Working Memory Training Enhances Reflective Decision-Making in Individuals with Depressive Symptoms

Jessica A. Cooper\textsuperscript{1}, Marissa A. Gorlick\textsuperscript{2}, Seth Koslov\textsuperscript{3}, Darrell A. Worthy\textsuperscript{3}, Christopher G. Beevers\textsuperscript{1}, & W. Todd Maddox\textsuperscript{1}

\textsuperscript{1}The University of Texas at Austin; \textsuperscript{2}Yale University; \textsuperscript{3}Texas A&M University

\section*{Introduction}

- Dual systems: reflective system uses working memory resources to develop and test hypotheses; reflexive system depends on learning via reinforcement.
- Depression is associated with deficits maximizing rewards in both reflexive (history-independent) tasks\textsuperscript{1} and reflexive (history-dependent) tasks\textsuperscript{2} where higher immediate rewards must be sacrificed for long-term gain.
- Depressed individuals show reduced sensitivity to positive stimuli and rewards\textsuperscript{3,4} and hypersensitivity to negative stimuli and punishment\textsuperscript{5,6}.
- Attention training toward positive stimuli attenuates depressive deficits in reflexive decision-making\textsuperscript{7}.
- Experiment 1 determines whether attention training broadly attenuates reward processing deficits, including reflexive decision-making.
- Depression is associated with deficits in working memory\textsuperscript{8,9} and other reflexive processes that may affect reflexive decision-making performance\textsuperscript{9}.
- Experiment 2 tests whether working memory training attenuates depressive deficits in reflexive decision-making.

\section*{Experiment 1}

- 3 blocks of 168 trials; 504 trials total
- Neutral and positive valence words from the Affective Norms for English Words list (ANEW\textsuperscript{10}) matched for letter length and frequency use in the English language.
- Depression associated with decision-making deficits in untrained groups.
- Low and high span: equated on non-depressive controls.
- No benefit of attention training.

\section*{Experiment 2}

- Modified automated operational span (Ospan\textsuperscript{11}) procedure.
- Span of letters interrupted with math problems.
- Low and high span: equated on number of items.
- Depression associated with decision-making deficits in control conditions.
- High span group > depressive control.
- High span group not different from non-depressive control.
- No advantage for low-span group.

\section*{Conclusions}

- Attention training is not effective in attenuating reflective DM deficits.
- Engaging working memory with a high-demand working memory task before reflective decision-making improves performance.
- Computational modeling suggests increased fit of simple heuristic-based strategies after high-span WM task.
- Combined with previous work, indicates that targeted training can be used to improve decision making deficits in different types of tasks.
- Future work will look at long-term training with emotional stimuli to produce persisting improvements.

\section*{References}