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Introduction

• Most researchers believe that there is a strong association between early language acquisition and normal cognitive development (critical period hypothesis, Lenneberg, 1967); however, there is no consensus on the neurological mechanism of this association. We analyzed published reports of children who grew up without exposure to formal language, such as feral children, and deaf linguistic isolates, since these cases present a rare opportunity to study the effect of syntactic language on the developing brain.

• Feral children grew up in an isolated environment, with little or no exposure to human language (see the case of Genie and Victor of Aveyron).

• Deaf linguistic isolates grew up communicating to their families using home sign, a system of iconic gestures which is typical of families that live isolated from a sign language community, and which often develops spontaneously between deaf children and their hearing parents. This type of communication consists of simple commands but lacks much in the way of syntax.

Materials and Methods

• We analyzed all published reports of individuals not exposed to a syntactic language until puberty, who were subsequently treated as adults following several years of rehabilitation: two reports of feral children and eight reports of deaf linguistic isolates.

• All tests performed on these individuals were sorted by how much these tests rely on the ability to create and inspect novel mental images:

• For example, tasks of vocabulary comprehension do not require creating any novel mental images. On the other hand, a subject's ability to follow the direction of "putting the bowl on top of the cup," hinges not only on their ability to recognize the words "bowl" and "cup" (simple task) but also to imagine the two objects in the correct and novel spatial arrangement.

• We call the cognitive process of actively creating mental images mental synthesis.

Clinical outcome of syntactic language deprivation

• According to our analysis, feral children and deaf linguistic isolates performed poorly in all of the more complex tests that require mental synthesis.

• The consistent observation of reduced myelination and asynchronous connections between the PFC and the posterior cortex.

• Myelination and electrophysiological studies suggest that the likely problem of linguistically deprived children is the reduced connectivity between the PFC and the posterior cortex.

• The PFC-posterior cortex connection model indicates that syntactic language exercises in neurotypical children, which include > second-order imagining, exposure to fictional stories and complex conversations, etc., provide the necessary input for fine-tuning those connections.

• The model predicts that mental synthesis relies on synchronous networks, whereby fiber conduction velocity is equilibrated by increased myelination of longer fibers (see Fig. 1).

• A long exposure to a syntactic language before the end of the critical period appears to result in reduced myelination and asynchronous connections between the PFC and the posterior cortex.

• Exposure to a syntactic language past the critical period can improve mental synthesis, but it has little effect on the cognitive problem of mental synthesis disability.

• Thus, it is very important to develop mental synthesis before the end of critical period.

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