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Investigating the association between white microstructure and cognitive performance in the oldest old : a DTI analysis from the Fibratlas cohort

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Introduction

Normal aging

- Modification of cognitive functions (especially in processing speed, working memory, executive functions, and long-term episodic memory).
- Microstructural changes in the white matter of the brain (observable using diffusion tensor imaging^{1,2})

Significant role of white matter in processing speed, executive function, and episodic memory : important role of the cingulum and corpus callosum in tasks involving executive function³.

Few studies on correlation brain microstructure and cognitive function **on very old individuals** (over 80 years old)

Preliminary study with 30 subjects from Fibratlas Cohort :

No role for the cingulum and corpus callosum in verbal episodic memory performance
No association between the left and right cingulum frontal parahippocampal and corpus callosum forceps minor bundles and cognitive function examined.
Questionable small negative correlation between FA and digit span

Research issues :

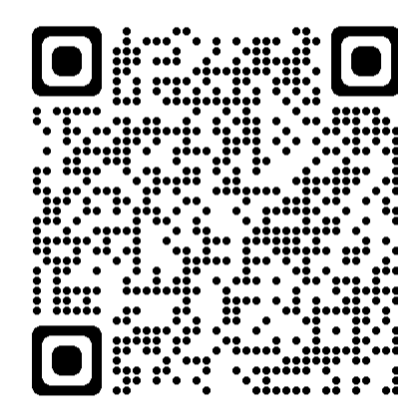
Investigate correlation between Corpus Callosum and Cingulum with cognitive performance in processing speed, executive functions, and episodic memory in very old age

Methodology

Participants

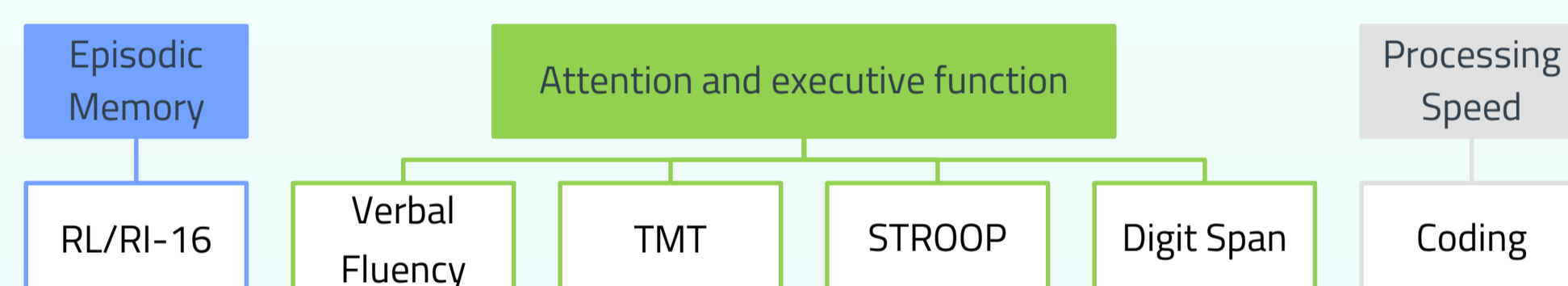
Sample of 73 participants aged 82 to 93,6 (m= 84,9 ± 3) from **FIBRATLAS cohort**

- Healthy french participants
- No history of neurologic or neurosurgical disease
- No major impairment
- IADL ≥ 4



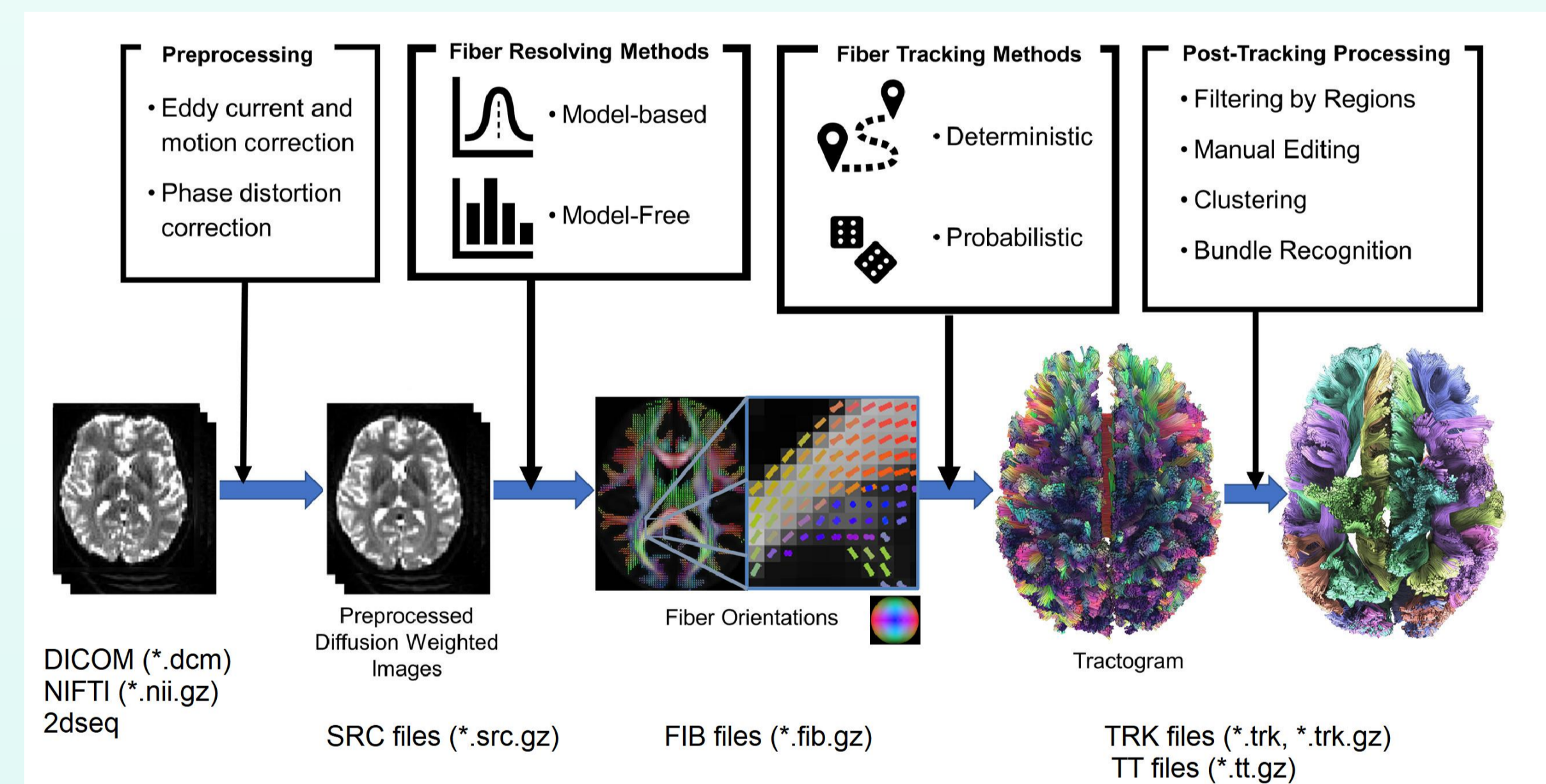
Materials & Methods

1 Analysis of **cognitive measures** extracted from the neuropsychological assessment performed at inclusion



2 Reconstruction of **cingulum bundle** and **corpus callosum** using **DSI Studio**

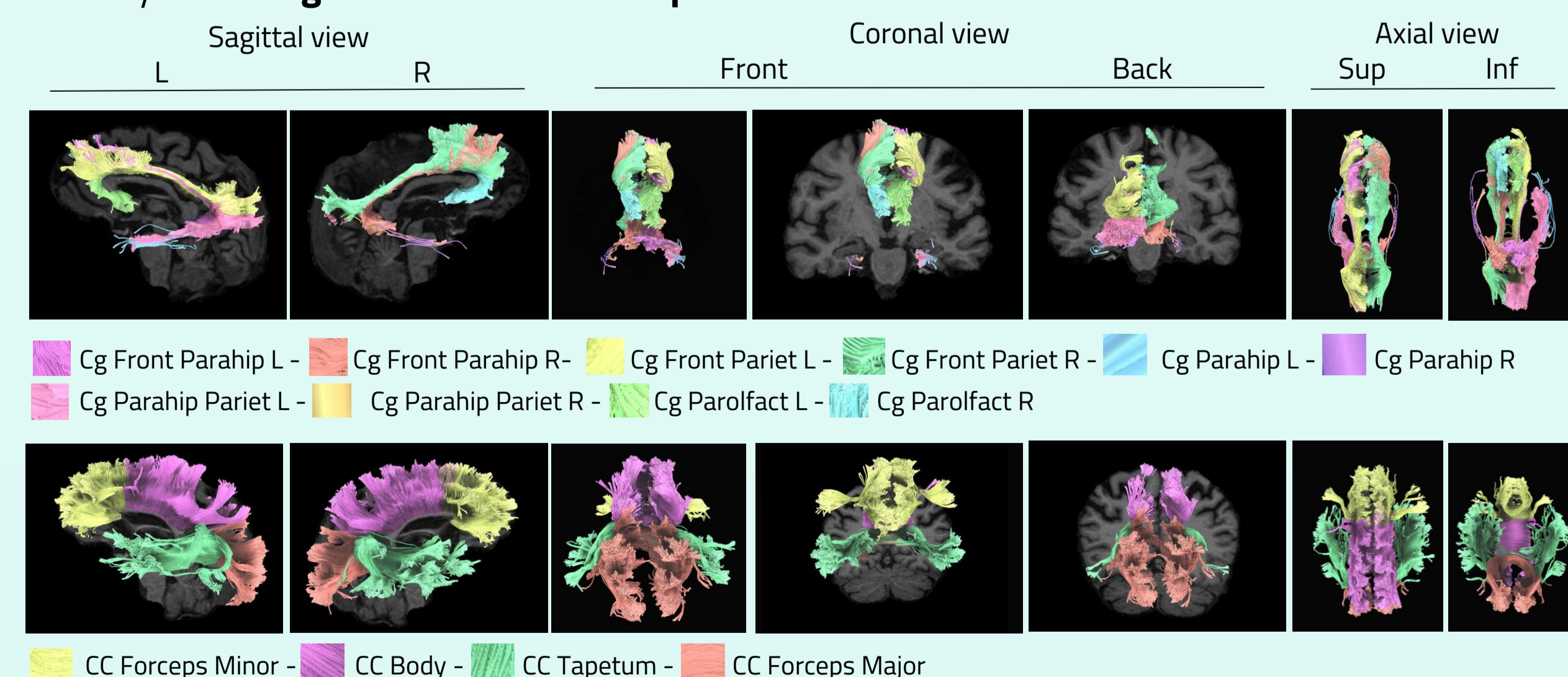
A deterministic fiber tracking algorithm⁴ was used with augmented tracking strategies⁵ to improve reproducibility



Source : https://dsi-studio.labsolver.org/doc/how_to_analyze_dmit.html

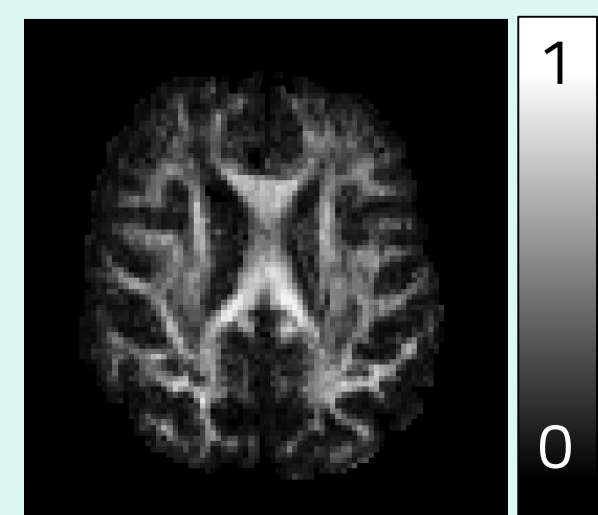


3 Analysis of **cingulum bundle** and **corpus callosum**



4 White matter bundles metrics analysis*

| FA | Fractional Anisotropy | measure of the directional dependency of a diffusion process (value 0 to 1) |
|----|-----------------------|--|
| MD | Mean Diffusivity | average of the three eigenvalues of the diffusion tensor (mm ² /s) |
| AD | Axial Diffusivity | diffusion speed of water molecules along the main diffusion direction (mm ² /s) |
| RD | Radial Diffusivity | diffusion speed of water molecules perpendicular to the primary diffusion direction (mm ² /s) |



*degree of diffusion weighting used : b-value=1200s/mm²

Results

Correlations between scores and white matter bundles metrics were examined. Partial correlations were performed to control the effect of age. Only significant correlations are reported below.



Conclusion

- ✓ **No role for the cingulum and corpus callosum in verbal episodic memory performance**
- ✓ **Significant but moderate relationship found between tests of executive function and different parts of the Corpus Callosum and Cingulum Frontal Parietal**
- ✓ **Fractional Anisotropy : relevant measure for investigating links between white matter bundles and executive function**
- ✓ **Questionable moderate negative correlation between FA and Digit Span test**
- ✓ **This study could be complemented by analysis of a larger number of bundles involved in episodic memory performance, executive function and processing speed (fornix, uncinate bundle, inferior and superior longitudinal bundles).**

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