The impact of early and late literacy on the functional connectivity of vision and language-related networks

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Introduction: Learning to read leads to functional and structural changes in the cortical regions related to vision and language. The visual word-form area (VWFA) is though to play a key role in the interaction between these two systems (Dehaene et al. 2015). For instance, the VWFA is activated not only from bottom-up during reading but also in a top-down manner during speech listening without visual stimulation (Dehaene et al. 2010). The objective of this study was twofolded: how literacy acquisition affects four intrinsic functional connectivity networks related to vision and language (a dorsal language [DLN], a bilateral auditory [AN], a low-level [LLVN] and a high-level visual [HLVN] networks); and to explore the role of the VWFA as an interface between high-level vision and language functions.

Methods: Independent component analysis (ICA) was applied to functional magnetic resonance imaging data from 40 adult participants with variable levels of literacy (illiterate, late literate and early literate). The four functional connectivity networks were compared across groups using dual-regression (Filippini et al. 2009). In addition, we directly explored the functional connectivity between the VWFA and each of the studied networks. Finally, the strengh of connectivity between the VWFA and each network was compared across groups and correlated with individual reading fluency scores.

Results: ICA produced 40 networks, and spatial crosscorrelation was used to identify the four networks of interest. Literacy was positively correlated with increased connectivity within the four networks. A major difference separating early literate from illiterate and late literate subjects was found. The connectivity between the VWFA and the DLN increased with literacy. Conversely, the strength of connectivity between the VWFA and the HLVN correlated negatively with literacy. Finally, , the HLVN-VWFA connectivity was negatively correlated with reading scores while the connectivity between the DLN-VWFA was positively correlated with reading scores.

Discussion:Literacy has a strong influence on the visual and language functional networks. Literacy modifies the VWFA connectivity, by making it functionally closer to the language system, and more distinct from other associative visual areas that do not contribute to the reading process. The current results suggest that early acquisition of literacy plays a critical role for the tuning of the functional brain architecture.

References: -*Dehaene S et al. Nat Rev Neurosci.(2015)16:234 244*
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