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A Professional Corporation
Diplomate in Clinical Neuropsychology
American Board of Professional Psychology

June 21, 2022

Michael Burt, Esq.
Law Office of Michael Burt PC
1000 Brannan Street Suite 400
San Francisco, California 94103

RE: Robert Bowers
DOB: 9/4/72

Dear Mr. Burt:

You have asked me to consult on the case of Robert Bowers, with a focus on the neuropsychological assessment findings based on the testing conducted by Paul Moberg, Ph.D. and the integration of the computed tomography (CT), CT/Positron Emission Tomography (PET) and magnetic resonance imaging (MRI) studies also performed on Mr. Bowers. You have also asked for a preliminary review of records and opinions, with a more comprehensive report to follow when other expert consultation reports have been submitted. You have provided me with a flash drive with the following records:

- Raw neuropsychological data from Paul Moberg, Ph.D. (December, 2019, January, 2020)
- Magnetic Resonance Imaging (MRI) Digital Imaging and Communications in Medicine (DICOM) files from the University of Pittsburgh Medical Center Health System Imaging Center at Presbyterian Hospital, 1.2.2022
- Computed Tomography (CT) DICOM files from 10.27.2018
- Social History Records
- Clinical and Quantitative PET Report by Andrew Newberg, M.D. June 9, 2022
- Clinical and Quantitative MRI Report by Murray Solomon, M.D. June 16, 2022

I have not personally examined Mr. Bowers, so the opinions that follow are from my review of the records, concentrated on the integration of the findings across those assessments from a cognitive neuroscience, clinical neuropsychology and neuropsychological assessment perspective. I have a 47-year academic, clinical, and research career in all of these areas, as outlined in my vita that is attached. At the time of my retirement from full-time academia, I was a tenured Full Professor of Psychology and Neuroscience as well as the Founding Director of Brigham Young University's Magnetic Resonance Imaging Research Facility. Attached is my vita and you will see that I have over 400 peer-reviewed articles in the neuroscience, medical, and neuropsychological literature, most of it focused on neurocognitive, neurobehavioral, and neuroemotional disorders and the corresponding neuroimaging findings. I have applied all of this background to the assessment of Mr. Bowers' neuroimaging and neuropsychological findings and the opinions that follow.

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As I understand, Mr. Bowers has been undergoing a multifaceted neurological, neuropsychiatric, neuroimaging and clinical neuropsychological assessment approach, where not all findings have been reported as I write this preliminary report. Accordingly, I will just be making preliminary statements concerning my opinions at this time.

It is my understanding that Mr. Bowers has been assessed with schizophrenia. Schizophrenia is a brain disorder with any number of common findings in clinical and quantitative neuroimaging as well as electroencephalographic (EEG) studies, neuropsychological test findings and clinical assessment. In fact, in checking with the National Library of Medicine (pubmed.gov) on the day that I write these opinions, there are approximately 15,000 articles dealing with some aspect of brain pathology, electrophysiological abnormalities, neuropsychological and neuroimaging findings in schizophrenia. I will summarize some of those clinical research studies as they apply to Mr. Bowers.

The neuroimaging studies have also been reviewed by Murray Solomon, M.D., board certified neuroradiologist, where from a clinical, observational standpoint, Mr. Bowers' MRI demonstrates presence of a significant number of white matters hyperintensities (WMH), hippocampal asymmetry, minimal cavum septum pellucidum, somewhat atypical appearance of the corpus callosum, along with additional findings from a quantitative image analysis perspective of Mr. Bowers' brain as indicated in Dr. Solomon's report dated June 16, 2022. As will be discussed below, some of these clinical MRI features are those observed with a greater frequency in individuals assessed with schizophrenia.

It has long been known that individuals with schizophrenia have a higher frequency of EEG abnormalities [Hyde & Weinberger. Seizures and schizophrenia. Schizophr Bull. 1997;23(4):611-22. doi: 10.1093/schbul/23.4.611]. In the EEG Note Ambulatory record from the University of Pittsburgh Medical Center dated December 14, 2021, the following diagnosis was made following EEG assessment: Change in mental status (ICD10-CM R41.82, Working diagnosis), Convulsion (ICD10-CM R56.9, Working Diagnosis). The clinical interpretation was: "This ambulatory EEG recording suggests a bitemporal focal cerebral dysfunction as well as potential seizure tendency in the setting of mild diffuse slowing. No seizures or interictal epileptiform abnormalities were recorded during this EEG recording." EEG findings are objective indicators of underlying brain dysfunction.

It is also my understanding that a number of what are referred to as "soft neurological signs" have been documented based on the physical exam of Mr. Bowers. These soft neurological findings as documented in Mr. Bowers included fine tremor, decreased hopping on left leg, decreased fine fingers movements, with some perseverated movements on a finger-touching task, diminished olfactory discrimination, presence of a palmomental reflex on the left and positive Babinski on the right. It has long been established that soft neurological signs have an increased frequency in individuals with schizophrenia (Bachman et al. Neurological soft signs in the clinical course of schizophrenia: results of a meta-analysis. Front. Psychiatry, 23 December 2014 | https://doi.org/10.3389/fpsyt.2014.00185).

From a literature review on objective quantitative and clinical brain abnormalities identified in neuroimaging studies, Landin-Romero et al. (Midline Brain Abnormalities Across Psychotic and Mood Disorders. Schizophrenia Bulletin vol. 42 no. 1 pp. 229–238, 2016; doi:10.1093/schbul/sbv097) states the following: "Patients with schizophrenia are known to have increased prevalence of abnormalities in midline brain structures, such as a failure of the septum pellucidum to fuse (cavum septum pellucidum) ….", atypical corpus callosum shape and asymmetry of limbic system structures [Huang et al. A Deformation-Based Shape Study of the Corpus Callosum in First Episode Schizophrenia. Front Psychiatry. 2021 Jun 4;12:621515. doi: 10.3389/fpsyt.2021.621515; Turk et al. Corpus callosum in schizophrenia with deficit and non-deficit syndrome: a statistical shape analysis. Gen Psychiatr . 2021 Dec 1;34(6):e100635. doi: 10.1136/gpsych-2021-100635; Torrey Peterson. 1974. Schizophrenia and the limbic system. The Lancet. 304, 7886, 1974, 942-946. https://doi.org/10.1016/S0140-6736(74)91143-X].

Numerous studies have shown "widespread disruptions in white matter integrity" in individuals with neuropsychiatric disorder, including schizophrenia [see Dong D. et al. Shared abnormality of white matter integrity in schizophrenia and bipolar disorder: A comparative voxel-based meta-analysis. Schizophr Res. 2017; 185:41–50. https://doi.org/10.1016/j.schres.2017.01.005; Li J, Kale Edmiston E, Chen K, Tang Y, Ouyang X, Jiang Y, et al. A comparative diffusion tensor imaging study of corpus callosum subregion integrity in bipolar disorder and schizophrenia. Psychiatry Res.2014; 221:58–62. https://doi.org/10.1016/j.pscychresns.2013.10.007; Squarcina L, et al. Similar white matter changes in schizophrenia and bipolar disorder: A tract-based spatial statistics study. PLoS One. 2017; 12:e0178089. https://doi.org/10.1371/journal.pone.0178089; Lee et al. Common gray and white matter abnormalities in schizophrenia and bipolar disorder. PLoS ONE 15(5): e0232826. https://doi. org/10.1371/journal.pone.0232826].

Specific to the corpus callosum in schizophrenia, Piras et al. [Corpus callosum morphology in major mental disorders: A magnetic resonance imaging study. Brain Commun. 2021 May 11;3(2):fcab100. doi: 10.1093/braincomms/fcab100], in comparison to other "mental health" conditions found in individuals with schizophrenia to exhibit "…thinner corpora callosa than controls …" Michalczyk et al. (Serum inflammatory markers and their associations with white matter integrity of the corpus callosum in schizophrenia patients and healthy controls. Prog Neuropsychopharmacol Biol Psychiatry; 2022 Jun 8;116:110510. doi: 10.1016/j.pnpbp.2022.110510) state: "Schizophrenia is associated with disrupted integrity of white matter microstructure of a variety of brain regions, especially the corpus callosum (CC)." Using diffusion tensor imaging (DTI), Zhao et al. [A Comparative Multimodal Meta-analysis of Anisotropy and Volume Abnormalities in White Matter in People Suffering from Bipolar Disorder or Schizophrenia. Schizophrenia Bulletin. 2022 Jan 21;48(1):69-79. doi: 10.1093/schbul/sbab093] found significant difference in white matter anisotropy in the corpus callosum associated with schizophrenia, as well as the cingulum and other white matter ROIs.

In a meta-analytic review of neuroimaging findings, Iliuta et al. (Magnetic resonance imaging in Schizophrenia. Experimental and Therapeutic Medicine. 22: 765, 2021; DOI: 10.3892/etm.2021.10197) found: "regarding MRI imaging in patients with schizophrenia, the most frequent findings are enlargement of lateral ventricles, cortical atrophy, affecting mostly temporal

and frontal lobes, and white matter abnormalities." Those are observed in Mr. Bowers' neuroimaging.

I attach a PowerPoint with some select images from the hundreds of scan images available from Mr. Bowers' January 3, 2022 MRI which show white matter abnormalities, temporal lobe asymmetries, cavum septum pellucidum (minimal), corpus callosum and quantitative neuroimaging differences. As discussed above, these anomalies/abnormalities/findings are some of the most common observations in the neuroimaging of an individual with schizophrenia and they are all present in Mr. Bowers' brain. In the PowerPoint, I show a typical, healthy MRI, including typical appearance of the corpus callosum, ventricular size and symmetry of right and left hemisphere brain structures. These images can be used to compare Mr. Bowers' findings.

As indicated above, Mr. Bowers underwent neuropsychological assessment conducted by Paul Moberg, Ph.D., ABPP, a board-certified clinical neuropsychologist. You have provided me with the raw data for my review. Dr. Moberg administered a comprehensive and thorough neuropsychological battery, including several test validity measures, all of which Mr. Bowers passed. Accordingly, these results reflect a cooperative examinee who put forth sufficient effort, resulting in interpretable test findings. On the Wechsler Adult Intelligence Scale-IV, while Mr. Bowers obtained a Full-Scale IQ score of 120 (91st percentile) his Processing Speed Index score was just 86 (18th percentile). The difference is highly significant. Reduced processing speed is associated with presence of white matter hyperintensities, such as those seen in Mr. Bowers' brain as well as being a common problem in schizophrenia. As stated by Klauser et al. [White Matter Alterations Between Brain Network Hubs Underlie Processing Speed Impairment in Patients with Schizophrenia. Schizophr Bull Open . 2021 Jul 17;2(1):sgab033. doi: 10.1093/schizbullopen/sgab033]: "Processing speed (PS) impairment is one of the most severe and common cognitive deficits in schizophrenia." Processing speed impairments relate to white matter abnormalities in the brain, including white matter hyperintensities [d'Arbeloff et al. White matter hyperintensities are common in midlife and already associated with cognitive decline. Brain Commun . 2019;1(1):fcz041. doi: 10.1093/braincomms/fcz041 ; Prins & Scheltens. White matter hyperintensities, cognitive impairment and dementia: an update. Nat Rev Neurol. 2015 Mar;11(3):157-65. doi: 10.1038/nrneurol.2015.10].

Schizophrenia is also associated with impaired executive control [Luvsannyam et al. Neurobiology of Schizophrenia: A Comprehensive Review. Cureus. 2022 Apr 8;14(4):e23959. doi: 10.7759/cureus.23959. eCollection 2022 Apr.], where impaired performance on the Wisconsin Card Sorting Test and the Rey-Osterrieth Complex Figure Test have been the most commonly used measures to show deficits. Mr. Bowers is impaired on these measures as well. In addition, the testing shows Mr. Bowers is impaired in social cognitive functions, which is also a well-established finding in schizophrenia [Green MF, Llerena K, Kern RS. The "Right Stuff" Revisited: What Have We Learned About the Determinants of Daily Functioning in Schizophrenia? Schizophr Bull. 2015 Jul;41(4):781-5. doi: 10.1093/schbul/sbv018. Epub 2015 Mar 7. PMID: 25750248; PMCID: PMC4466185]. Finally, his motor function, language production and immediate and delayed memory were demonstrated to be impaired, consistent with the schizophrenia research and clinical findings associated with the disorder.

Finally, the objective, quantitative analysis of the PET imaging performed on Mr. Bowers was distinctly abnormal, as summarized by Dr. Newberg as follows: "There are a number of metabolic abnormalities on this PET scan. When there are a large number of brain areas that have abnormal metabolism and asymmetries, the findings are consistent with extensive clinical abnormalities including emotional regulation impairment, cognitive and motor processing problems, and psychotic symptoms. This patient carries the clinical diagnosis of schizophrenia, a complex disease that has both positive and negative symptoms that are associated with multiple brain abnormalities. For example, schizophrenia has been associated with significantly abnormal asymmetries in the brain, often with the right sided structures less active than the left, as is observed with this patient. In addition, there is recognition of dysfunction in the limbic system, frontal lobes, and striatum in patients with schizophrenia, all of which are abnormal in this patient."

I am also preparing a 3-D image analysis of Mr. Bowers' brain to show the locations of the different brain areas and regions of interest (ROI) as described above, from both the MRI, CT and PET neuroimaging findings, where certain abnormalities/anomalies have been identified. As seen in the last image of the PowerPoint, the MRI studies of Mr. Bowers are sufficient to extract a rendered image of his brain which will facilitate in objectively viewing where the different neuroimaging-based brain findings are located.

In summary, Mr. Bowers has objective neuroimaging, electroencephalographic, physical exam neurological and neuropsychological objective results, all indicative of underlying brain dysfunction. These objective abnormalities are consistent with brain abnormalities seen in schizophrenia. I am prepared to elaborate on any of the above points, should there be a need.

Sincerely,

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