

INTRODUCTION

There has been recent emphasis on mild forms of TBI, including sports related concussion, due to increasing concern regarding serial concussion and the potential for chronic neuropsychological deficits and frontal lobe dysfunction (Ptito, et al., 2007). Functional magnetic resonance imaging (fMRI) is useful in detecting subtle neural activity related changes as a result of injury, and could help characterize functional brain pathology during recovery. In the current study, fMRI was utilized longitudinally in individuals that have sustained concussion to investigate the relationship between involvement in left and right prefrontal cortex (PFC) during recovery and performance on the ImPACT (Immediate Post-Concussion Assessment and Cognitive Testing) (Lovell, et al., 2000).

HYPOTHESIS

During recovery, performance on neuropsychological testing will improve as recruitment of PFC (functional activity) decreases over time.

METHODS

Subjects: 10 individuals with mild TBI. Subjects ranged in age from 15 to 23 with 7 males and 3 females.

fMRI Data: Functional data were collected for participants at two time points. The average duration between scans was 42.88 days (SD=22.58). SPM 5 was utilized for functional data preprocessing, ROI data extraction, and all group level analyses. Scans were conducted on a 3.0 Tesla Signa (GE) Scanner.

ImPACT Testing: Subjects completed the computerized concussion evaluation following both scans to measure post-injury cognitive performance.

Figure. 1

Average functional activation for all subjects at time 1 ($p < .05$)



Average functional activation for all subjects at time 2 ($p < .05$)



Activation for Group 1 > Group 2 ($p < .05$)



Figure. 2

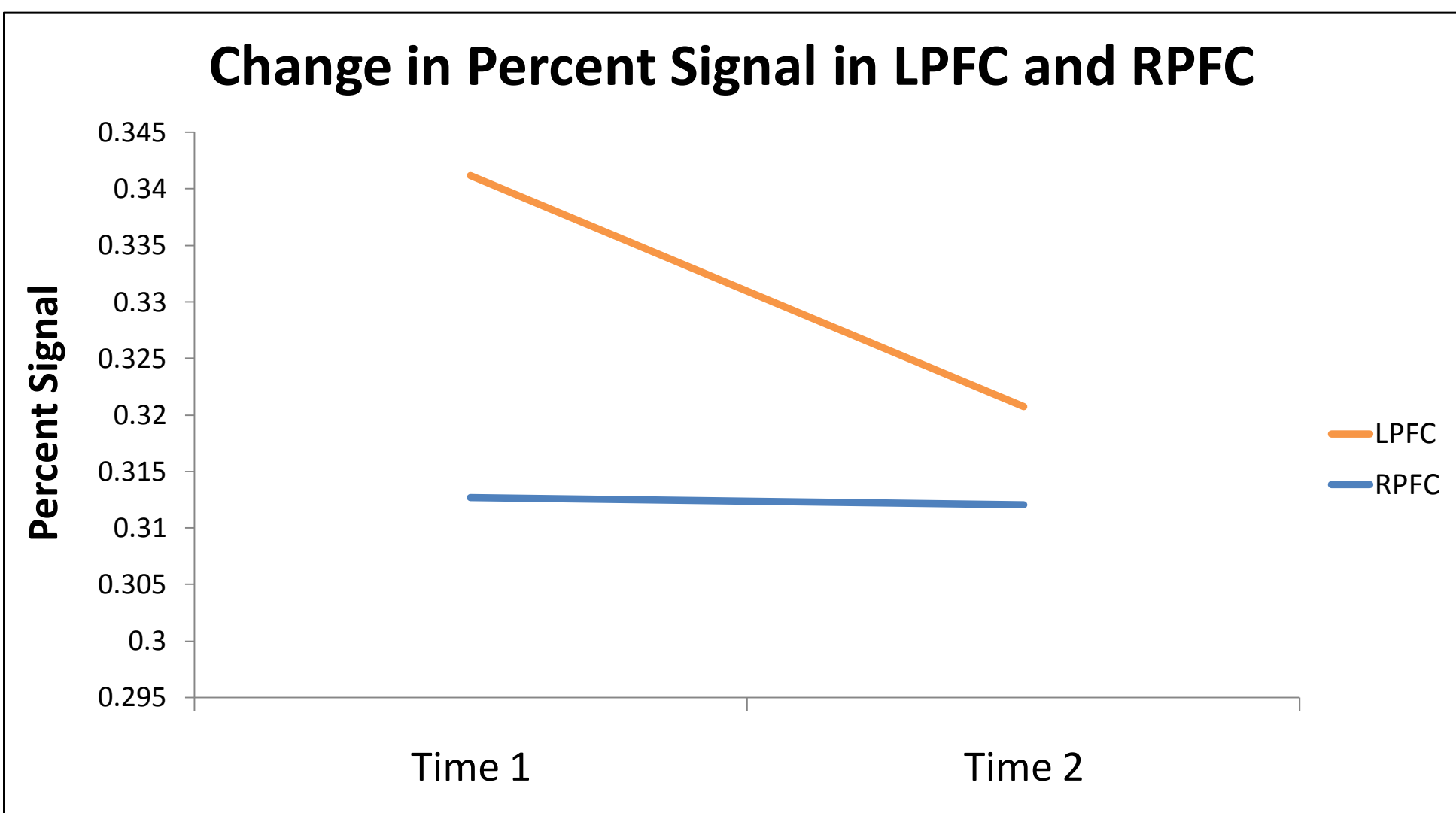
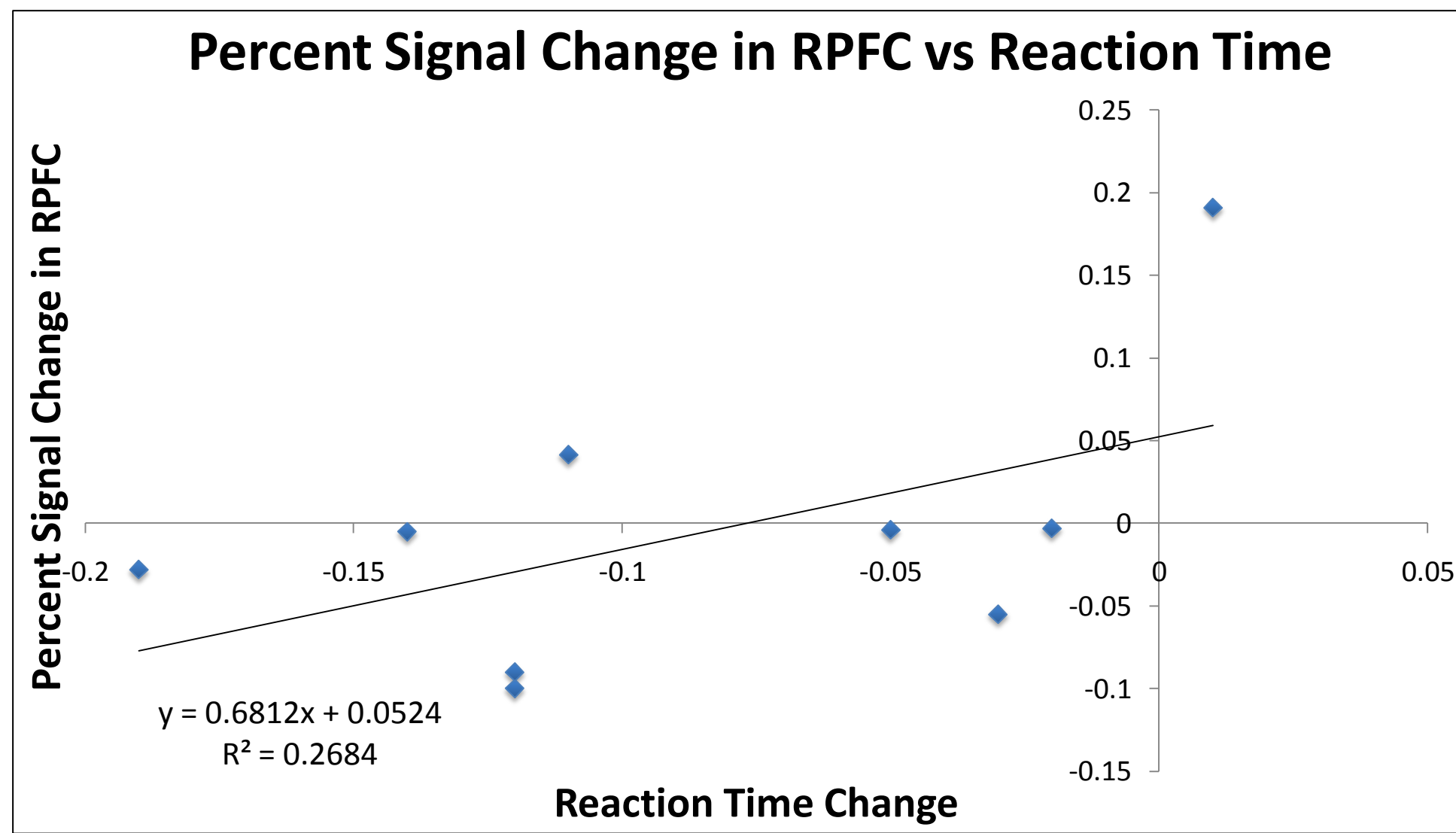
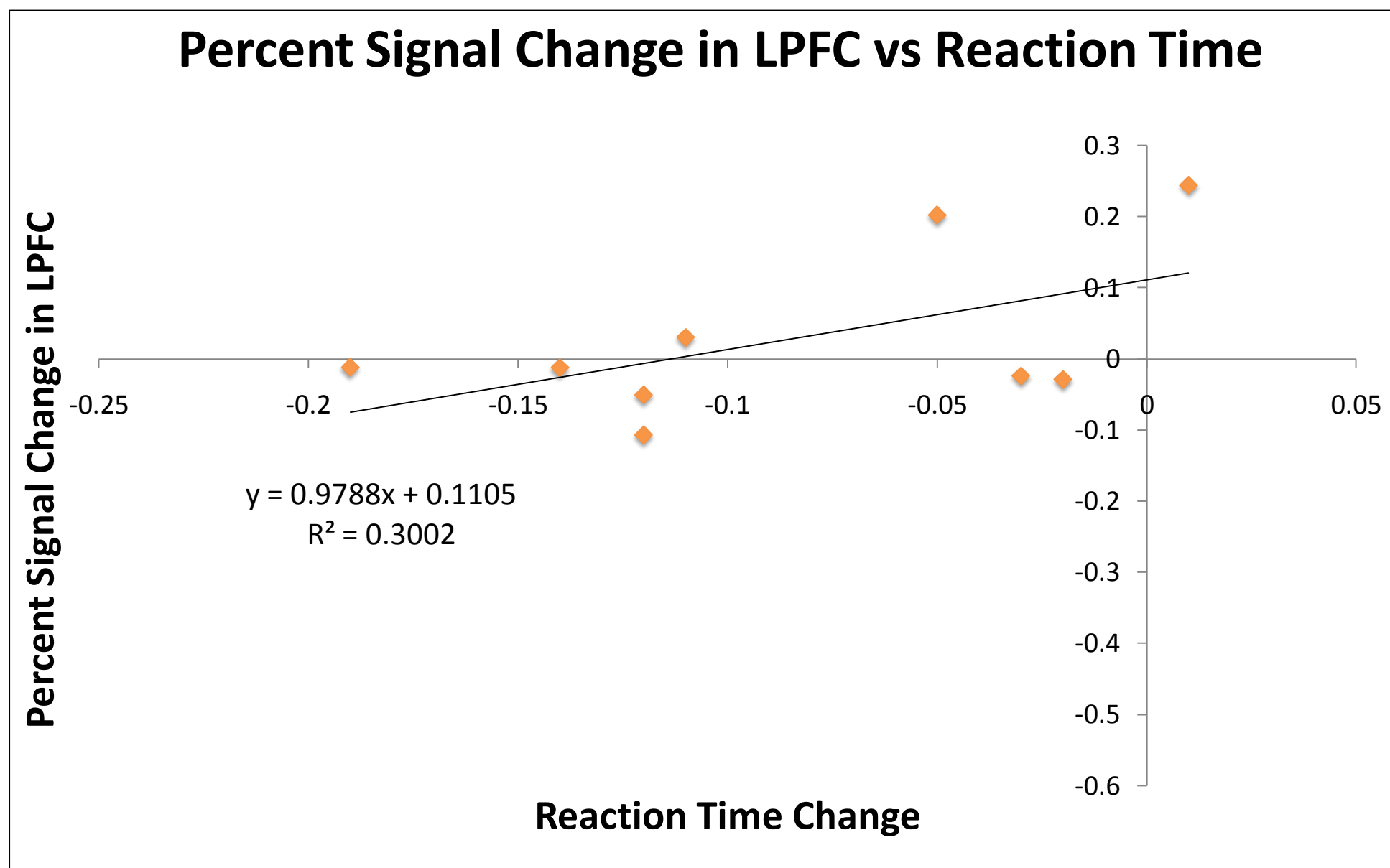


Figure. 3



RESULTS

Percent signal change decreased in both LPFC and RPFC over time. The average change was $-.0204\%$ in LPFC and $-.00065\%$ in RPFC. See Figures 1 and 2.

This change in activation correlated with reaction time change, indicating that decreased activation in PFC is associated with better performance and decreased reaction time (LPFC: $r(9) = .548$, $p < .127$, RPFC: $r(9) = .518$, $p < .153$). See Figure 3.

Though change in activation in PFC was related to reaction time, it did not correlate with performance on other cognitive indices on the ImPACT, such as visual and verbal memory tasks.

CONCLUSIONS

The results indicate that PFC involvement diminishes during the recovery process following concussion and that changes in left PFC are greater than right PFC. These data are consistent with a literature documenting decreased, as opposed to more elaborate, involvement of PFC resources as performance improves during recovery (Hillary, 2008).

This study demonstrates that fMRI could aid in the detection of abnormalities and changes in brain activation following mild TBI and has utility for the examination of recovery early after concussion.

REFERENCES

Hillary, F.G. (2008). Neuroimaging of working memory dysfunction and the dilemma with brain reorganization hypothesis. *Journal of the International Neuropsychology Society*, 14, 526-534.

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