Cortical and white matter myelin contents are linked in newborns

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1 Introduction

Myelin → membrane that encases axons and provides electrical insulation and metabolic support (Simons & Nave, 2015)

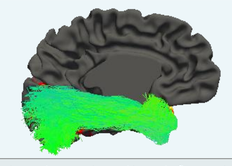
Mainly localized in white matter, but grey matter also contains myelinated axons (Timmler & Simons, 2019)

Hypothesis

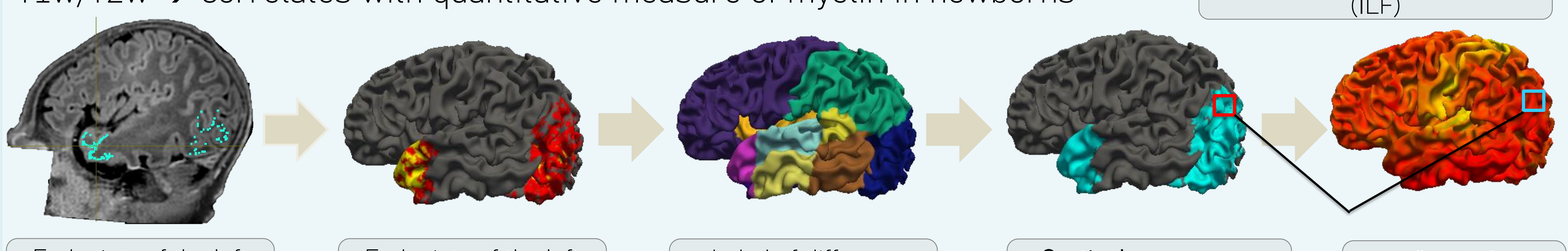
During infancy, white matter myelination is linked to the myelination of the cortex, so that the T1w/T2w of white matter bundles correlates with T1w/T2w of their cortical targets

2 Methods

Data of n = 279 infants collected by the Developing Human Connectome project (dHCP)
Bundle identification done with pyBabyAFQ (Grotheer et al., 2022)
T1w/T2w → correlates with quantitative measure of myelin in newborns



Inferior longitudinal fasciculus (ILF)



Endpoints of the left ILF in **volume** space | Endpoints of the left ILF in **surface** space | Label of different **cortical** regions | **Cortical** gray matter regions of ILF endpoints | Cortical Myelinmap

3 Results

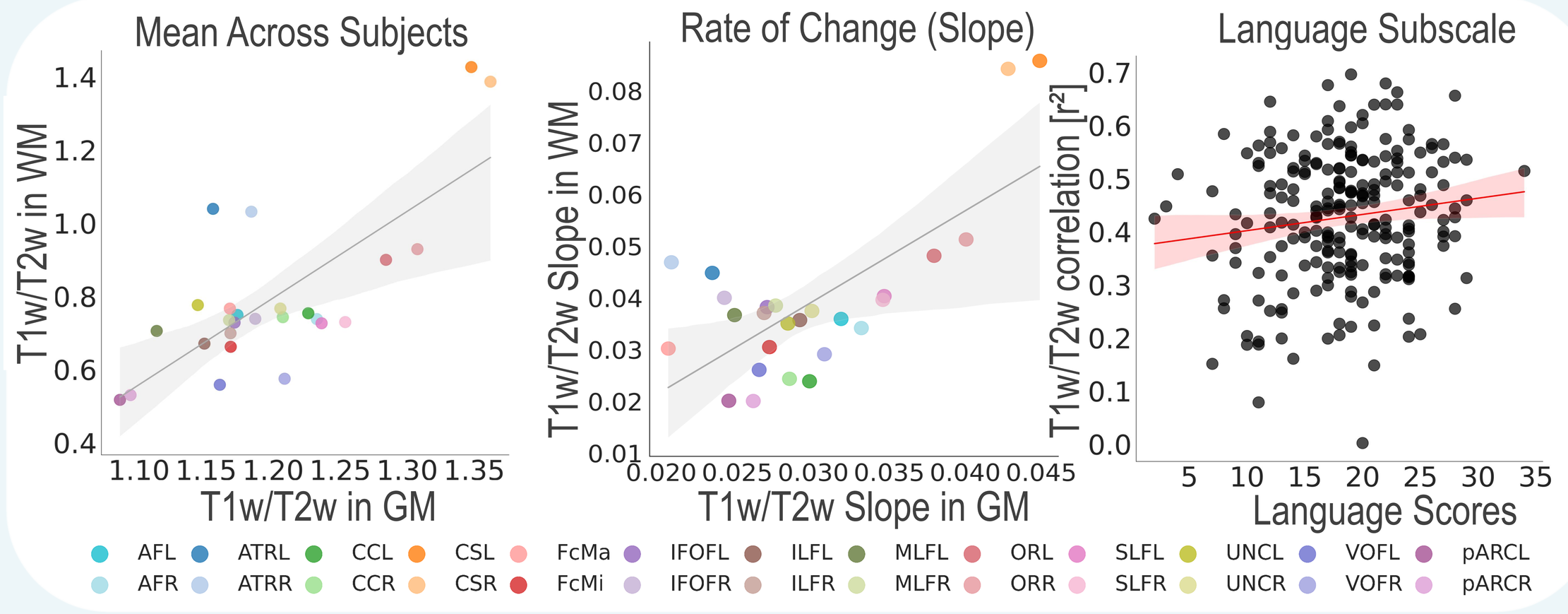


Figure 1. **(A)** Relationship between T1w/T2w of white matter (WM) tracts and their respective gray matter (GM) targets (r^2 = 0.55, p = $1.45e^{-5}$). Each dot is a tract, averaged across all participants . **(B)** Relationship between the rate of change (slope) of T1w/T2w along white matter (WM) tracts and their gray matter (GM) targets (r^2 = 0.49, p = $6.28e^{-5}$). The slope indicates the increase in T1w/T2w values with infants' age in weeks), each dot is a tract. **(C)** Relationship between the Language subscale of the Bayley-III and T1w/T2w in the correlation between T1w/T2w in gray and white matter in each individual subject (r^2=0.02; p-value= 0.04). Abbreviations: L=left hemisphere R=right hemisphere, AF=arcuate fasciculus, ATR=anterior thalamic radiation, CC=cingulum cingulate, CS=corticospinal tract, MLF=middle longitudinal fasciculus, ILF=inferior longitudinal fasciculus, OR=optic radiation, UNC=uncinate fasciculus, SLF=superior longitudinal fasciculus, VOF=vertical occipital fasciculus, IFOF=inferior frontal occipital fasciculus, FcMi=forceps minor, FcMa=forceps major, pARC=posterior arcuate fasciculus

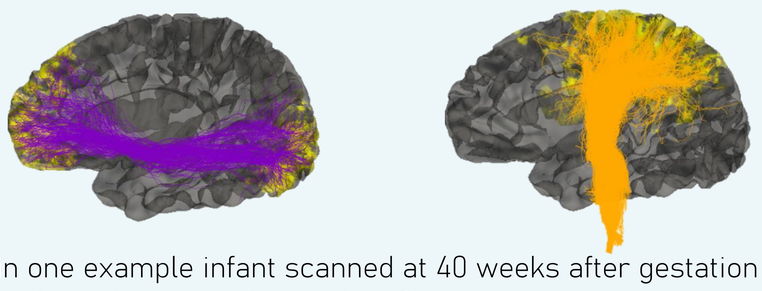


Figure 2. Examples of the tracts identified with pyBabyAFQ in one example infant scanned at 40 weeks after gestation (time between birth and scan: 6 days). The yellow dots represent the cortical endpoints of the respective tracts . Purple: inferior frontal occipital fasciculus; Orange: corticospinal tract.

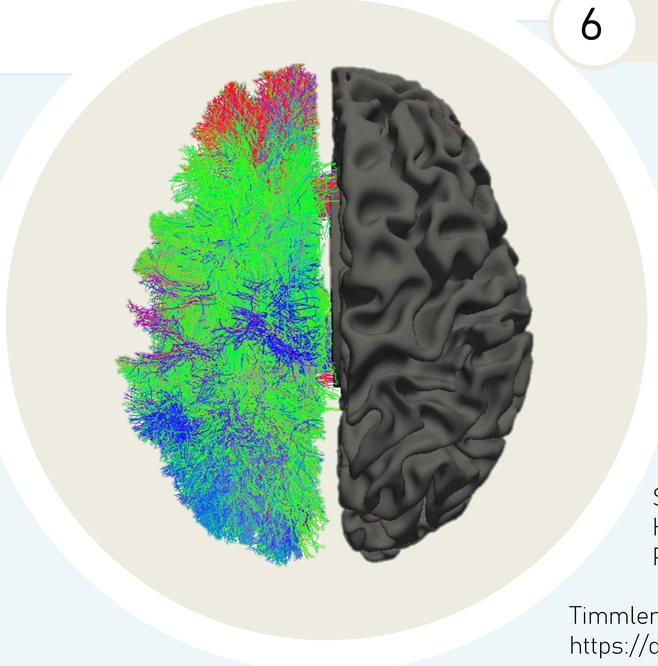
5 Discussion

coordinated genetic regulation

activity-dependent mechanisms

common metabolic and microenvironmental factors

"vocabulary explosion" at 17 to 18 months



6 Conclusion

T1w/T2w in white-matter tracts and their cortical targets is highly correlated — both in absolute levels and developmental change — with the corticospinal tract showing the strongest effect.
Individual differences predict linguistic proficiency, highlighting coordinated white-matter–cortex maturation as a substrate for language ability.

7 References

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