

Cognitive Markers of Mental Health

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Introduction

In this study, we explore a potential alternative approach to mental health diagnosis. Our framework uses a battery of perceptual, memory, and cognitive control tasks to build a “cognitive profile” for each individual.

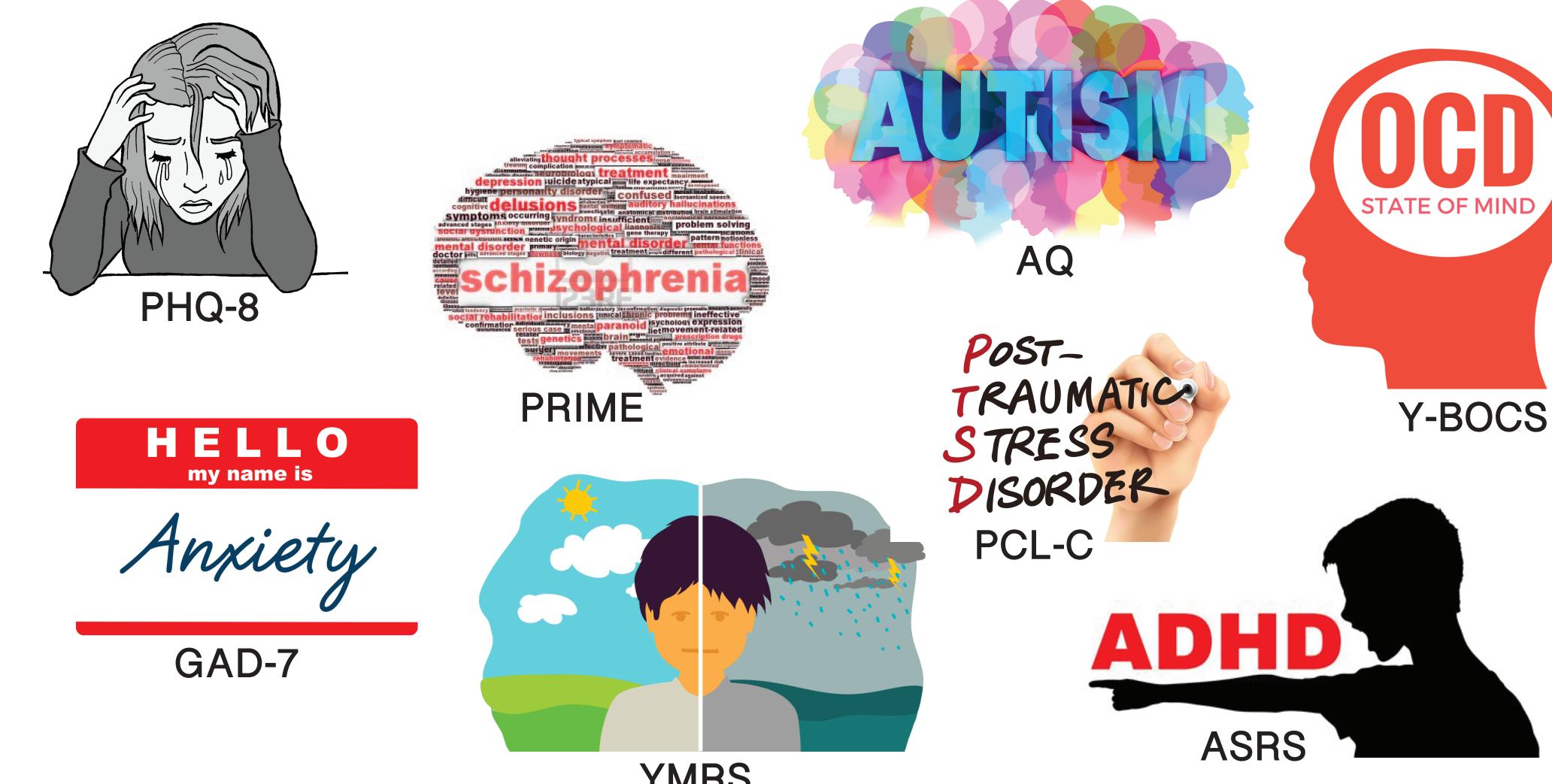
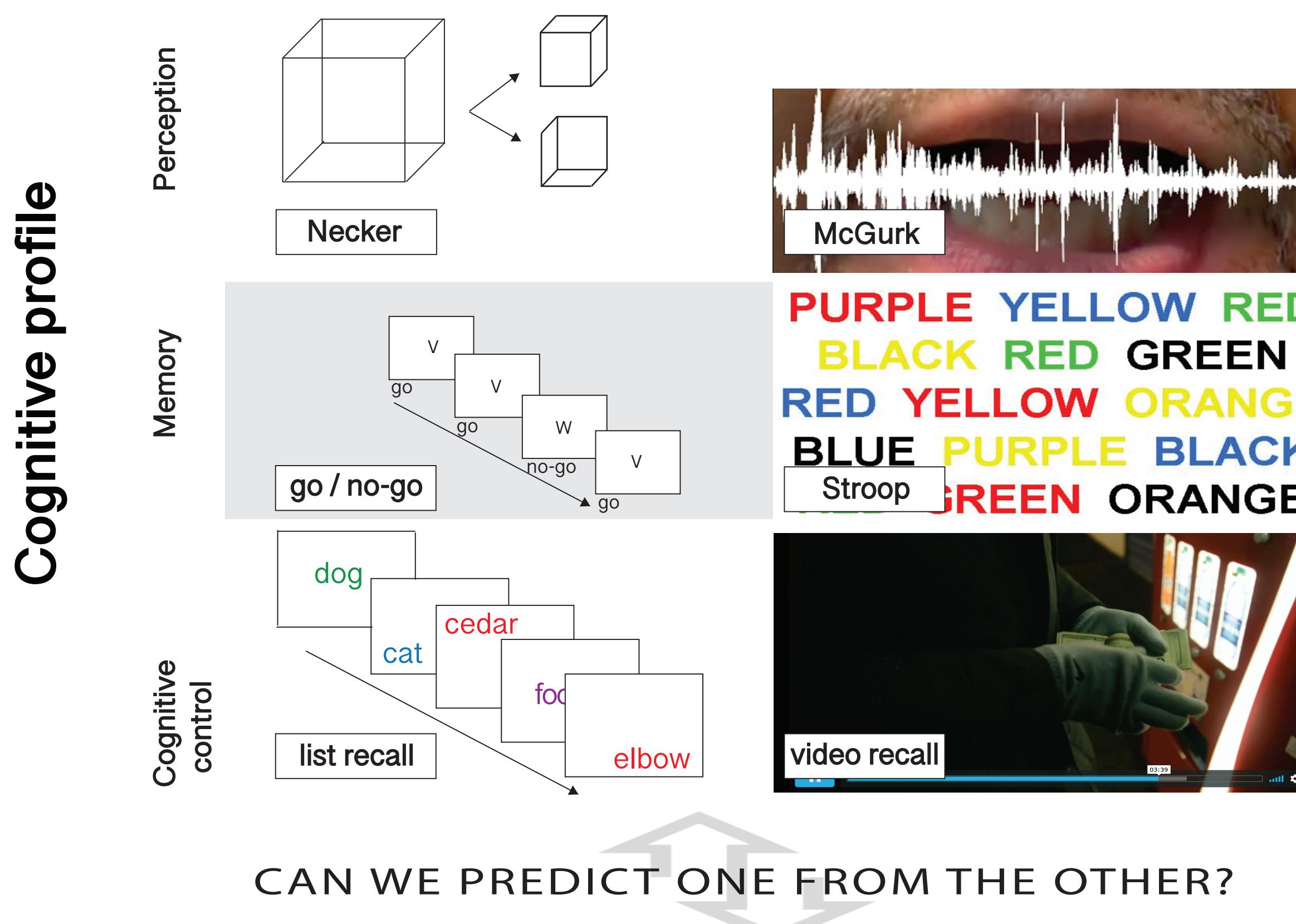


Figure 1. Cognitive and Mental Health Assessment. a) Battery of six cognitive tasks used to create cognitive profiles b) Battery of eight psychiatric screening assessments used to create mental health profiles.

We are exploring whether individuals' cognitive profiles can be used to predict their “mental health profiles,” which reflect depression, anxiety, PTSD, ADHD, autism, and other psychiatric dimensions. We estimate individuals' cognitive profiles using their normed psychiatric screening surveys.

Visualizing cognitive and mental health profiles

For visualization, we reduce high-dimensional cognitive profiles and mental health profiles to three-dimensional data using principal components analysis (PCA). We then use the reduced cognitive data to plot each participant as a point in three-dimensional space. We use reduced mental health data to determine the color of each participant's data point.

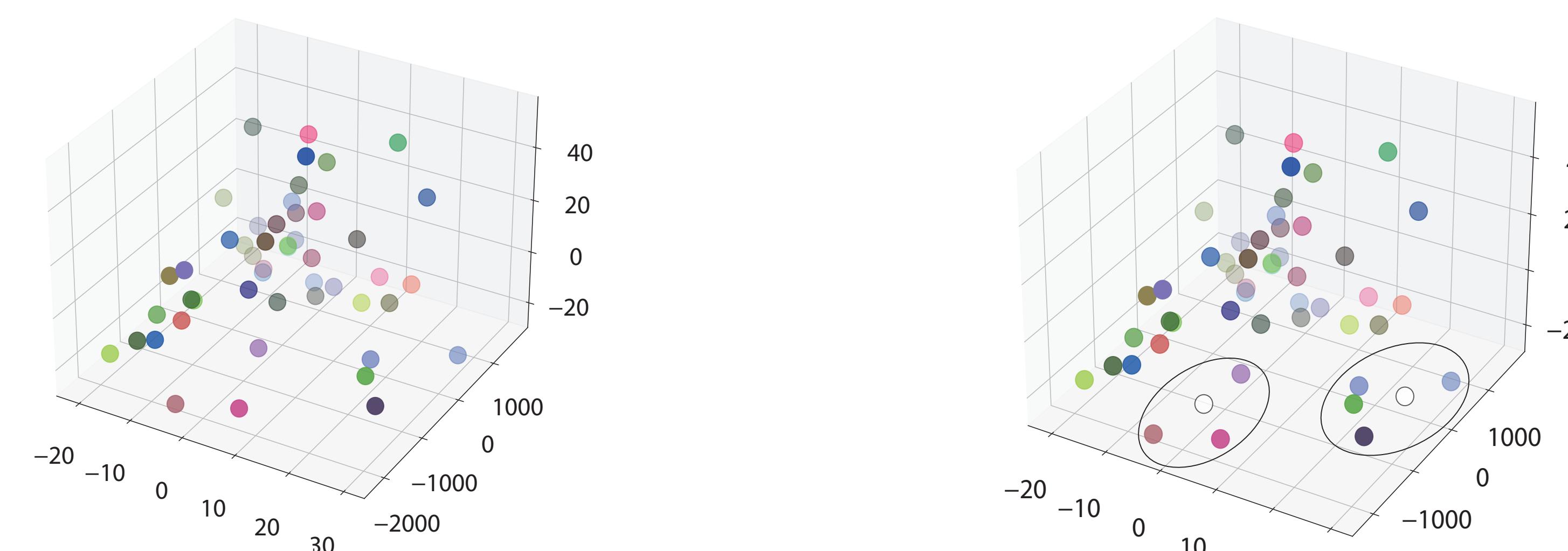


Figure 2. Using cognitive data to make mental health predictions. a) Participants plotted as datapoints in “cognitive space”. The location of each data point reflects a participant's cognitive profile and the color of each data point reflects their mental health profile. b) Two hypothetical participants (white datapoints) plotted alongside participant data. Predicting mental health profiles from cognitive profiles is akin to plotting these participants' data points in their respective locations, based on cognitive data, then predicting their “colors” (mental health profiles) based on the colors of nearby points.

Variation in cognitive traits across participants

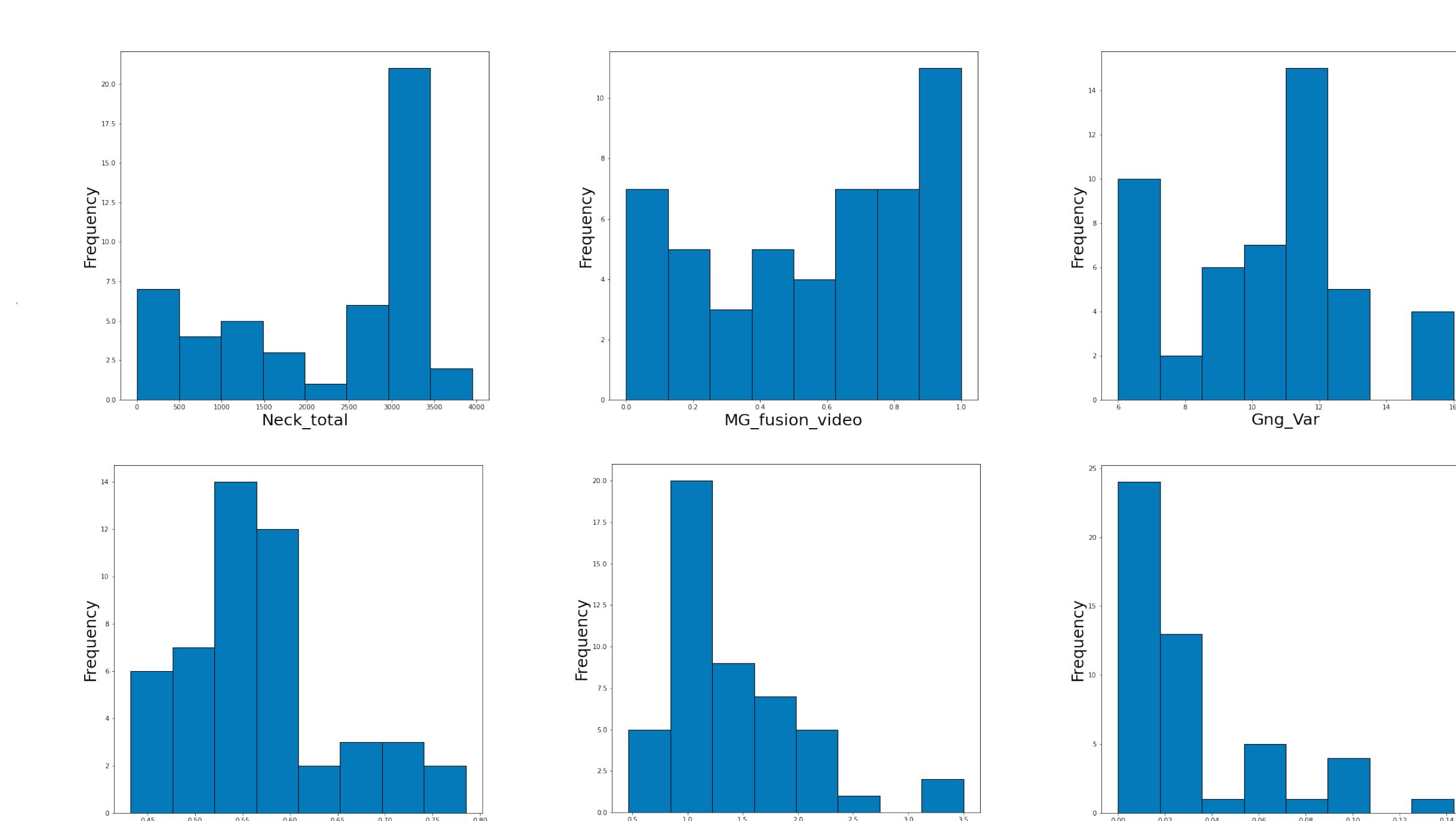


Figure 4. Distribution of cognitive task scores. Distribution of cognitive task scores for each of the six tasks.

Continuing data collection

In preparation for further data collection, it is important to assess the quality of data collected from our initial cohort of online participants ($n=50$). We find that trends in our mental health data replicate known comorbidities. Further, participants complete “catch questions” on mental health surveys with high accuracy.

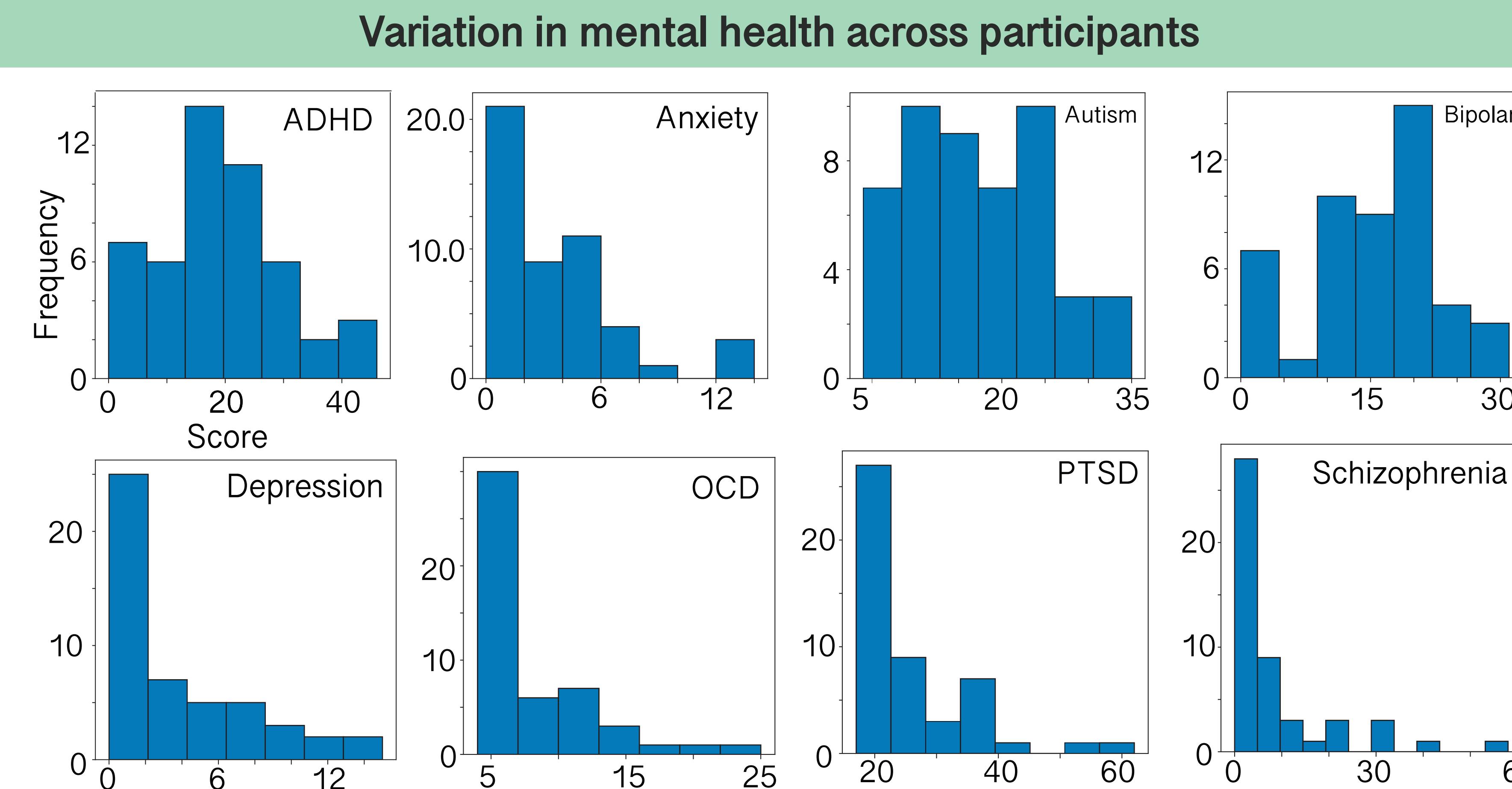


Figure 3. Distribution of mental health screening scores. Distribution of assessment scores for each of the eight screening assessments.

Participants' mental health profiles were based on tendencies and symptoms associated with eight classic psychiatric disorders. We found that participants exhibited a wide range of tendencies and symptom levels (above). They also exhibited varied cognitive performance (right).

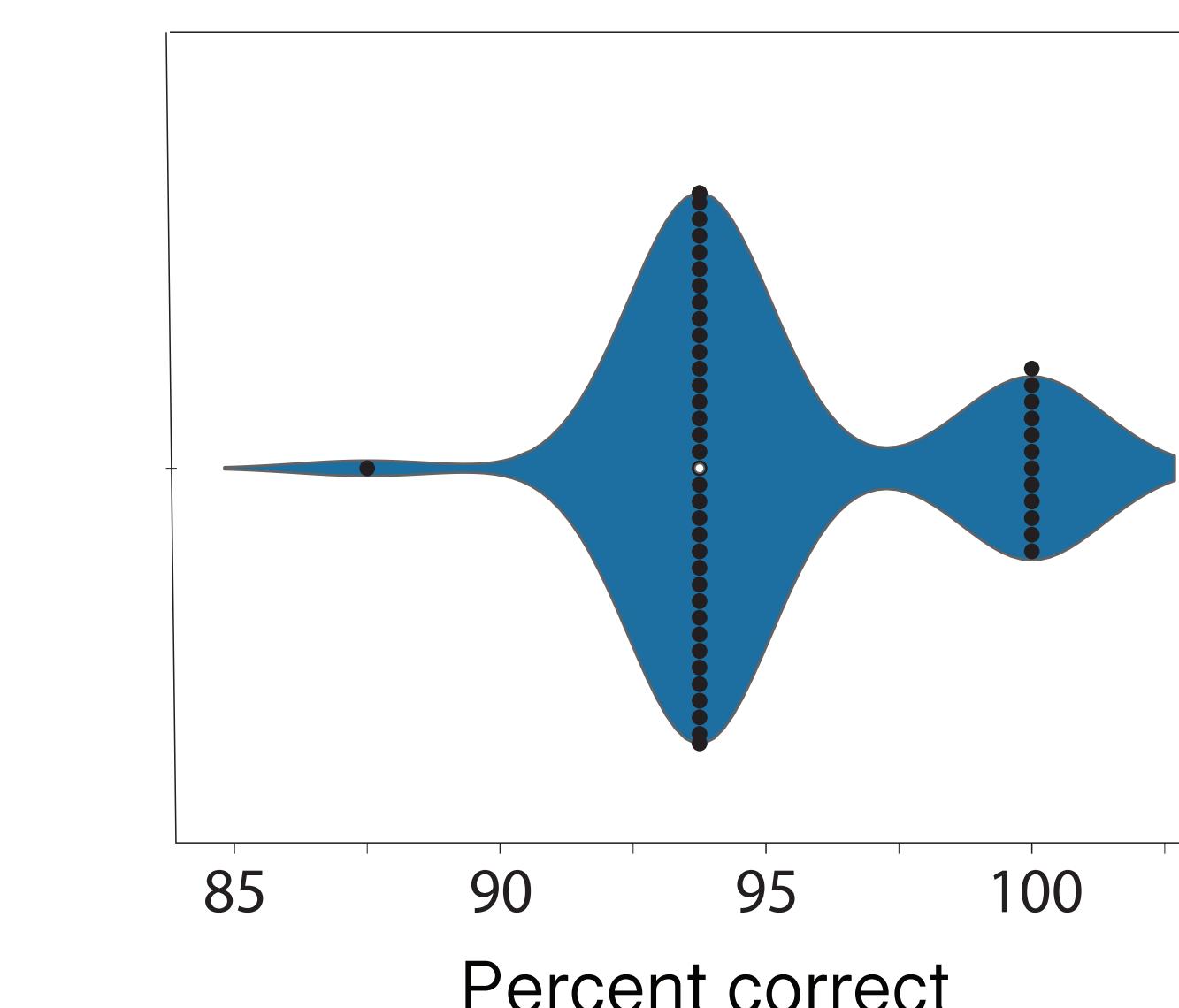


Figure 5. High proportion of correct responses to “catch questions”. Catch questions are questions that are objective and simple to answer. If participants answer them correctly, it suggests that they are paying attention and completing surveys accurately. In our data, we find participants respond correctly in a high proportion of “catch questions” included in the mental health surveys.

Future directions

Our approach is designed to leverage relationships between cognitive and mental health profiles in big datasets, with many participants. Thus, we will continue this phase of the project by collecting additional data from online participants. We will fine-tune a predictive model to predict mental health profiles from cognitive profiles. After building this model on data from the general population, we will seek to validate this model in clinical populations.

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