INTRODUCTION

The serial reaction time task (SRTT) is a common behavioral measure of implicit (motor) learning; however, its neurobiological correlates are not well understood. To date only a handful of functional neuroimaging studies have examined the SRTT.

Previous behavioral studies linking implicit learning and reading ability using SRTT have shown mixed results (cf. Howard et al., 2006; Laasonen et al., 2014). Our study aims to:

1. extend the functional neuroimaging literature by investigating the relationship between reading ability and brain activation during SRTT with the largest sample size to date.
2. replicate and extend the previous behavioral work linking SRTT and reading skill by treating reading ability as a continuum and exploring the neurobiological signature.

METHODS

Serial Reaction Time Task

Based on previous work (e.g., Rauch et al., 1997), the SRTT was made up of two stimulus conditions: randomly ordered unstructured trials and structured trials which had a repeating pattern. Each block was made up of a 12-item sequence presented twice. Each functional run was composed of 4 unstructured and 3 structured blocks. Participants (n=40) were asked to press one of four buttons corresponding to the location of the asterisk.

Participants performed the SRTT as a block-design fMRI experiment inside of a Siemens Tim Trio 3T Scanner. The task was repeated over three separate scan runs, each run was composed of three structured and four unstructured blocks with 150 whole-brain images of 32 slices, TR=2, TE=30, FA=80. Data analysis was performed using R. fMRI data was processed using AFNI (Cox, 1996).

RESULTS I

Analysis of Reaction Times (RT) found no significant differences between structured and unstructured blocks in the 1st run. Significant differences were found between structured and unstructured blocks in the 2nd and 3rd run of the experiment (p<.001).

A significant negative correlation was found between KTEA standard scores and RT for structured trials. Additional significant correlations were found between both structured and unstructured conditions for all three runs.

Additionally, significant correlations were found for both TOWRE PDE (r=-.61) and WRE (r=-.46), but not for the SWE (r=-.22).

RESULTS II

Replicating previous work, we found significant task-based activation of bilateral Caudate, Putamen, and Thalamus during the task (A). These areas also showed significant condition X run interactions (B,C). However, unlike previous studies, our results found greater activation in the Left Hemisphere across all runs and conditions, with Right Hemisphere activation decreasing across runs.

Additionally, brain-behavior correlations found negative correlations (p<.01) between brain activation during both structured and unstructured blocks and those behavioral measures that correlated with RT (TOWRE PDE, TOWRE WRE, and KTEA). These correlations fall in language specific cortex: Left IFG, STG, MTG, and Bilateral Angular Gyrus.

REFERENCES

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CONCLUSIONS

1) Faster participants show better reading and learning ability as measured by behavioral assessments.
2) SRTT replicates previous studies showing activation of Putamen and Thalamus.
3) Brain activations change in later runs, as RT differentiates between structured and unstructured conditions, to favor particular brain regions in response to successfully learning the pattern.
4) When these activations are correlated with reading and learning measures, we see that brain regions related to reading (IFG, STG, MTG, VWFA) are negatively correlated with task activations.

Future Directions

We are continuing to collect data. Moving forward, we aim to recruit more participants with lower reading scores to better sample the continuum.

CONTACT

Peter J. Molfese, PhD
Research Scientist
Haskins Laboratories
300 George Street, New Haven CT 06515
molfese@haskins.yale.edu
www.haskins.yale.edu

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