

## MR Spectroscopy Findings

Previous MRS studies showing abnormal chemical ratios at 1.5T:

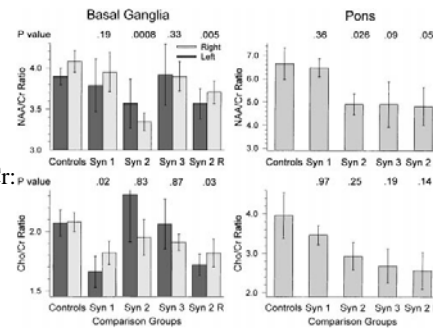
- **Basal ganglia and pons, decreased NAA/Cr ratio:**
  - Haley et al., Radiology, 2000 (TE=272 ms)  
N=40: 5 Syndrome 1, 12 Syndrome 2, 5 Syndrome 3, 18 controls
  - Meyerhoff et al., 2001 (TE=272 ms)  
N=22: 11 Syndrome 2, 11 controls
- **Left hippocampus, decreased NAA/Cr ratio:**
  - Menon et al., 2004 (TE=30 ms)  
N=15: 10 with GWS, 5 controls
- **Weiner et al. report a new study with no significant differences (unpublished)**

Current study – single voxel MRS at 3T:

- Restudy the 1997-8 Seabees (controls and Syndromes 1, 2, 3) with  $^1\text{H}$  MRS
- Obtain estimates of brain chemical ratios in same brain regions at 3T, using short echo time (TE=30 ms) and more precise quantitation procedure
- Measure chemical relaxation times in basal ganglia to explore mechanism.

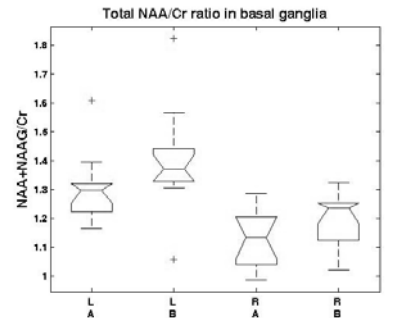
### Findings: Group differences in NAA/Cr ratio in BG

- Haley et al., 2000, lower NAA/Cr:
  - Group difference,  $p < 0.001$
  - LBG: 9 % difference,  $p < 0.09$
  - RBG: 18 % difference,  $p < 0.001$
- Meyerhoff and Weiner et al., 2001, lower NAA/Cr:
  - RBG: 11 % difference,  $p = 0.05$
- Current findings (Groups A vs B):
  - GWS: 12 in group A, 13 in group B
  - Unbalanced 2 way ANOVA
  - NAA+NAAG/Cr,  $A < B$ ,  $p = 0.018$  (R+L)BG
  - NAA+NAAG/Cr,  $R < L$ ,  $p < 0.0001$
  - LBG:  $A < B$ , 7 % difference
  - RBG:  $A < B$ , 6 % difference



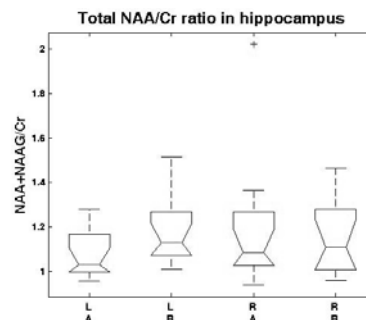
	LBG NAA/Cr (STDEV)	RBG NAA/Cr (STDEV)
Group A	1.30(0.12)	1.13(0.10)
Group B	1.40(0.17)	1.20(0.09)
p-value (t-test)	0.11	0.06
p-value (non-param.)	0.017	0.07

**NAA/Cr lower in group A, bilaterally**



### Findings: NAA+NAAG/Cr differences in hippocampus

- Menon et al., 2001, lower NAA/Cr (total):
  - LHP: 9% difference,  $p = 0.008$
  - RHP: no difference
- Preliminary findings (Groups A vs B):
  - GWS: 13 in group A, 12 in group B
  - LHP: 9% difference,  $A < B$ ,  $p = 0.05$
  - RHP: no difference
  - sensitive to outliers, needs further analysis



	LHP NAA/Cr (STDEV)	RHP NAA/Cr (STDEV)
Group A	1.08(0.11)	1.19(0.28)
Group B	1.18(0.16)	1.16(0.17)
p-value (t-test)	0.064	0.72
p-value (non-param.)	0.05	0.79

**NAA/Cr in LHP lower in group A**

## Conclusions

- MRS detects chemical differences between groups A and B, small but significant in certain brain structures.
- In general, NAA/Cr is lower in group A than in B in several brain areas, suggests organic neuronal damage
- Overall consistency with previous findings (assuming A = Syndrome 2)
- Differences in magnitude and significance may be due to:
  - Differences in scanner field strengths (1.5T vs. 3T).
  - Prior study used long echo time (TE=272 ms), now short ET (=30 ms).
  - Groups are not exactly the same, and 11 years have elapsed
  - Presently using 2-tailed tests due to blinding; underestimates significance.
- Suggests that prior findings were correct and disease process remains.

## Future work

- Metabolite concentration corrections using measurements of in vivo relaxation times  $T_1$  and  $T_2$
- Water signal properties (might be very important for long echo data)
- Correlations with other projects,  
e.g. Hippocampal dysfunction related to NAA/Cr decrease?
- Plan the next stage