Computerized Cognitive Training for Individuals At Risk for Psychosis

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Objective:
Individuals at clinical high risk (CHR) for psychosis have neurocognitive deficits which are associated with functional disability and risk of transitioning to psychosis spectrum disorders, such as schizophrenia. Targeted cognitive training (TCT) aimed at engaging neuroplasticity in neural networks has been proposed as a therapeutic intervention for CHR individuals. However, while TCT has been shown to improves cognition and function in individuals with schizophrenia, research among CHR individuals is minimal. This study investigated whether cognitive training in CHR participants would improve functioning of fronto-parietal systems known to support core cognitive functions, particularly working memory.

Approach:
84 CHR participants were compared to 28 healthy control participants at baseline to identify areas of cognitive, social cognitive and neural impairments. Participants completed a comprehensive cognitive battery including the MATRICS Consensus Cognitive Battery for identifying cognitive impairments in individuals with psychosis. Structural brain images, resting state fMRI and diffusion tensor imaging of white matter was acquired as well as fMRI during performance of a working memory task and an emotion recognition task. The CHR individuals then completed either 40 hours/8 weeks of computer-based, targeted cognitive and social-cognitive training (TCT) or an equivalent amount of a computer game control condition (CON). Training targeted speed of processing, attention, memory, cognitive-control, and facial emotion recognition. All imaging data were processed using the Stanford Center for Reproducible Neuroscience protocol. Group differences in task activation between baseline and follow-up were computed for the TCT and CON groups.

Results:
Despite equivalent premorbid IQ, CHR individuals demonstrated impaired cognition relative to HC on reasoning and problem solving, visual learning, working memory, and processing speed (all $p<.04$) but not verbal learning or attention. In addition, CHR individuals were impaired on a measure of social cognition ($t=-2.54$, $p=.02$). CHR individuals in the TCT group improved on trained cognitive domains. In addition, FMRI working task results showed that CHR participants had a pre-to-post decrease in activity in left parietal cortex and left lateral prefrontal cortex, including left middle and inferior frontal gyri, and left parietal cortex during working memory trials, closer to that of HC. Training was also associated with altered activity within the emotion processing network, including the amygdala and dorsolateral prefrontal cortex.

Conclusion:
These results suggest that cognitive impairments in CHR individuals may be amenable to behavioral treatment like TCT. Neural changes via cognitive training might reflect cognitive and functional benefits of TCT in CHR individuals and support continued development of TCT for individuals at risk for psychosis as well as extension of these methods to address impairments such as reduced cognitive control of emotion in individuals with bipolar disorder.