

SUPPLEMENTARY INFORMATION

Dissociation of Cognitive Effort-Based Decision Making and Its Associations With Symptoms, Cognition, and Everyday Life Function Across Schizophrenia, Bipolar Disorder, and Depression

Barch *et al.*

Supplemental Materials

Exclusion/Inclusion Criteria: Exclusion criteria included: (1) DSM-5 diagnosis of substance abuse or dependence in the past 6 months; (2) IQ less than 70 as measured by the Wechsler Test of Adult Reading (1); and (3) history of severe head trauma and/or loss of consciousness. Additional exclusion criteria for patient groups included (1) medication changes in the month prior to study participation (2) inpatient or partial hospital status. Additional criteria for controls included (1) no personal or immediate relative with a history of schizophrenia, schizoaffective disorder, or bipolar disorder (2) no current or past major depression and (4) no current psychotropic medication.

Dot Probe Expectancy Task. This task is a measure of the goal representation component of cognitive control (2). This task uses three or four dots in different configurations as the visual stimuli. Participants need to maintain a cue in working memory in order to decide how to respond to a subsequent probe. Participants were shown a series trials with visual dot patterns in a two stimulus sequence on a computer screen. The first stimulus was the cue; the second the probe. A target response was required to indicate “target” with a button press when a valid probe (“X” visual stimulus) followed a valid cue (“A” visual stimulus) and to respond “non-target” with a different button press to all other stimuli (including the “A” stimulus). The

interstimulus interval (ISI) was 2000 ms. The dependent variable was d' -context, which has good test-retest reliability (ICC = 0.76 (3)). This variable indexes hit rates for AX trials relative to false alarms for trials on which an X probe was followed by an invalid cue (i.e., BX trials); and is a measure of the ability to use the context of the invalid cues to correctly modulate responses to X probes, which are ambiguous without the cue information.

Running Span Task. This task is a measure of working memory (4). Participants were instructed to report the final 1, 2, 3, 4, or 5 letters presented in a list that varied from 2 to 8 letters. Instructions (Report last 2, etc.) were shown prior to each list presentation. Each of the 5 report sizes was tested with four consecutive lists. Participants had to get at least 2 lists correct within each report size to move on to the next level. Stimuli were presented at central fixation for 500ms, with 200ms ISIs. The dependent measure was the total number of items recalled in correct order.

Results including Assessment Modality (In person, Virtual) as a factor.

In an analysis that included Assessment Modality as an additional factor, we again observed a significant main effect of Reward Magnitude ($F(2,588)=167.28, p<.001, \eta_p^2=.36$) suggesting that people were more willing to expend cognitive effort as reward value increased. There was also again a significant main effect of Group ($F(4,294)=3.04, p=.019, \eta_p^2=.040$) that was modified by a significant Group x Reward interaction ($F(8, 588)=3.45, p<.005, \eta_p^2=.045$). There was no significant main effect of Assessment Modality ($p=.724$) and no interaction of Assessment Modality with any other factor ($ps>.55$). As shown below in Figure S1 for Virtual Assessment and Figure S2 for In Person Assessment, these group differences reflected the SZ and BD groups making significantly fewer cognitive hard task choices than the HC, P-MDD, and C-MDD groups in the higher Reward Level conditions. The C-MDD and P-MDD group did not make fewer cognitive hard task choices than HC in any condition.

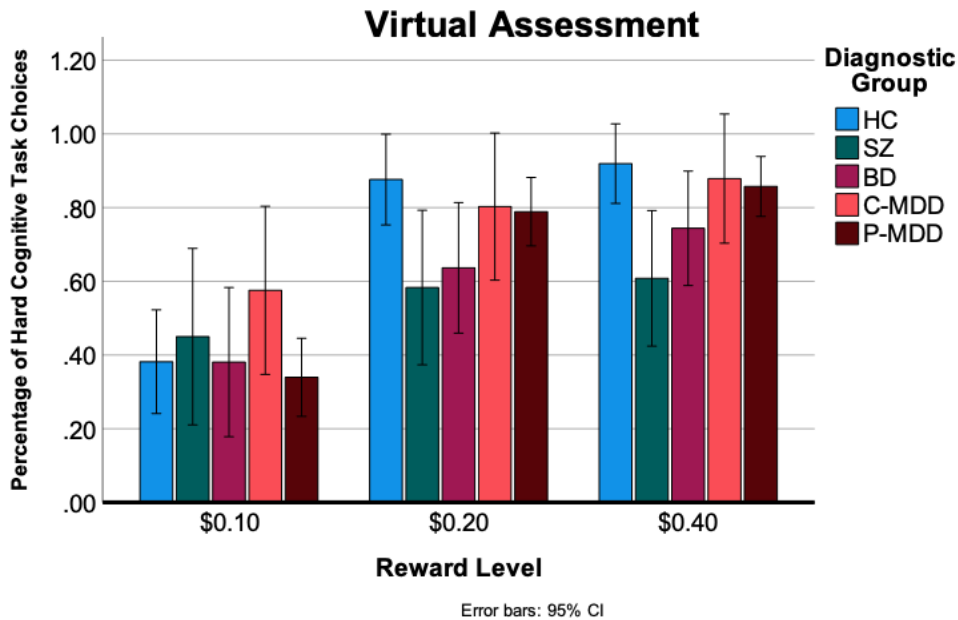


Figure S1: Percentage of Hard Cognitive Task Choices For Participants Assessed Virtually. HC=Healthy Control; SZ=Schizophrenia; BD=Bipolar Disorder; C-MDD=Current Major Depressive Disorder; P-MDD=Past Major Depressive Disorder; Error bars reflect 95% confidence intervals.

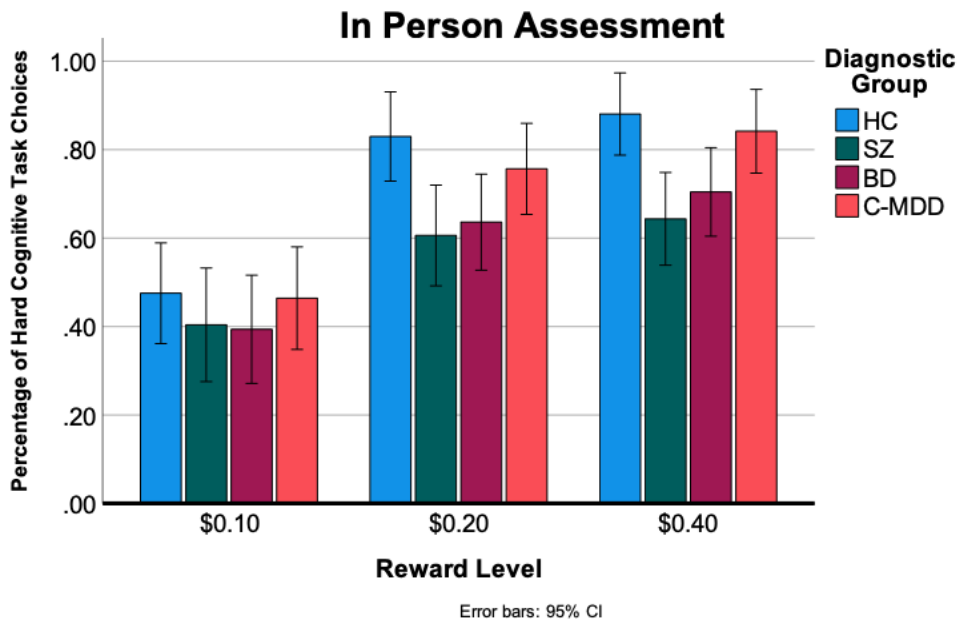


Figure S2: Percentage of Hard Cognitive Task Choices For Participants Assessed In Person. HC=Healthy Control; SZ=Schizophrenia; BD=Bipolar Disorder; C-MDD=Current Major Depressive Disorder; P-MDD=Past Major Depressive Disorder; Error bars reflect 95% confidence intervals.

Supplemental References

1. Wechsler D (2001): Wechsler test of adult reading. San Antonio, TX: The Psychological Corporation.
2. Henderson D, Poppe AB, Barch DM, Carter CS, Gold JM, Ragland JD, et al. (2012): Optimization of a goal maintenance task for use in clinical applications. *Schizophrenia bulletin*. 38:104-113.
3. Strauss ME, McLouth CJ, Barch DM, Carter CS, Gold JM, Luck SJ, et al. (2013): Temporal Stability and Moderating Effects of Age and Sex on CNTRaCS Task Performance. *Schizophrenia bulletin*.
4. Gold JM, Barch DM, Feuerstahler LM, Carter CS, MacDonald AW, 3rd, Ragland JD, et al. (2018): Working Memory Impairment Across Psychotic disorders. *Schizophr Bull*.