) compared illiterates with literate adults in their processing of strings made out of letters (either words or pseudowords) or visual objects. In a visual search task, literates outperformed illiterate participants for all types of materials. More interestingly, while illiterate participants processed letters in a similar way as non-letters, literates performed considerably better in the letter condition than in the object condition, and better with words than with pseudowords. This, according to the authors, reflects the advanced ability of literates to break down

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written strings into smaller units following literacy acquisition, an ability that partly generalises to the visual processing of non-linguistic material. In other words, literacy acquisition promotes a type of analytic, part-based processing that does not seem to be inherent to the visual system as it is not observed in illiterate people.

Many aspects of reading and writing can be characterised as universal across cultures and writing systems. There are, however, also some important differences. Chinese, for instance, makes use of a morphosyllabic system whereas English uses an alphabetic script. Zhou et al. (2018) compared native Chinese-speaking children (L1) with children learning Chinese as second language (L2). As expected, the native Chinese-speaking children showed a clear advantage in Chinese word reading and writing, but the L2 group showed an advantage in English word reading and writing. Crucially, whereas phonological awareness was essential for both groups when learning to read and write in English as second language, it was only for the L2 young learners that Chinese literacy performance varied solely according to their phonological awareness skills. In contrast, in reading and writing Chinese, the L1 children recruited a range of skills beyond phonological awareness, in particular morphological awareness and visual-spatial as well as visual-motor (copying) skills. Zhou et al. conclude that the latter set of skills are crucial for Chinese reading and writing and suggest that children who first learn an alphabetic or alphasyllabic script may be disadvantaged as they are prone to rely only on phonological skills for learning Chinese.

Although good phonological awareness skills are essential for proficient reading, it is also the case that literacy greatly improves phonemic awareness. Indeed, individuals with reading impairments tend to show typical symptoms, in particular deficits in phonological awareness and in phonological processing more generally. Stein (2018) argues that this does not necessarily mean that phonological processing deficits are the one and only causal factor for developmental dyslexia. He suggests that one important underlying cause of dyslexia is a deficit of the magnocellular system, characterised by transient responses and hence responsible for timing visual events when reading. This deficit would result in impaired temporal processing in the brain and hence in difficulties in the linear sequencing of sounds and letters in a word. According to this account, the phonological awareness deficit in dyslexia is thus a secondary symptom of a primary low-level deficit.

Banai and Ahissar (2018) also argue that low-level auditory deficits underlie reading impairments. They propose that sensitivity to distributional statistics is impaired in affected individuals. In particular, their implicit memory of speech stimuli is assumed to decay faster than in typical readers, thereby limiting the temporal window over which distributional statistics can be calculated. Impaired distributional learning therefore, they argue, results in impoverished speech categories that hamper reading acquisition. As this view proposes that dyslexic individuals suffer from a deficit in integrating stimuli across long temporal intervals, it seems in contradiction to the magnocellular deficit hypothesis.

Distinguishing cause from effect in reading impairments however is far from trivial. Huettig, Lachmann, Reis, and Petersson (2018) suggest that many deficits associated with developmental dyslexia are in fact a consequence of reduced and/or suboptimal reading experience. They point out that almost all deficits observed in individuals with dyslexia have also been observed in illiterate and low literate people. They conclude that the search for the causes of reading impairments will only succeed if both quantitative and qualitative reading experience is taken adequately into account.

Literacy impacts not only individual minds but also society and humanity as a whole. Morais (2018) develops a conceptual framework to account for the complex interactions between literacy and democracy. He argues that literacy does not stop at the end of the reading acquisition process but has continuous profound effects on thinking and knowledge. Morais suggests that literacy can be negative if it is focused on mere skills and oriented towards serving purely capitalist market needs or totalitarian and pseudo-democratic systems. He argues that literacy must be free to serve the flow of ideas and critical thinking, open to analysis of complex issues, and enable well-informed public debate and collective decision-making. Morais argues that the more literate individuals are the better they participate in exercising control over the affairs of their community and can contribute to truly democratic governing. This idea is particularly challenging in the light of the fact that, as Morais remind us, illiteracy rates remain quite high worldwide, with about 15% of people aged 15 years or more (this represents 758 million!) who are illiterate in the sense that they are unable to read and write a very short and simple statement (the United Nations definition for literacy, UNESCO, 2016).

Illiterate individuals are over-represented among the elderly in many countries (24% of individuals aged 65 years old or more are illiterate, UNESCO, 2015). Kosmidis (2018) discusses the fact that their discrepancies in cognitive functioning compared with literates calls into question the appropriateness of the cognitive measures used in clinical assessments. Indeed in many tests illiterate individuals' performance resembles that of literates suffering from a progressive neurodegenerative disease (e.g. dementia), leading to potential over-diagnosing

illiterate individuals. Kosmidis critically analyzes several ways of improving diagnostic assessment of elderly illiterate individuals. This issue is complicated by the fact that literacy modifies both brain functioning and brain structures, and by the possibility that, according to the cognitive reserve hypothesis, increased education (usually correlated with literacy level) affords the brain increased resistance to cognitive decline and brain pathology or alterations correlated with aging. She suggests that perhaps the most appropriate approach to the neuropsychological assessment of illiterate elderly individuals would be to train them on the test before assessment, to the extent that schooling trains a series of cognitive strategies, procedures and skills that illiterate unschooled individuals have had no opportunity to automatise. This would help illiterate participants to develop metacognitive processes that are needed to understand the demands of the tasks at hand and rehearse strategies.

Indeed, as literate people we tend to forget that over our recent past the human mind has become the literate mind and that the history of humankind over the last thousands of years is inextricably linked to the history of literacy. The recent technological advances for instance are unimaginable without the advent of literacy. Reading and writing also change our brains and cognitive processing in non-trivial ways. The papers in this special issue provide pertinent examples of this. Investigating how cultural inventions such as reading and writing modulate perceptual and cognitive processing and brain functioning thus offers a valuable tool to understand the human mind and brain itself.

References

Banai, K., & Ahissar, M. (2018). Poor sensitivity to sound statistics impairs the acquisition of speech categories in dyslexia. *Language, Cognition and Neuroscience*, *33*(3), 321–332.

Fernandes, T., Coelho, B., Lima, F., & Castro, S. L. (2018). The handle of literacy: Evidence from preliterate children and illiterate adults on orientation discrimination of graspable and non-graspable objects. *Language, Cognition and Neuroscience*, *33*(3), 278–292.

Huettig, F., Lachmann, T., Reis, A., & Petersson, K. M. (2018). Distinguishing cause from effect – Many deficits associated with developmental dyslexia may be a consequence of reduced and suboptimal reading experience. *Language, Cognition and Neuroscience*, *33*(3), 333–350.

Kosmidis, M. H. (2018). Challenges in the neuropsychological assessment of illiterate older adults. *Language, Cognition and Neuroscience*, *33*(3), 373–386.

Malik-Moraleda, S., Orihuela, K., Carreiras, M., & Duñabeita, J. A. (2018). The consequences of literacy and schooling for parsing strings. *Language, Cognition and Neuroscience*, *33* (3), 293–299.

Morais, J. (2018). Literacy and democracy. *Language, Cognition and Neuroscience*, *33*(3), 351–372.

Stein, J. F. (2018). Does dyslexia exist? *Language, Cognition and Neuroscience*, *33*(3), 313–320.

UNESCO. (2015). *UIS fact sheet*. September 2015, No. 32. Retrieved from http://www.uis.unesco.org/literacy/Documents/fs32-2015-literacy.pdf

UNESCO. (2016). *Education for people and planet. Global education monitoring report 2016*. Paris: Author. Retrieved from http://unesdoc.unesco.org/images/0024/002457/245752e.pdf

Zhou, Y., McBride, C., Leung, J. S. M., Wang, Y., Joshi, M., & Farver, J. A. (2018). Chinese and English reading-related skills in L1 and L2 Chinese-speaking children in Hong Kong. *Language, Cognition and Neuroscience*, *33*(3), 300–312.