Mapping the dimensions of agency and the impacts of neuropsychiatric symptoms.

Walton, A. E.[1], Roth, R. M. [2,3], Holtzheimer, P. E. [2,3], Roskies, A. L.[1].

[1]Dartmouth College, Department of Philosophy, [2]Dartmouth College, Geisel School of Medicine, [3]Dartmouth-Hitchcock Medical Center, Department of Psychiatry

For a more web-friendly version of our poster with animated content, please visit the website below:

https://sites.dartmouth.edu/ashley-walton/brainposter2022

Introduction

Neuroethics research conceptualizes agency as a multi-dimensional construct[1,2]. Both the effects of neuropsychiatric disease, as well as interventions to treat disease, can result in changes from baseline across the different dimensions of agency.

Exactly how to define the relevant agency space and how to measure these changes is a focus of current research. We address these questions by means of a convergence of qualitative and quantitative findings regarding the experiences of a range of patient populations.

The overall goal of our project is to articulate a framework for assessing agency and to develop an Agency Assessment Tool (AAT) for capturing changes in agency that result from disease and ameliorative neurological interventions. We ultimately aim to use the AAT to assess agency in a population of Parkinson Disease (PD) patients before and after DBS treatment.
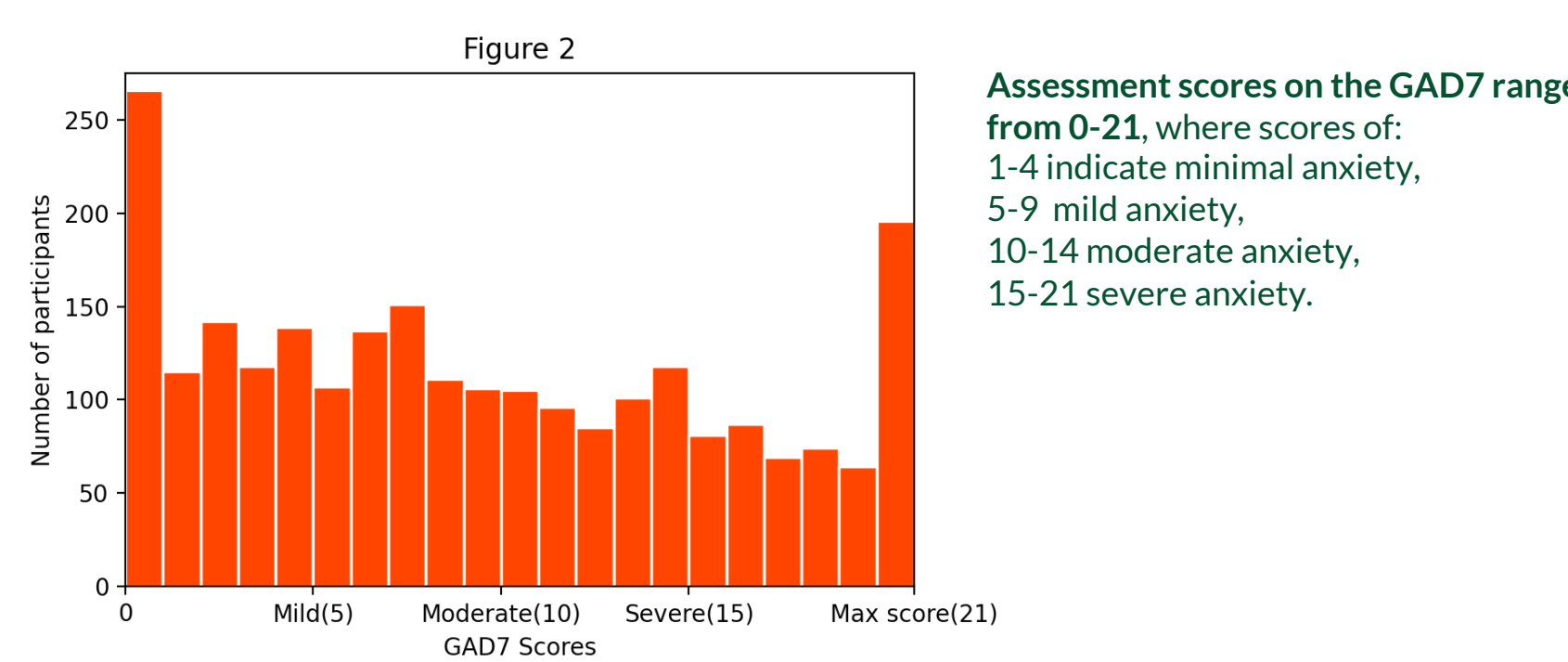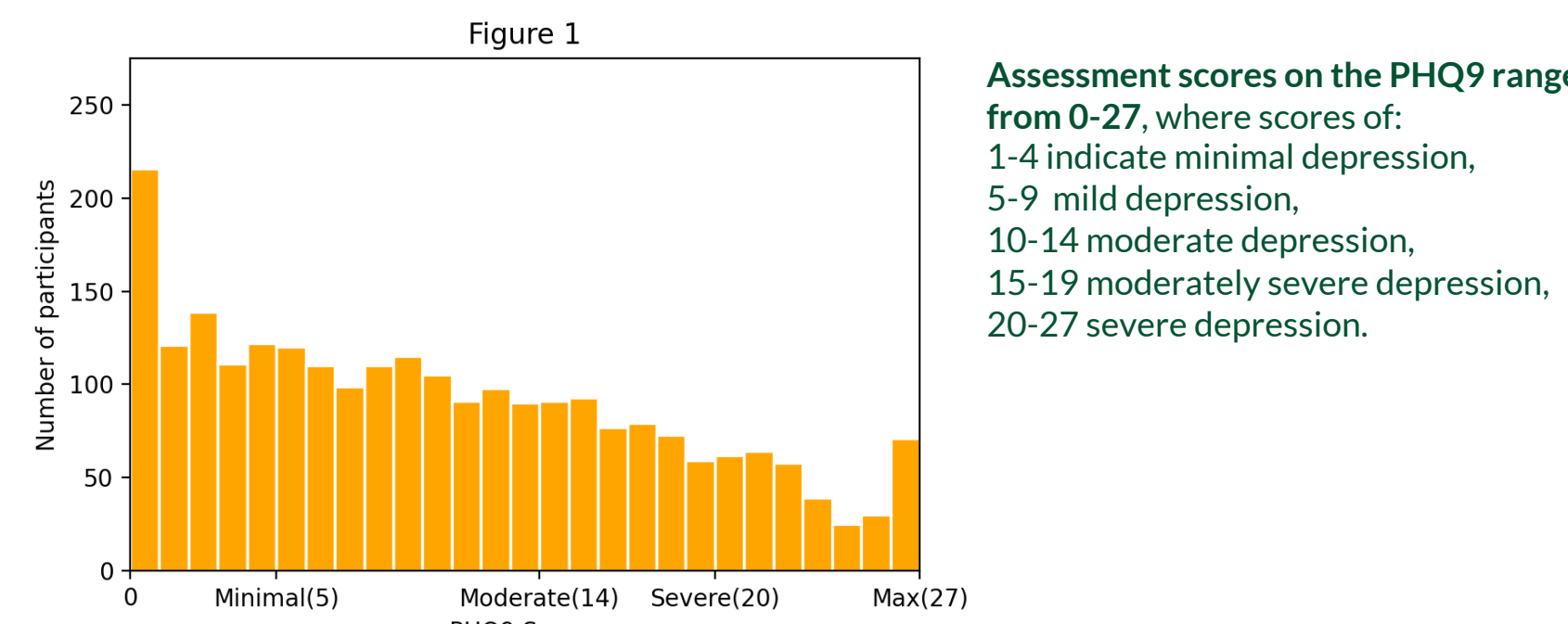
1. Agency Assessment Tool (AAT)

The Agency Assessment Tool (AAT) is an online survey that includes 124 questions using a 7-point Likert scale. We have grouped the questions into 20 theoretical/conceptual dimensions relevant to agency: Behavioral Control; Decision-making; Emotional Control; Goal Pursuit; Life Control; Morality; Responsibility Attribution; Motor Control; Need for Cognition; Philosophical Worldview; Privacy; Rational Integrity; Reflective Skills; Imaginative Skills; Relational; Risk; Self-trust; Self-conception; Temporal Continuity and Volition.

The AAT was administered online via Amazon Mechanical Turk, Qualtrics and Prolific. A total of 2,468 adults took the survey who reported no history of reading disability and a minimum of an 8th-grade reading level. As part of the survey, participants were asked about any past or active diagnosis of a mental condition and filled out self-assessments for neuropsychiatric symptoms (see below).

2. Measures of neuropsychiatric symptoms

All 2,468 participants filled out the Generalized Anxiety Disorder-7 (GAD7)[3] and the Patient Health Questionnaire-9 (PHQ9)[4] as measures of the severity of their anxiety and depression (see Figures 1 & 2). While all participants filled out the PHQ9 and the GAD7, out of the 2,468 total participants 1,878 participants filled out the self-report Yale-Brown Obsessive-Compulsive Scale (YBOC)[5] as a measure for OCD symptom experience.

Figure 1

Assessment scores on the PHQ9 range from 0-27, where scores of:
1-4 indicate minimal depression,
5-9 mild depression,
10-14 moderate depression,
15-19 moderately severe depression,
20-27 severe depression.

Figure 2

Assessment scores on the GAD7 range from 0-21, where scores of:
1-4 indicate minimal anxiety,
5-9 mild anxiety,
10-14 moderate anxiety,
15-21 severe anxiety.

3. Exploratory Factor Analysis

Plotting participants' factor loadings in three-dimensional "agency" space

To identify potential dimensions of agency and examine how neuropsychiatric symptoms impact an individual's position in a multi-dimensional "agency" space, we used an exploratory factor analysis.

As is common with these conditions, there was significant co-morbidities where only a small number of participants scored highly on only the anxiety, depression or OCD assessments. In order to best visualize the impacts of neuropsychiatric symptoms on agency we ran factor analysis on a sample that included both "control" participants (blue) whose scores on the self-assessments indicated no symptom experiences related to anxiety, depression or OCD, as well as participants whose scores indicated symptom experiences of all three conditions (orange).

The scree plot indicated that four components account for a large proportion of the variance. We ran a factor analysis with four components using an oblique rotation. This non-orthogonal rotation was chosen because it allows factors to be correlated, which we expect of the different dimensions of agency.

The graph on the right shows participants' loadings on the first three factors, plotted in three-dimensional space. Separation between the groups was observed across the different factors, meaning that they occupied different regions in the multi-dimensional "agency" space. *For an animation of this graph, please see the webpage version of our poster (link in the top right).*

This analysis was for visualization purposes. In order to quantify differences between groups, we ran a separate factor analysis on the control participants to define a short version of the AAT that we could use to quantify differences across neuropsychiatric groups.

Participant Group	N	Assessment Scores
Control	268	PHQ9 < 5; GAD7 < 5; YBOC < 8
OCD/Anxiety/Depression	977	PHQ9 ≥ 5; GAD7 ≥ 5; YBOC ≥ 8

4. Exploratory Factor Analysis on Control Participants to create a short version of the AAT

Factor analysis was used to developed a shortened version of the AAT. As is standard in test development we used only the control participants, where first the factor structure of a control population is used to select questions that best capture the construct of interest. Then these questions are given to patient populations to observe differences in scores on these factors. The factor analysis was run with an oblique rotation on a control group of 587 participants. To maximize our sample size, we included participants we collected that did not take the YBOC. The scree plot indicated that four components accounted for the large proportion of the variance, so we ran a four-factor analysis with an oblique rotation. Questions that loaded onto the factors with greater than or equal to a value of .5 were selected, as shown below.

Factor 1: "Positive" Agency

Loading	AAT Question
.75	I live in accordance with my values and beliefs.
.71	Most of my decisions are consistent with my deep commitments.
.69	I have the ability to form my own character.
.66	I have free will.
.66	I usually take measures to achieve my goals.
.66	When faced with a touch decision, I carefully consider the pros and cons.
.64	Free will is a basic part of human nature.
.63	I try to use the same moral criteria to judge myself as I use to judge others.
.63	I am who I am due to my own choices.
.63	I am still an author of my story, even if others play a role.
.62	I generally feel very present in my life.
.61	Every person is responsible for their own actions.
.60	Even when I'm fearful, I'm capable of calming myself down or pushing through it.
.60	I trust my own perceptions of the world.
.59	I see my life as an ongoing project that is continuous and coherent.
.59	I am able to negotiate boundaries of my private spaces in a way that is comfortable to me.
.59	I try to identify and do what makes me happy.
.59	I am the author of my life's story, at least to a considerable extent.
.58	I know how to look at my emotions from a more objective perspective.
.57	The skills I've developed and my abilities are central to who I am.
.56	I have ability to initiate gross motor movements (walking, running, throwing, ect.).
.55	My actions align with my beliefs.
.55	The shape of my life so far informs my choices today.
.55	I am in full control of what I do.
.55	I have the ability to carry out fine motor movements (writing, grooming, folding or buttoning clothes, ect.).
.54	Even though I've grown and changed, who I am at my core stays constant.
.54	Most people in my life respect my ability to make my own choices.
.54	I take responsibility for my mistakes.
.53	When faced with a moral choice, I will do the right thing even if it is the more difficult course of action.
.52	I have control over my body.
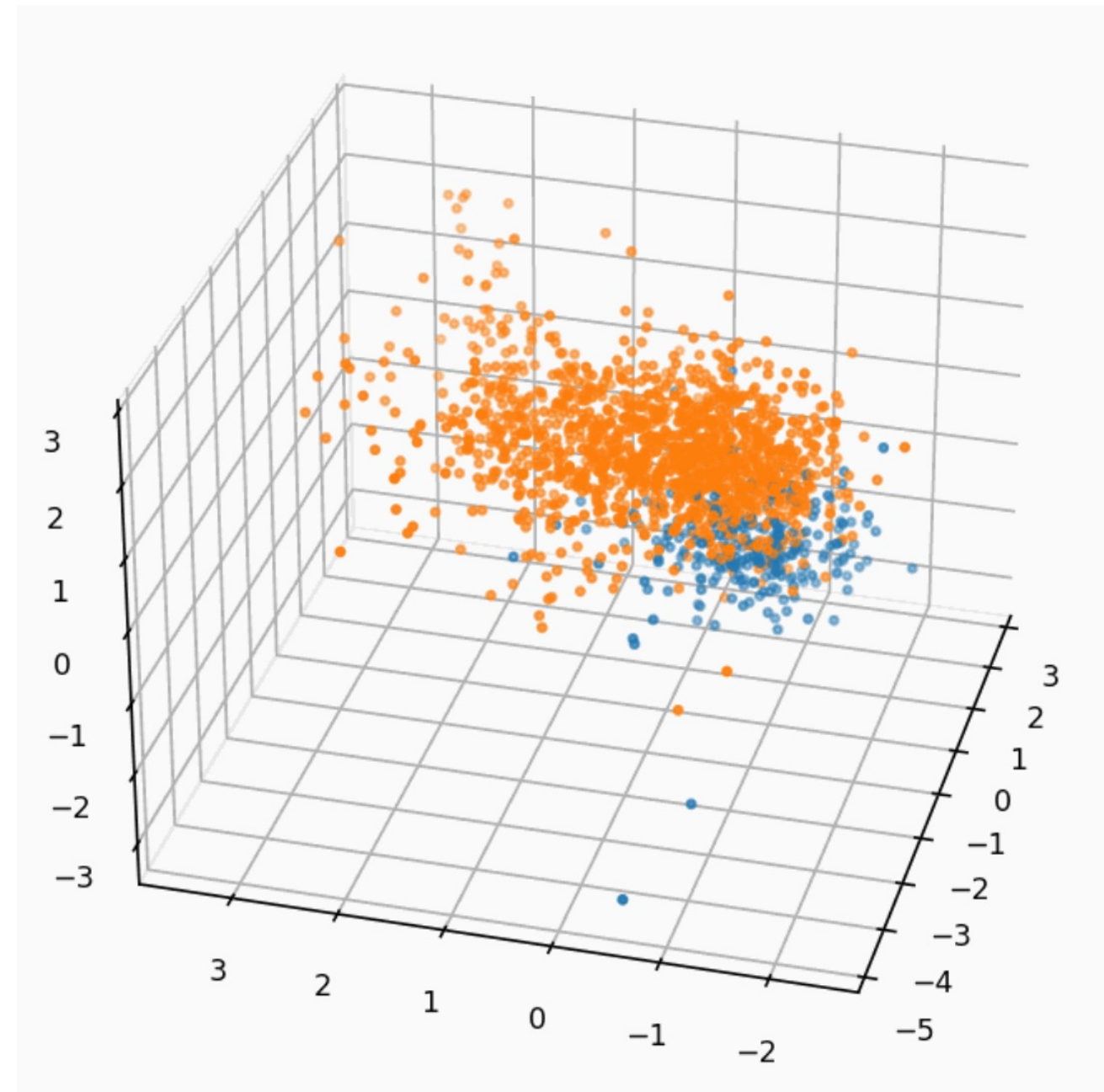
Factor 2: "Negative" Agency

Loading	AAT Question
.62	Fear keeps me from doing projects that are important to me.
.61	I have trouble functioning due to anxiety.
.60	I find myself in emotional ruts that I don't know how to get out of.
.59	There are thoughts that won't go away even when I try to get rid of them.
.58	I sometimes do things and I don't understand why I'm doing them.
.57	I feel like I'm just going through the motions.
.57	I can become overwhelmed by sadness.
.57	My behavior sometimes doesn't make sense to me.
.55	I have trouble motivating myself.
.54	I feel like I'm trapped in my life and have very little ability to change anything.
.52	I find myself doing things without really willing them.
.51	I feel alienated from myself.
.51	I lost interest partway through projects.
.50	I worry too much.

Factor 3: Risk-taking

Loading	AAT Question
.80	I take risks that could have harmful physical consequences.
.79	I take risks that could harm me.
.69	I engage in dangerous social behaviors.
.68	I take risks that could harm others.
.64	I take risks that could have legal consequences.
.62	I take risks that could have financial consequences.

Factor 4

No questions loaded onto Factor four with a value of equal to or greater than .5
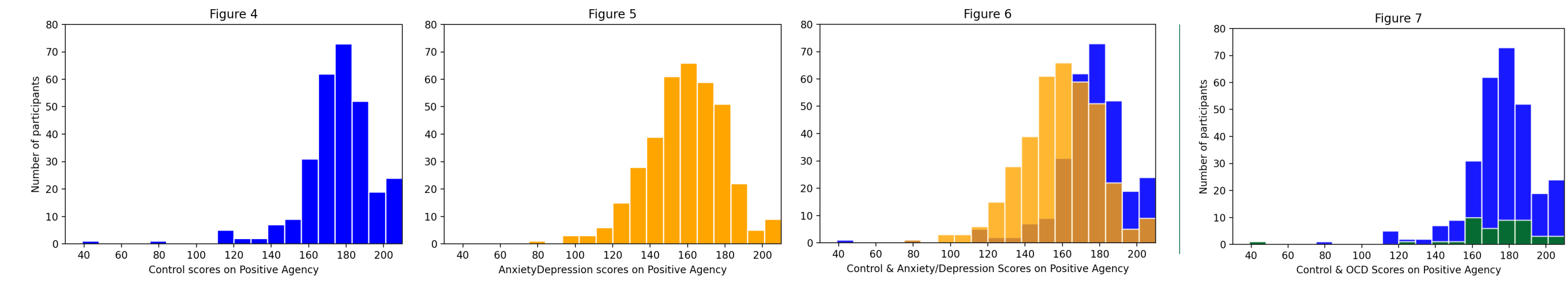
5. Relationships between participants' scores on AAT Factors and neuropsychiatric symptoms

In order to observe differences in agency across individuals with neuropsychiatric symptoms, we took the "shortened" version of the AAT that included all questions that loaded onto a factor with a value equal to or great than .5 and summed the scores for the Control, Anxiety/Depression and OCD participants. Groups were defined based upon their assessments scores as described in the table to the right. We used data only from the 1,878 participants that took the YBOC so we could ensure that the Anxiety/Depression group did not include individuals also experiencing OCD symptoms.

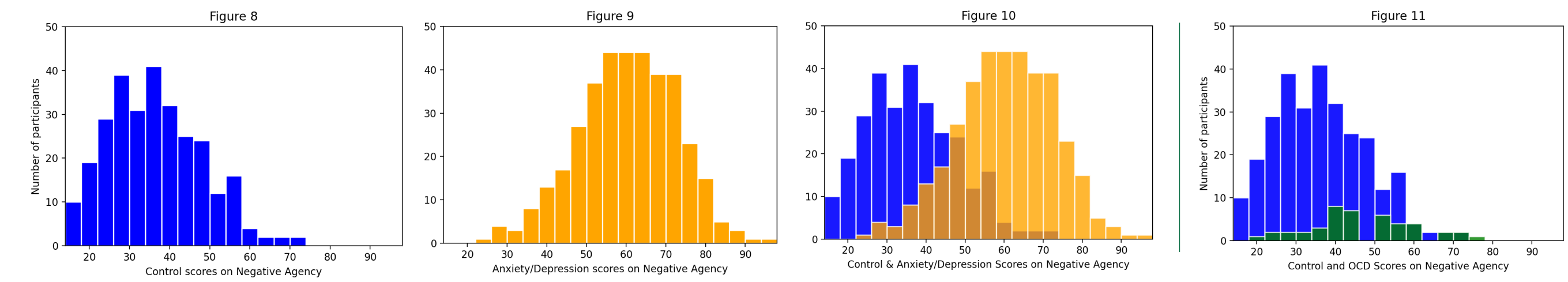| Participant Group	N	Assessment Scores
Control	288	PHQ9 < 5; GAD7 < 5; YBOC < 8
Anxiety/Depression	368	PHQ9 ≥ 5; GAD7 < 5; YBOC < 8
OCD	44	PHQ9 < 5; GAD7 < 5; YBOC ≥ 8

Participants' scores on Factor 1- "Positive" Agency questions

Histograms of participants' scores for the 30 questions that loaded onto the "Positive Agency" factor. Scores could range from 30-210.

Participant Group	Mean	Median	STD
Control	175.0	176	19.8
Anxiety/Depression	158.5	160	20.6
OCD	171.5	175	25.8

There was a significant difference between the scores of the Control and the Anxiety/Depression group (Mann–Whitney U = 26,528.5, n_1 = 288 n_2 = 368, P < 0.05 two-tailed), but not the Control and the OCD group (Mann–Whitney U = 5,857.5, n_1 = 288 n_2 = 44, P >.05 two-tailed).
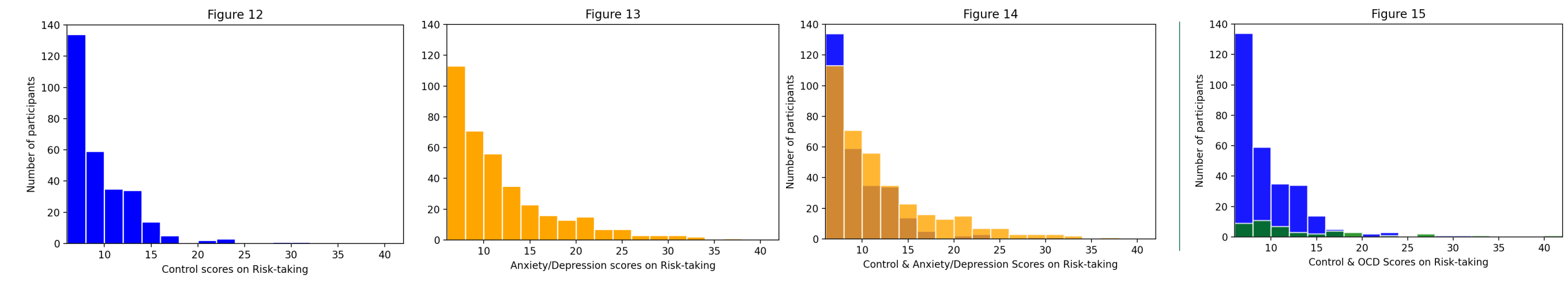
Participants' scores on Factor 2- "Negative" Agency questions

Histograms of participants' scores for the 14 questions that loaded onto the "Negative Agency" factor. Scores could range from 14-98.

Participant Group	Mean	Median	STD
Control	35.9	35	11.8
Anxiety/Depression	59.8	60	12.4
OCD	46.2	44.5	13.6

There was a significant difference between the scores of the Control and the Anxiety/Depression group (Mann–Whitney U = 9,233, n_1 = 288 n_2 = 368, P <.05 two-tailed), as well as the Control and the OCD group (Mann–Whitney U = 3,580, n_1 = 288 n_2 = 44, P <.05 two-tailed).

Participants' scores on Factor 3 - Risk-taking questions

Histograms of participants' scores for the 6 questions that loaded onto the "Risk-taking" factor. Scores could range from 6-42.

Participant Group	Mean	Median	STD
Control	8.9	8	3.7
Anxiety/Depression	11.3	9.5	5.8
OCD	12.7	10	7.5

There was a significant difference between the scores of the Control and the Anxiety/Depression group (Mann–Whitney U = 39,207.5, n_1 = 288 n_2 = 368, P <.05 two-tailed), as well as the Control and the OCD group (Mann–Whitney U = 3,993, n_1 = 288 n_2 = 44, P <.05 two-tailed).

Correlation between participants' scores on anxiety, depression and OCD assessments and their scores on AAT factors

Participants' scores on the "Positive" Agency factor were negatively correlated with their scores on the assessments for anxiety (GAD7), depression (PHQ9) and OCD (YBOC). Their scores on the "Negative" Agency and Risk-taking factors were positively correlated with their assessment scores.

Figure 16
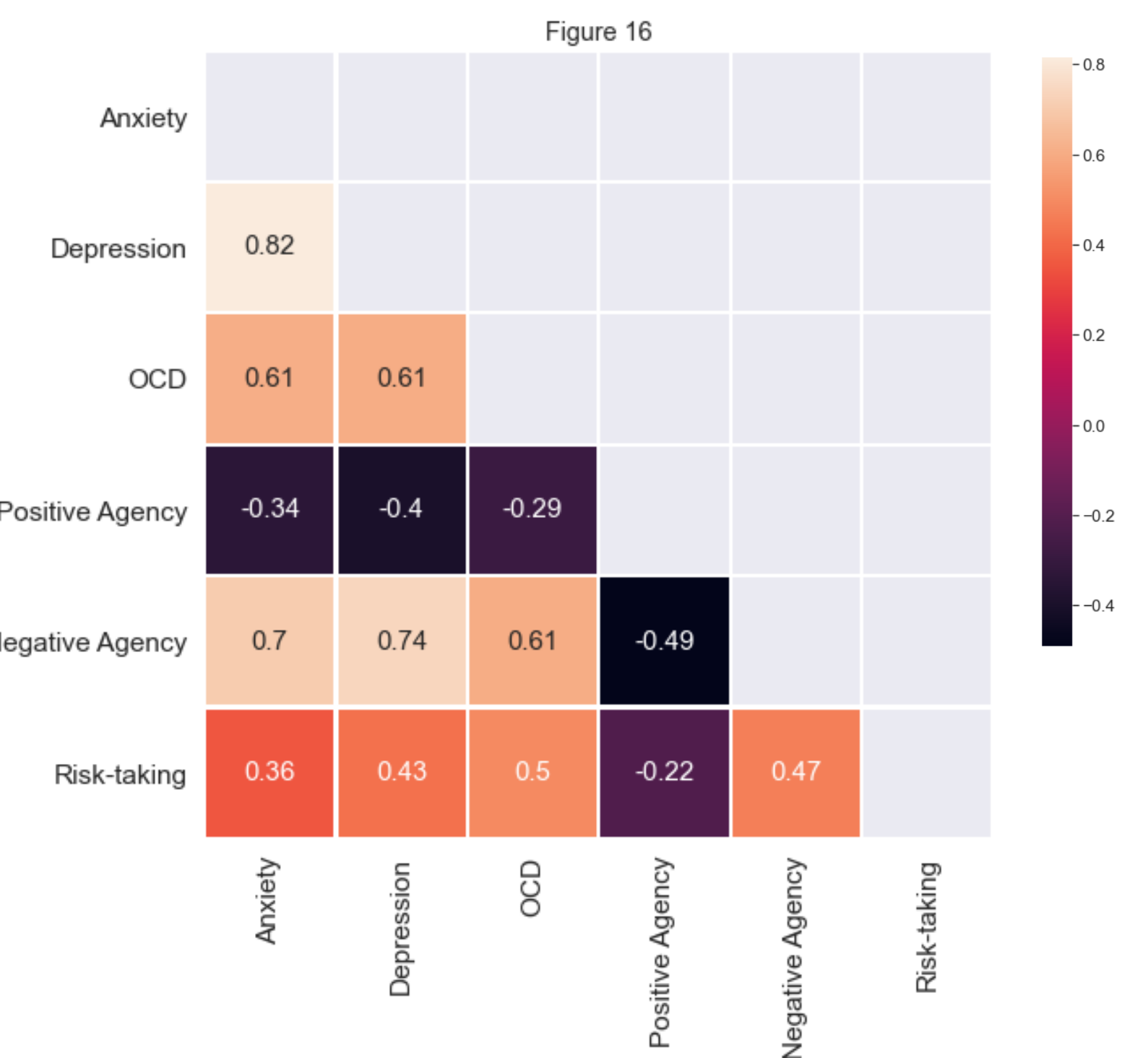
6. Discussion

Our aim is to develop an assessment of agency that is able to differentiate between different neuropsychiatric groups and is sensitive to the sorts of changes that can happen with deep brain stimulation. We are employing a data-driven approach to discern dimensions of agency, and as part of this approach factor analysis has identified survey questions for quantifying differences in agency experience between a control population and individuals with Anxiety, Depression and OCD symptoms

The questions that loaded highly onto the factors broadly correspond to things that contribute to agency ("positive"), things that detract from agency ("negative") and attitudes toward risk. However, there is complexity and nuance to the relationship between agency and attitudes toward risk that needs to be considered – where in addition to having different attitudes toward risk, different people and different groups may assess risk differently. For example, an individual with Generalized Anxiety Disorder or OCD may perceive their behavior as more risky than someone without these symptoms, and therefore would rate their behavior as more "risky". This is partially a limitation of self-report measures, but an important aspect to understand when attempting to describe an individual's agency experience.

Future work will employ different quantitative approaches to explore this complexity and further inform thinking about the dimensions of agency by exploring the relationships between these three factors, as well as the relationships between the different questions included within the "positive" and "negative" agency factors.

References

1. Roskies, A. L. (2015). Agency and intervention. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 370(1677), 20140215.
2. Schönau, A., Dasgupta, I., Brown, T., Versalovic, E., Klein, E., & Goering, S. (2021). Mapping the dimensions of agency. *AJOB neuroscience*, 1-15.
3. Spitzer R.L., Kroenke K., Williams J.B.W., Löwe B. A brief measure for assessing generalized anxiety disorder: The GAD-7. *Arch Intern Med*. 2006;166(10):1092-1097. doi:10.1001/archinte.166.10.1092
4. Kroenke K., Spitzer R.L., Williams J.B.W. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16(9):606-613.
5. Federici, A., Summerfeldt, L. J., Harrington, J. L., McCabe, R. E., Purdon, C. L., Rowa, K., & Antony, M. M. (2010). Consistency between self-report and clinician-administered versions of the Yale-Brown Obsessive-Compulsive Scale. *Journal of Anxiety Disorders*, 24(7), 729-733.