

Everyday taxi drivers: Do gifted navigators have larger hippocampi?

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Introduction

What is the relation between the hippocampus (HC) and navigation ability?

1. HC larger in navigation experts than non-experts¹.
2. HC lesions correlate with impaired navigation².
3. HC activity patterns correlate with place strategy³, distance coding⁴.
4. HC gray matter volume correlates with *some* navigational tasks^{5,6}.

But does navigation ability correlate with hippocampal volume in a typical, healthy population?

Structure-Function Hypothesis: Larger HC \leftrightarrow Better navigation

Measures

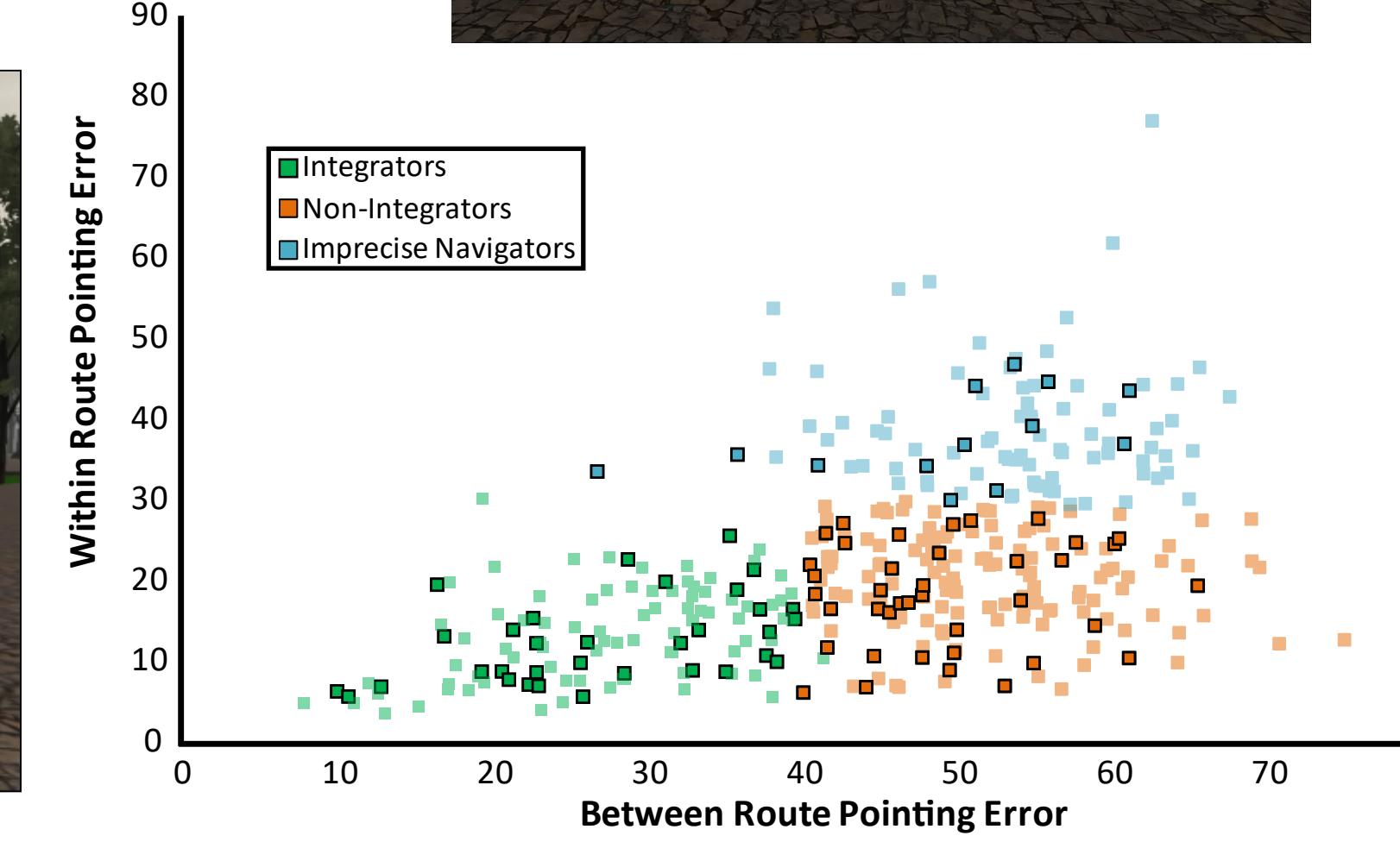
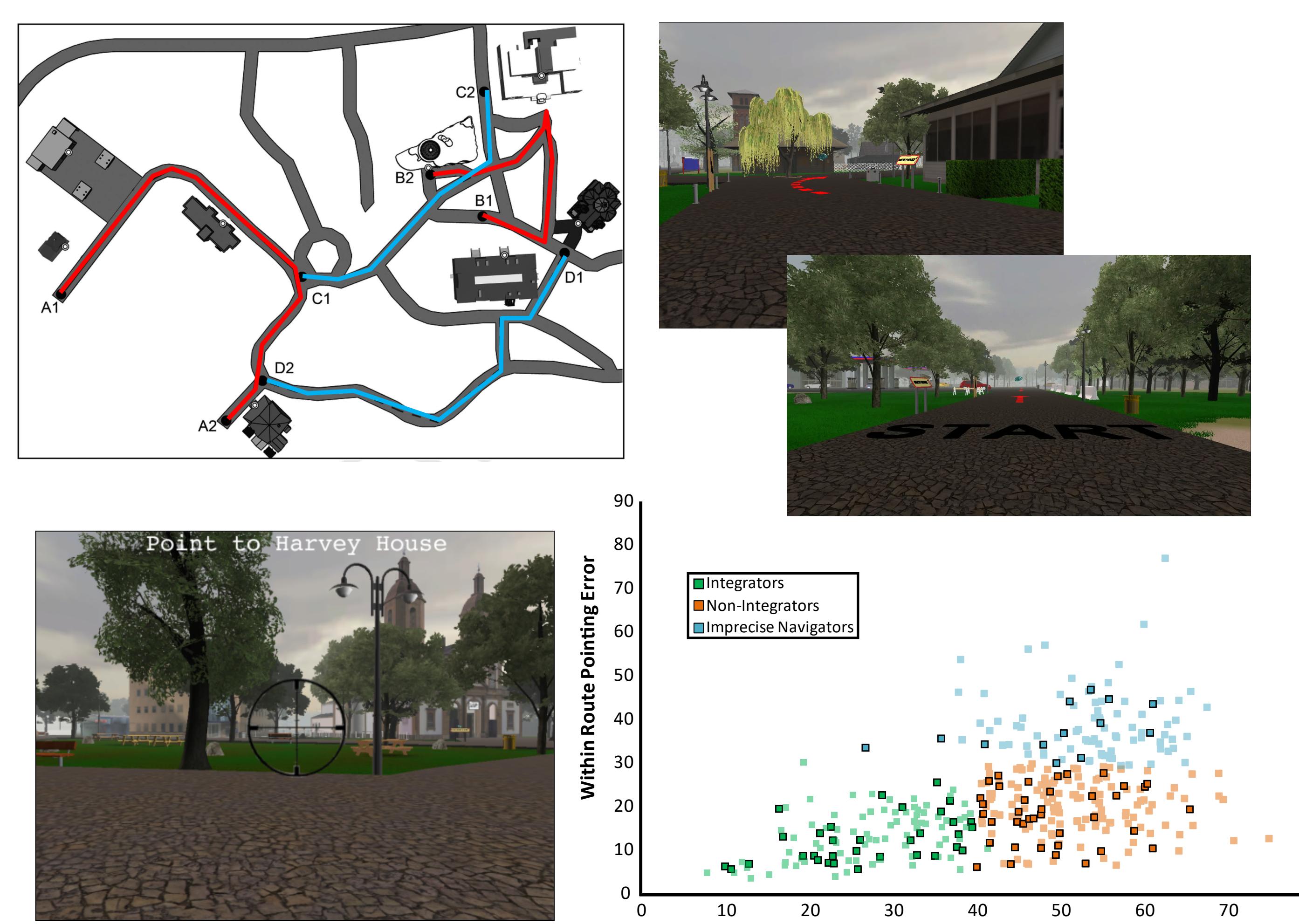
Behavioral Measures:

- Virtual Slichton^{7,8}
Santa Barbara Sense of Direction⁹
Verbal Ability
Mental Rotation Test (MRT)

N = 84 (52 women), excluding 2 outliers

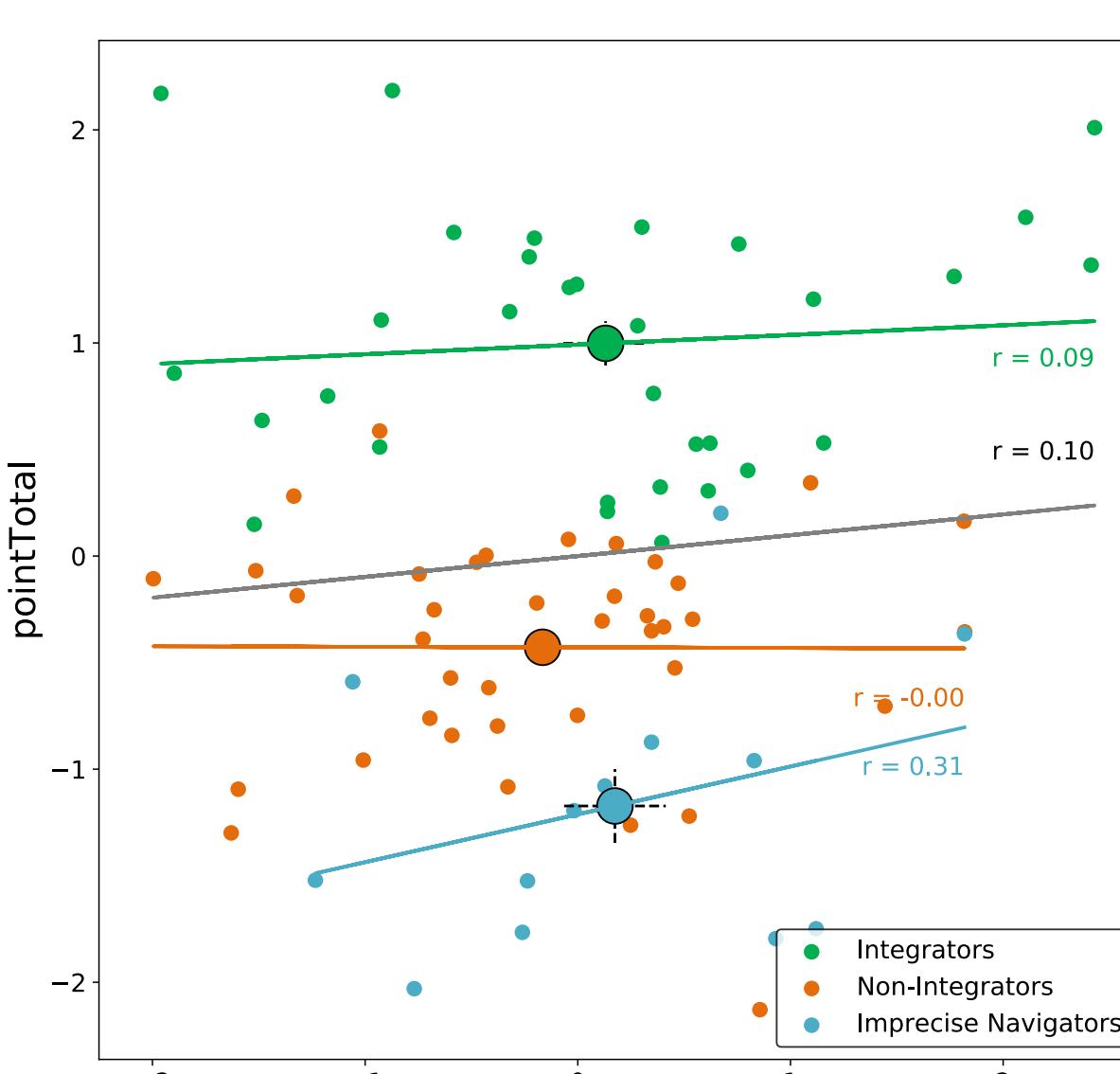
Pre-registered correlation: R-HC volume with pointing accuracy

Virtual Slichton

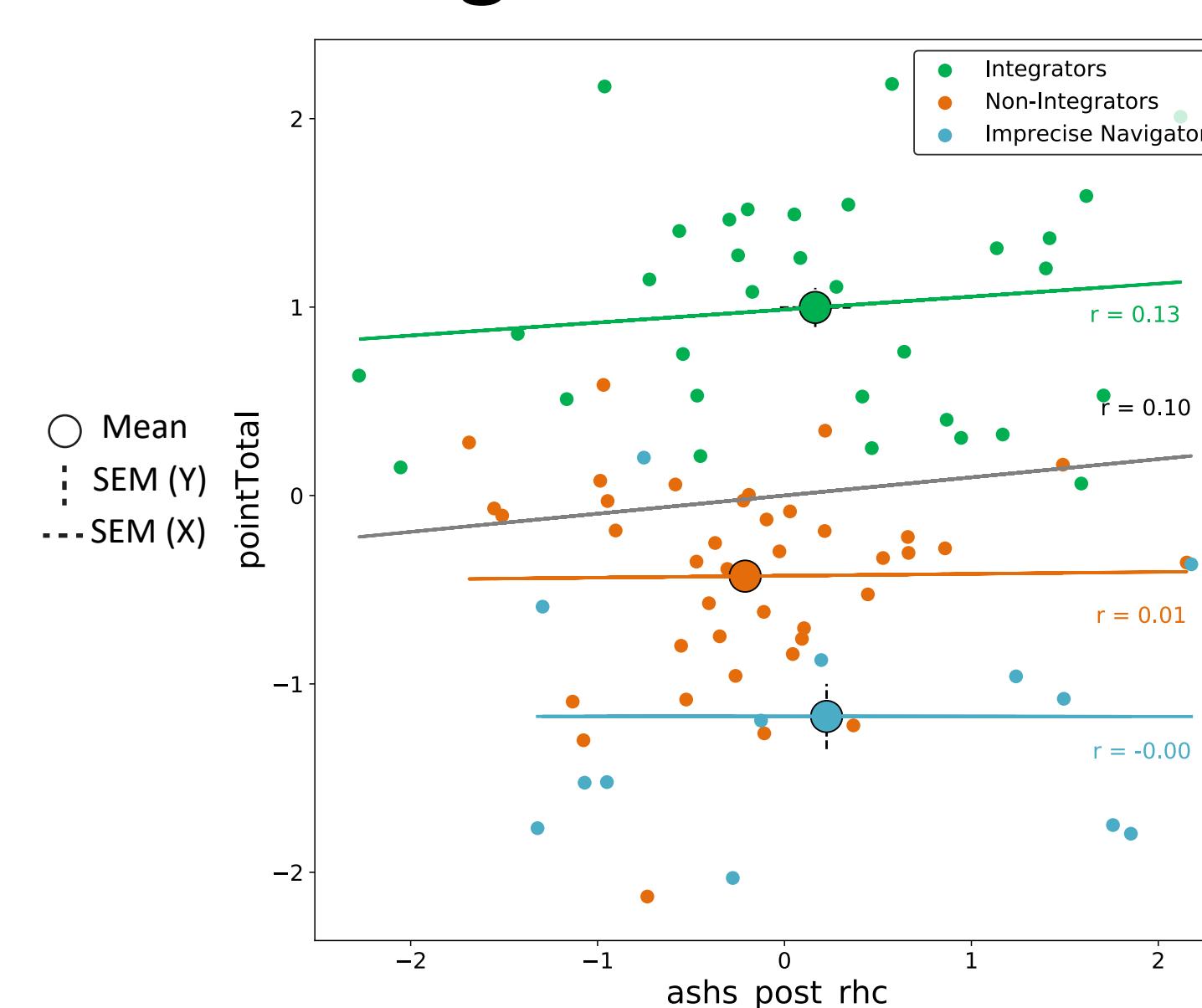


Pre-registered Results

Right Hippocampus

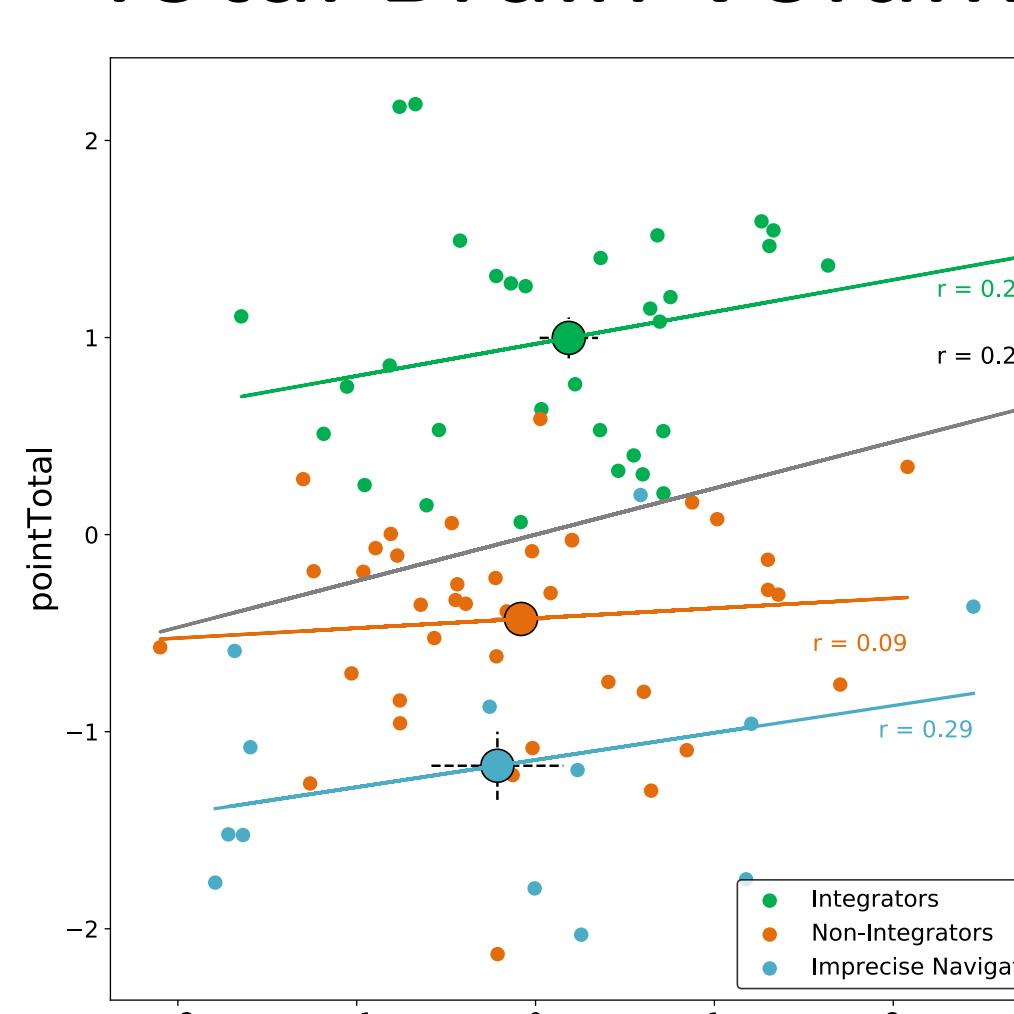


Right Posterior HC

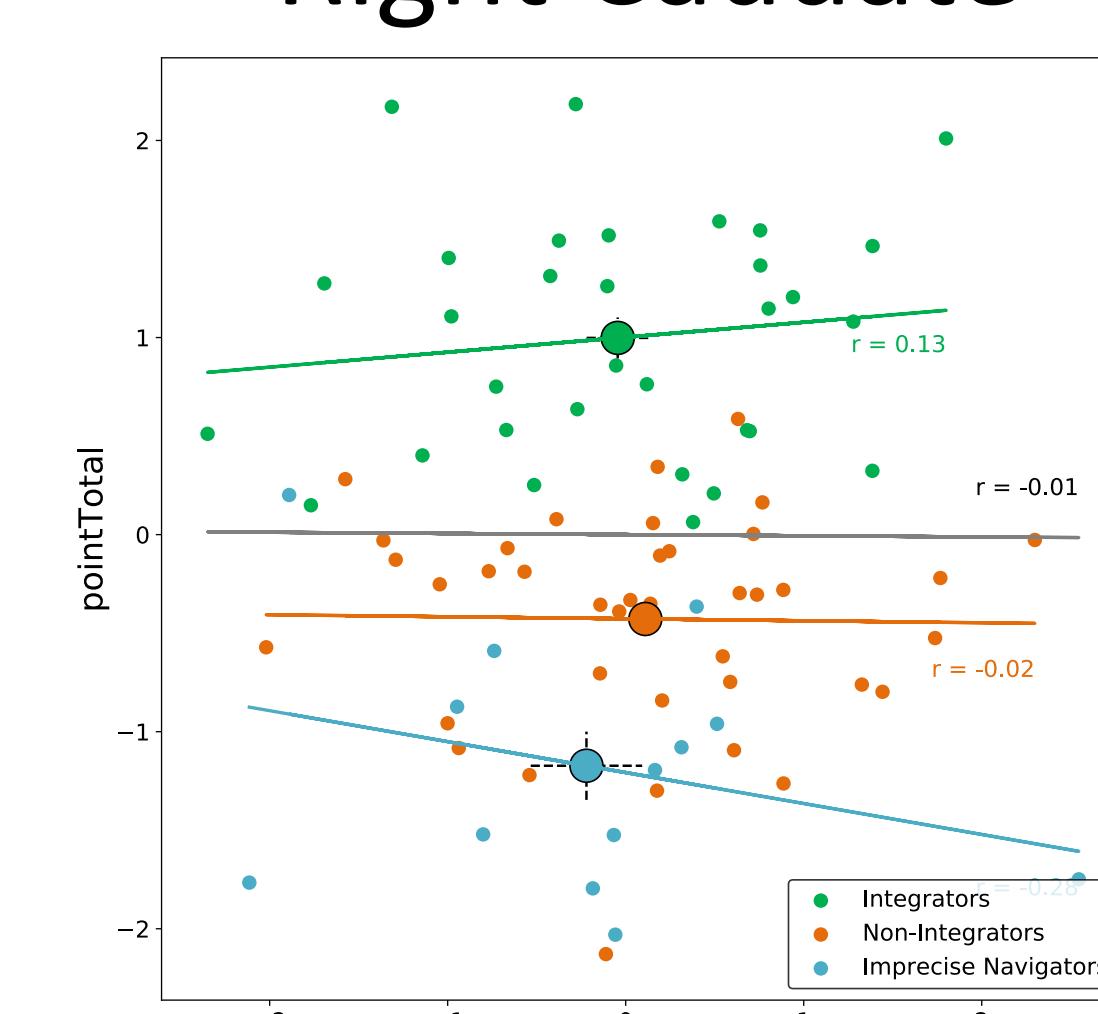


Exploratory Results

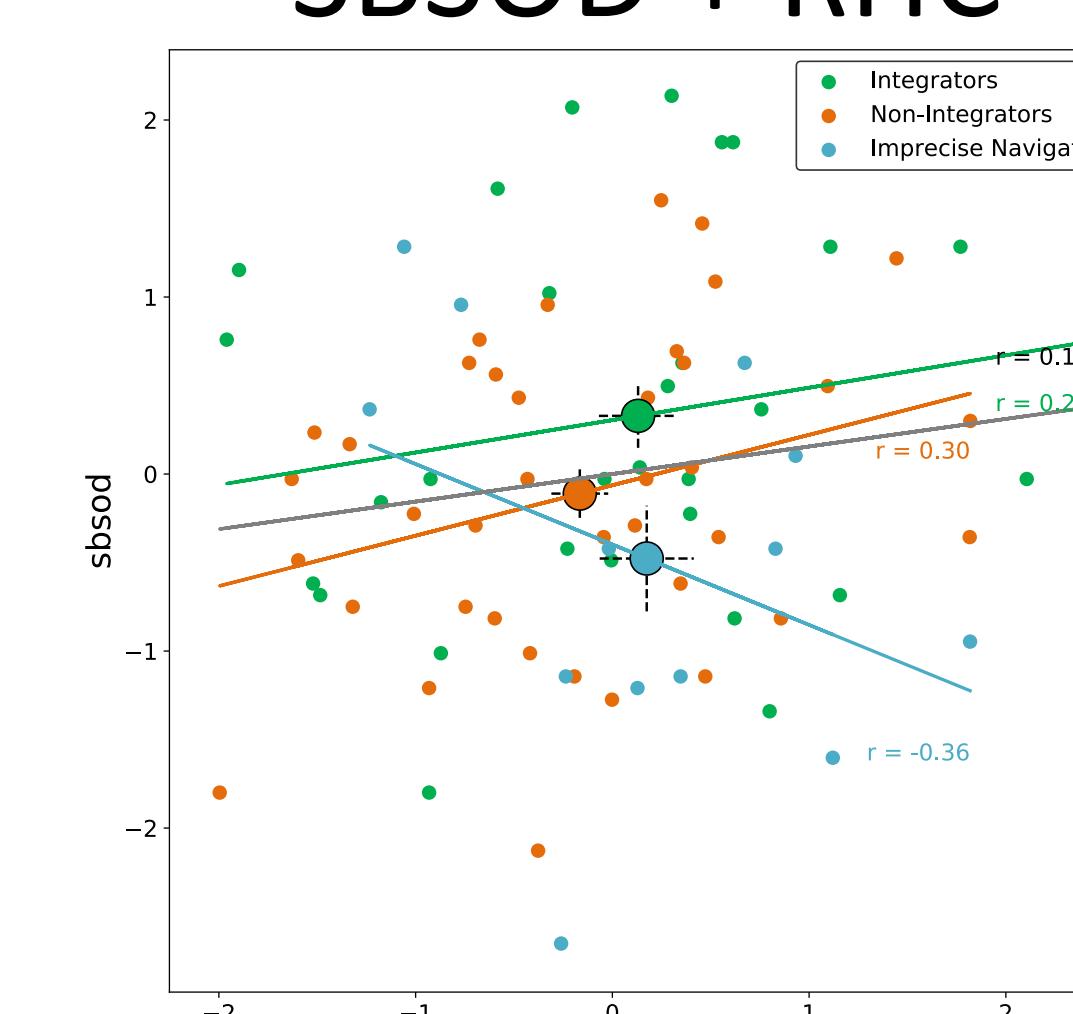
Total Brain Volume



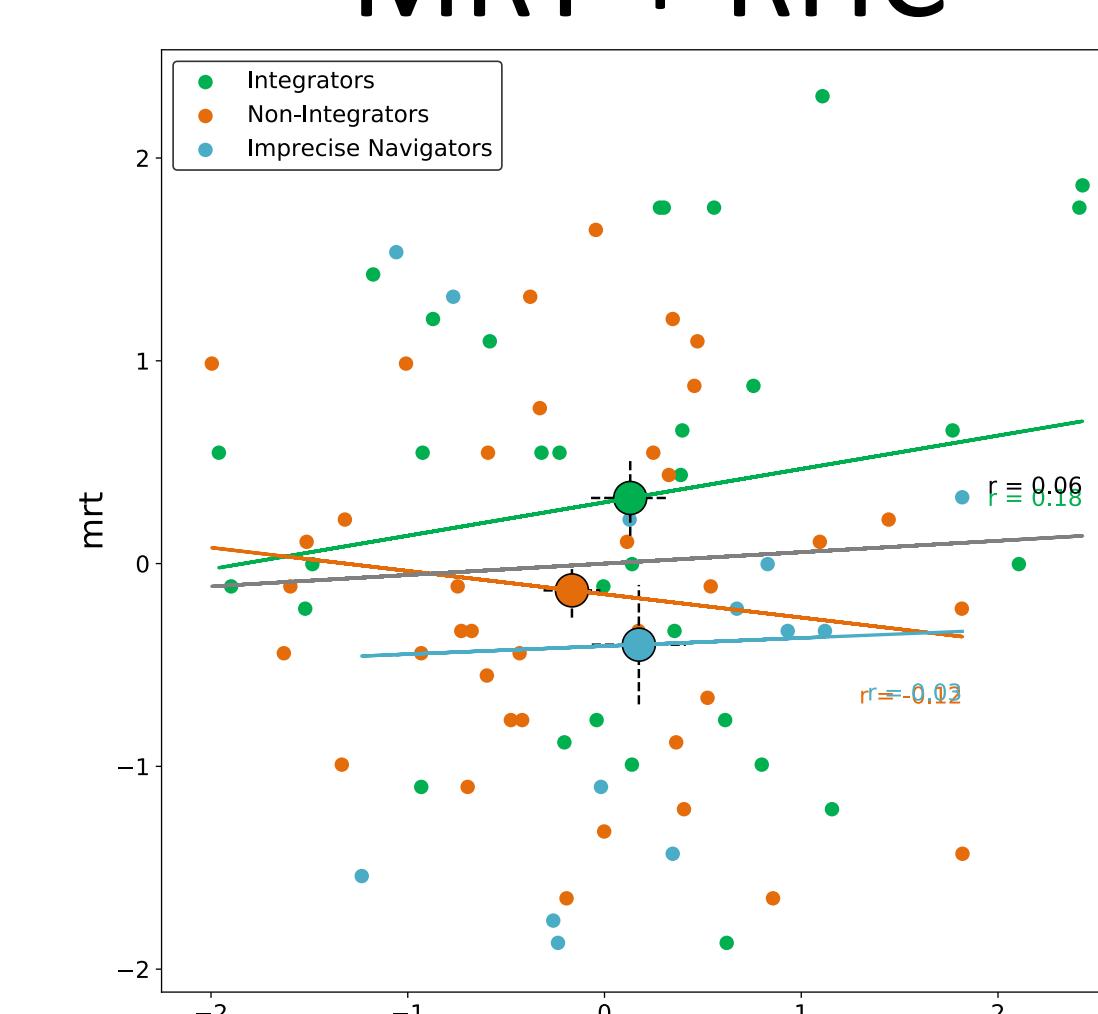
Right Caudate



SBSOD + RHC



MRT + RHC



Additional non-significant analyses:

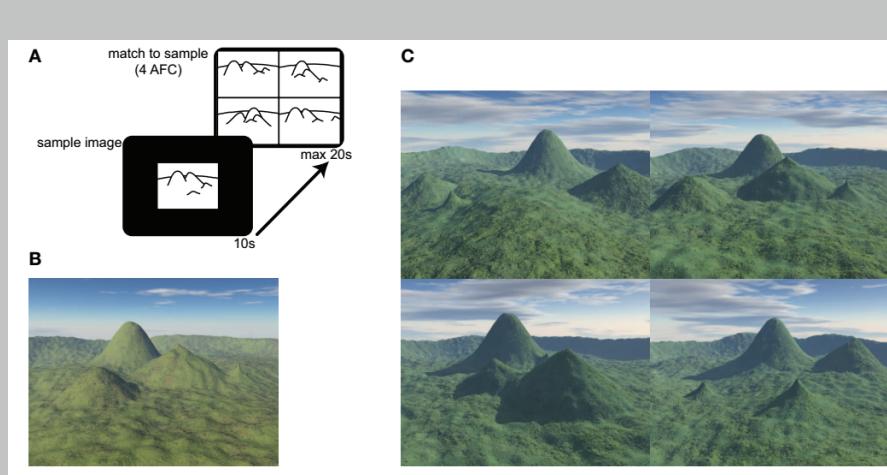
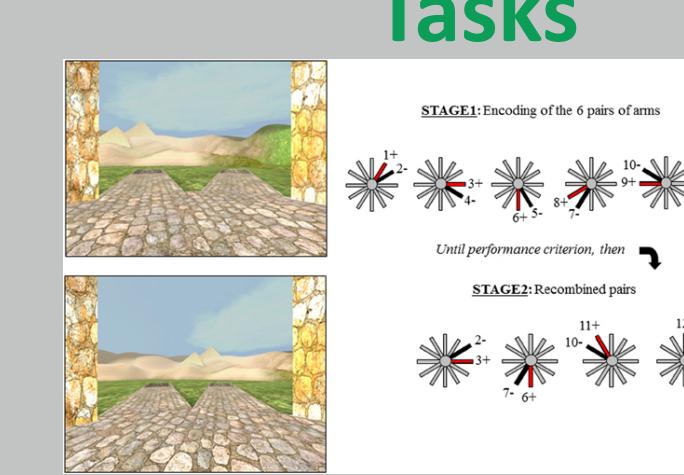
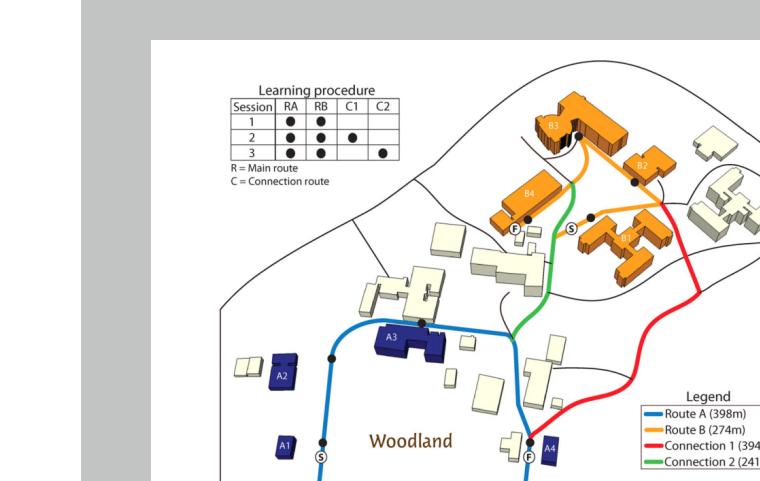
- Between, within-route pointing with HC, caudate
- Controlling for: Verbal, MRT, cortical volume, or brain volume
- Any other MTL brain region (ERC, BA35/36, PHC)
- Brain/behavior correlation did not differ between gender, age (although HC volume for men > women).

Inconsistency in the Literature

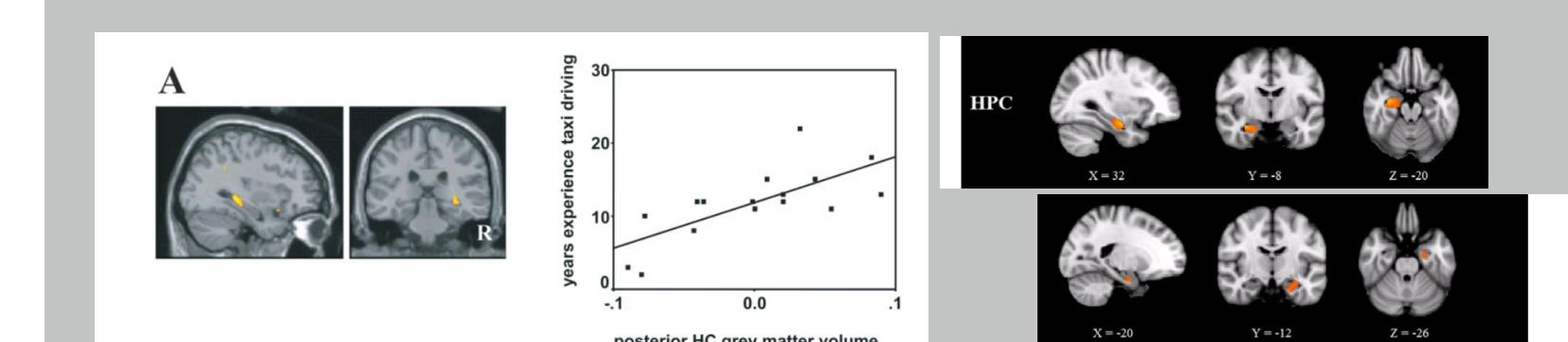
In the literature, variability in:

Analyses

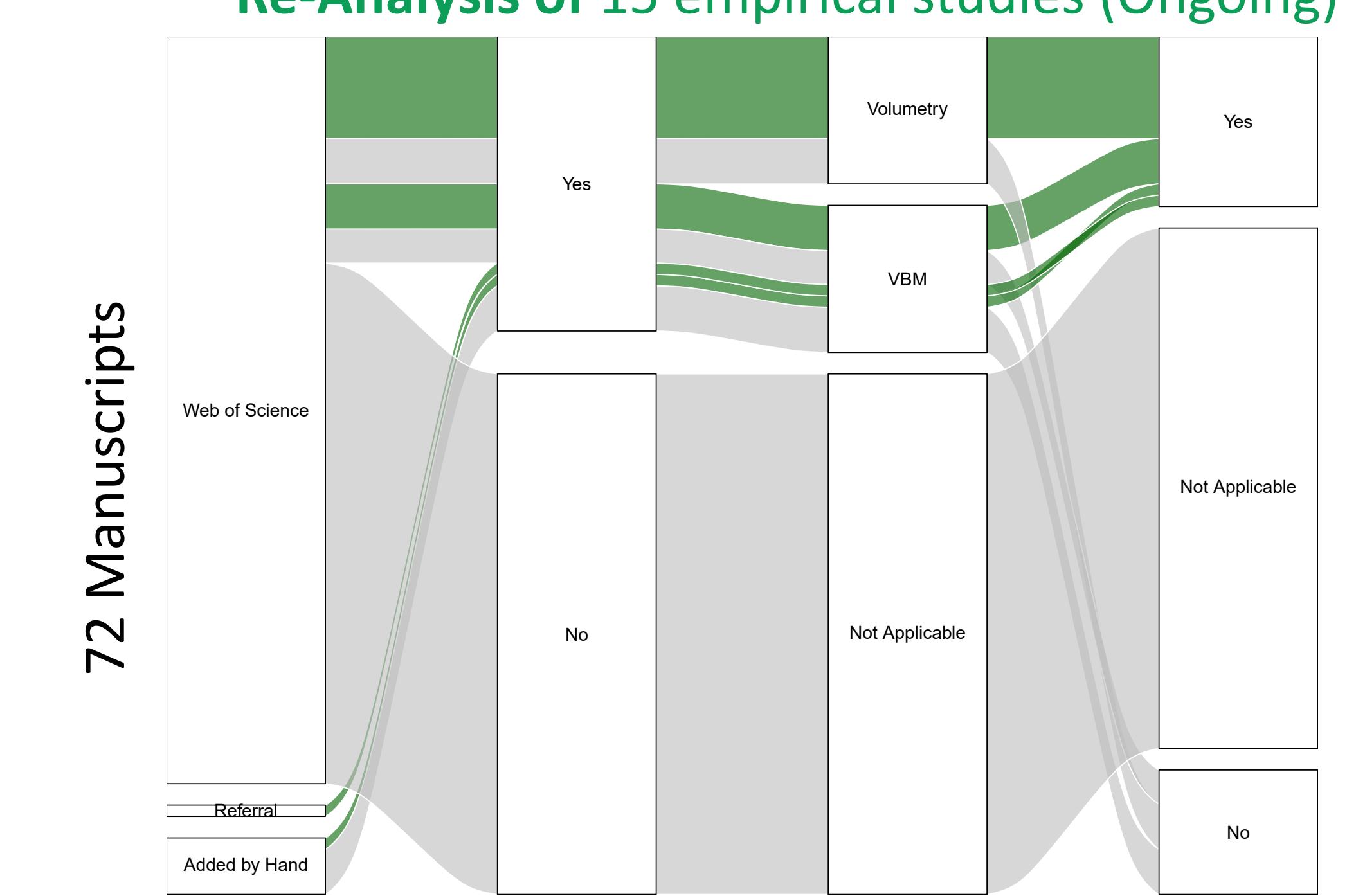
VBM / volumetry; controlling for age, sex, brain volume



Results



Re-Analysis of 15 empirical studies (Ongoing)



15 datasets

N = 1192 (adolescents, young adults, older adults)

Tasks: Virtual Morris water maze, radial arm maze, 4-mountains, SBSOD, turners/non-turners, real + virtual navigation

Details here: <https://stevenmweisberg.com/inav/>

Conclusions

- Navigation ability is only weakly (if at all) related to HC volume.
- Navigation ability may relate to cortical volume overall.
- Small sample sizes and variability in analyses could explain past results. A re-analysis will provide clarity.
- Past reports in other kinds of samples may reflect a true association in more extreme groups.

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