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July 1, 2023

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RE: Robert Bowers
DOB: 9/4/72

Dear Mr. Burt:

You have asked me to provide an update to my opinions of the June 21, 2022 report concerning Robert Bowers and the neuropsychological testing that was performed in December 2019 and January 2020 by Paul Moberg, Ph.D., ABPP. All of my core opinions as expressed in the June 21, 2022 report remain unchanged. Since then I have received the neuropsychological evaluation and raw data from the assessment by Daniel A. Martell, Ph.D., ABPP that was performed on May 22, 2023 and then elaborated on in Dr. Martell's June 12, 2023 report to the Honorable Robert J. Colville, District Judge, United States District Court for the Western District of Pennsylvania.

In addition to what I set forth in my previous report to you, I have now reviewed the records and reports of Dr. Crudele who reviewed the EEG data and prepared a report, Dr. Darby who conducted a neurologic examination, Dr. Dietz who conducted a psychiatric examination, Dr. Mayberg who reviewed the PET testing, Dr. Nadkarni who conducted a neurologic examination and reviewed the EEG, Dr. Newberg who reviewed the PET, Dr. Corvin who conducted a psychiatric examination, and Dr. Rogers who conducted a psychological examination. I have considered the data and opinions from each of these evaluations. I have also reviewed the trial testimony of Drs. Nadkarni, Solomon, and Newberg, as well as the testimony from Drs. Rajasekaran, Mettenburg and Mountz.

In particular, I have had the opportunity to review Dr. Martell's data and conclusions, and have considered his test results and opinions in assessing the similarities and differences between his findings and opinions and my own, based on my review of both. It is common in clinical

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evaluations to take into account serial administration of tests and to consider changes between administrations to better understand an individual's functioning and behavior.

I set forth my opinions concerning both the test findings from Dr. Moberg and Dr. Martell in the powerpoint which I previously prepared for you. I have now revised that demonstrative to reflect only the testing data and not the opinions of Dr. Martell. As already stated in my previous June 21, 2022 report, I have not personally examined Mr. Bowers, but I have an extensive background in neuropsychological and neuroimaging assessment and test interpretation. It is from that expertise that I render the opinions in this addendum and in the powerpoint.

My PowerPoint makes various references to a Bell Curve that is taken from the textbook titled, "*Neuropsychological Assessment*" by Lezak, M.D., Howieson, D.B., Bigler, E.D., and Tranel, D. (2012). New York: Oxford University Press. This Bell Curve, as shown in **Figure 1**, is not unique in any way to that publication and is a universally used Bell Curve to describe test results used by psychologists and physicians. I will give a few other figures from the powerpoint in this addendum report to further explain what I have done in reviewing these records to support my opinions.

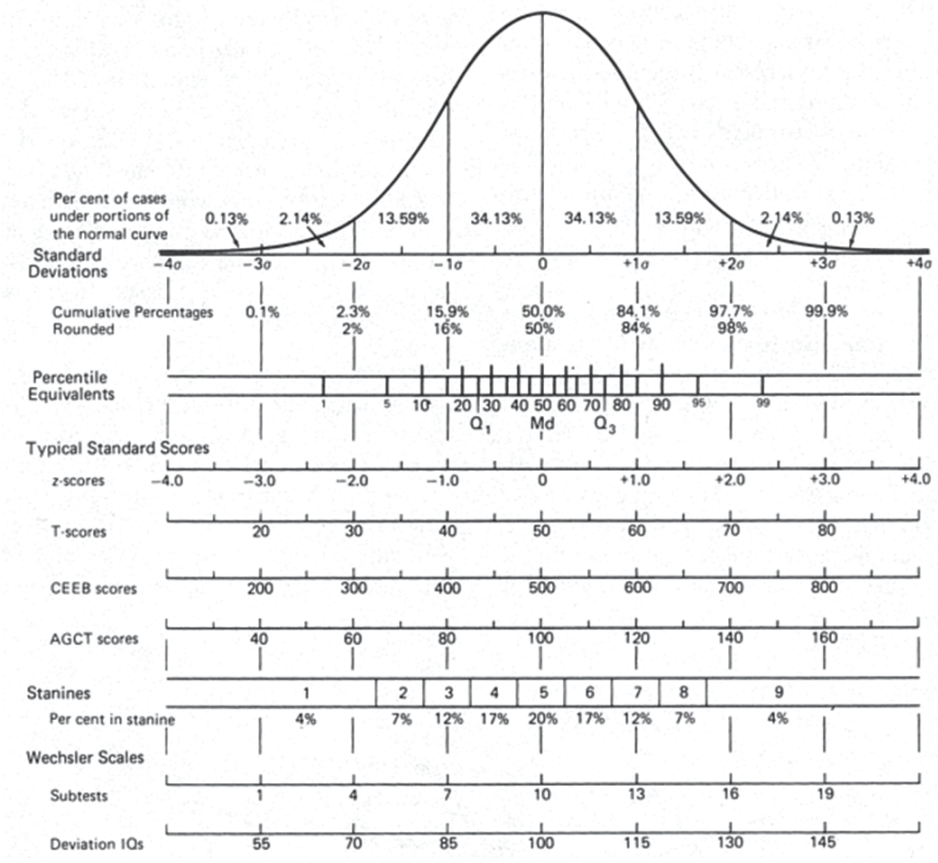
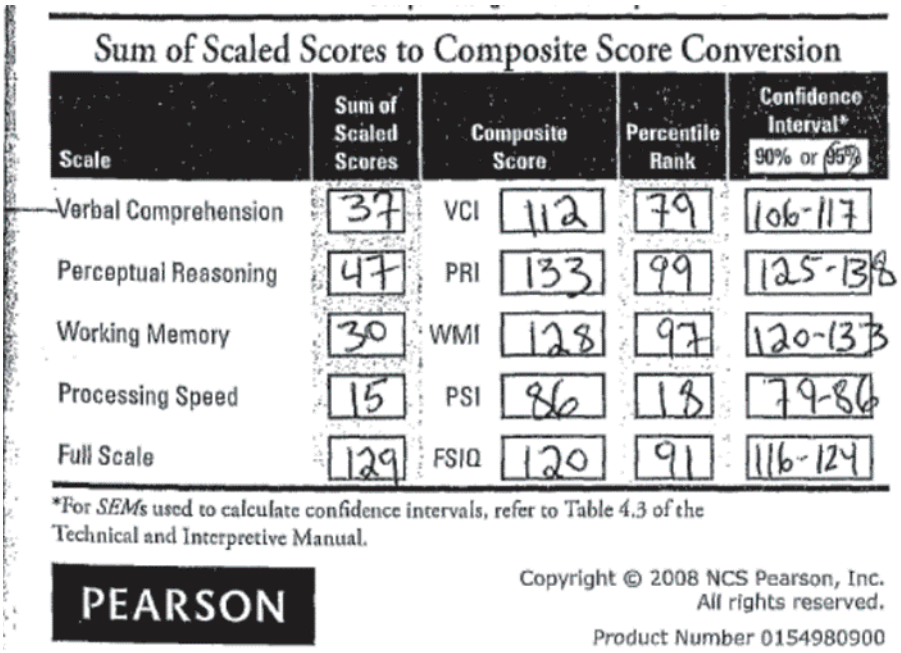


Figure 1

My basic opinions concerning Dr. Moberg's test findings, based on my review of the raw data received from him were explained in my original report. I have additionally reviewed Dr. Martell's raw data. Both Dr. Moberg and Dr. Martel administered validity tests and measures. Some where external to the tests being administered and some were embedded in the actual tests administered to Mr. Bowers. Mr. Bowers passed them all. The test results from both assessments were valid. As such, this is trustworthy data from which opinions can be rendered.

Below, pasted in, are the results of the Wechsler Adult Intelligence Scale – 4th Edition, as obtained by Dr. Moberg, presented as **Figure 2**. As can be seen, there are various index scores, or sub-categories, of intellectual assessment and each has its own unique score that is referenced back to the Bell Curve. Dr. Martell did not administer another IQ test but relies on Dr. Moberg's testing in the same manner that I am relying on it.



Sum of Scaled Scores to Composite Score Conversion

Scale	Sum of Scaled Scores	Composite Score		Percentile Rank	Confidence Interval* 90% or 95%
Verbal Comprehension	37	VCI	112	79	106-117
Perceptual Reasoning	47	PRI	133	99	125-138
Working Memory	30	WMI	128	97	120-133
Processing Speed	15	PSI	86	18	79-86
Full Scale	129	FSIQ	120	91	116-124

*For *SEMs* used to calculate confidence intervals, refer to Table 4.3 of the Technical and Interpretive Manual.

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Figure 2

What follows are summary points that have been made in greater detail concerning the role of IQ test results in neuropsychological test interpretation in the Lezak et al. *Neuropsychological Assessment* textbook. In order to explain the results of this test and explain the additional tests performed by both Drs. Moberg and Martell, I will use the Bell Curve distribution of results shown in different powerpoint slides, I will be referencing standard scores, scaled scores, which on the Bell Curve that you are seeing in my report as **Figure 1** is at the bottom of the Bell Curve illustration, where it indicates "Wechsler Scales" and the subtest categories are the scaled scores,

where they have a mean of 10 and a standard deviation of 3 and the IQ metrics are at the very bottom, presented as "Deviation IQs" and those are in standard scores where the mean or average is 100 and the standard deviation is 15. There will also be reference to T-scores which have a mean of 50 and a standard deviation of 10. Regardless of how the score is mentioned in the raw test data, or some output summary, one can always go from a scaled score, standard score, T-score, z-score and percentile score, so it is rather straightforward to understand where the individual's test scores are falling on the Bell Curve. These different types of scores are a technique by which we compare scores across different measures and subtests so that the scores are all on the same scale for comparison. This is standard practice and relies on the normative data for each test.

Returning to **Figure 2**, it is evident that there is a discrepant score, meaning it is substantially lower than all of the others and that happens to be with the Processing Speed Index (PSI) score. What neuropsychologists do with IQ scores is that they will utilize that information to establish some type of baseline ability, as well as contrast different index scores. The logic behind that is that much of what is assessed by an intellectual quotient or IQ score is the emergence of cognition in a child as their response to the environment, educational opportunities, genetic heritage, etc. develops, but the IQ metric becomes relatively well-established by late childhood/middle adolescence. It can also be a reference to examine other aspects of neuropsychological function. There is a principle of a "general ability factor" which is typically discussed as "g." "g" gives the neuropsychologist a reference point to look at as to what an individual's general abilities may be, and where scores may differ from that "g" factor. In individuals considered to be healthy, or neurotypical, there tends to be a hovering of scores within a certain statistical range around a general factor like FSIQ. In Mr. Bowers' case, that FSIQ score of 120 (91st percentile) is on the far right of the Bell Curve. What this suggests, then, is when we look at other neuropsychological indicators, they should at least be above average. In fact, if you look at all of the other index scores in **Figure 2** they are above average to even superior, except the Processing Speed Index (PSI). When scores like the PSI do not fall into that expected range, this provides indicators for neuropsychologists to identify weaknesses and neurological deficits in an individual. The clinical inference of a low PSI score will be discussed later in this report and in the powerpoint.

The relevance of the IQ score is not so much that Mr. Bowers was able to perform well on a summary IQ measure, but that it indicates that Mr. Bowers' test scores on other measures also should have consistently been recorded to be at least above average across the board of all tests. That is not observed in several of Mr. Bowers measures as will be explained in the powerpoint. Neuropsychologists assess brain function via different domains – motor, sensory, language, memory, visual-spatial, executive control, academic and intellectual, to outline those that both Dr. Moberg and Dr. Martel examined. Neuropsychologists look for neuropsychological test data that reflects a theme of similarities and/or difference scores across different domains, that in turn relate to what condition is being examined. As explained in my report, the information provided to me was that Mr. Bowers had schizophrenia, a diagnosis now confirmed by the reports of Drs. Nadkarni, Rogers and Corvin. I have also reviewed Drs. Dietz's report in which he offers a diagnosis of schizoid personality disorder. While there is no neuropsychological profile that is diagnostic of schizophrenia, there are literally thousands of articles in the peer reviewed literature on schizophrenia, like the classic article written in 1983 by Dr. Larry J. Seidman that discusses,

even with the limits of technology and understanding of schizophrenia in the 20th century, that schizophrenia was a brain disorder with particular neurobiological underpinnings related to frontal and temporal lobe abnormalities along with impairments in limbic system and other brain regions. Now, a more contemporary view adds white matter pathology and impaired neural connectivity. There is now 5 decades of neuropsychological and neuroimaging data on individuals with schizophrenia that examines brain dysfunction. This literature is discussed in my powerpoint.

I was also asked whether the neuropsychological testing could be interpreted as reflecting brain impairment in Mr. Bowers. Before going on with any further interpretation of neuropsychological data, the question of whether there is underlying brain dysfunction has already been answered by both the prosecution as well as defense neurologists who have reviewed the electroencephalographic (EEG) studies performed at the University of Pittsburgh Medical Center, which were also interpreted by a neurologist at UPMC when initially performed. All agree that the EEG is abnormal. I insert the statement from the prosecution neurologist, Angela Crudele, M.D., in my powerpoint on her conclusions as shown in **Figure 3** to address the conclusion that Mr. Bowers has abnormal brain function.

EEG DIAGNOSIS: Abnormal EEG because of
1. Occasional left temporal theta more than delta slow, often in runs, more prominent and at times quasi-rhythmic in drowsiness
2. Rare right temporal delta slow
3. Rare generalized theta more than delta slow

CLINICAL INTERPRETATION: This 43 hour and 48-minute ambulatory EEG without video is suggestive of independent left more than right temporal nonspecific cerebral dysfunction. There is also evidence for mild nonspecific generalized cerebral dysfunction. No epileptiform discharges or EEG seizures were recorded.

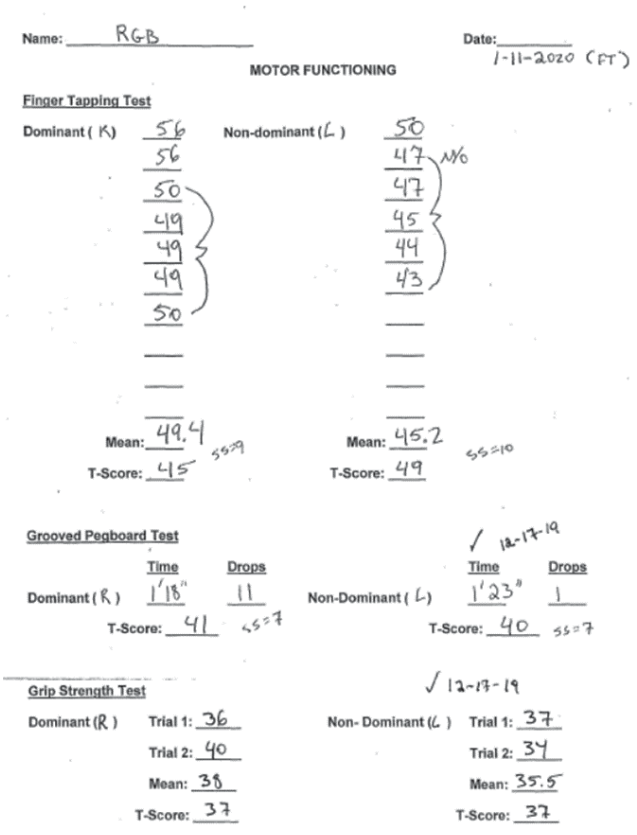
Figure 3

The clinical interpretation of EEG abnormalities was developed in the 1930s and is a well-established in the 21st Century as objective indicator of brain electrical activity. When an EEG is abnormal, it signifies that there is underlying brain dysfunction. As outlined by Dr. Crudele's statement, there are abnormalities that are nonspecific indicators of cerebral dysfunction as well as lateralized indicators affecting the temporal lobes, where the left temporal lobe is more affected than the right. Without any other test, this is an objective indication that there is brain dysfunction in Mr. Bowers. In the presence of these kinds of objective neurological indicators, one looks for deficits that would align with underlying brain pathology and the condition of schizophrenia. I already addressed in my June 21, 2022 report that there is a higher frequency of EEG abnormalities in those with a history of schizophrenia.

As identified in my June 21, 2022 report, a working hypothesis of schizophrenia had been made as indicated in the report of Dr. Newberg. The reports I recently reviewed by Drs. Rogers, Nadkarni

and Corvin confirm the clinical confirmation of the diagnosis of schizophrenia. Part of what I have been asked to do is to review how the neuropsychological tests and the neuroimaging studies are consistent with the research on schizophrenia and may help explain or not explain the behaviors and functioning associated with a diagnosis of schizophrenia. I will be commenting on some of the points raised by Dr. Nadkarni as they have relevance to the neuropsychological interpretation.

First, as pointed out by Dr. Nadkarni, and reviewed in my prior report, his clinical examination indicates motor impairments. Motor impairment was identified in terms of tremor by the prosecution retained neurologist as well. Turning to the motor testing that Dr. Moberg performed, he did the finger oscillation test, the grooved pegboard, and strength of grip measurement. I highlight these in my PowerPoint and you can see Dr. Moberg's handwritten findings there that relate values in T-scores and those scores place him in a low average to upper borderline range of test ability on those measures. Additionally, the dominant hand should be superior on all of these tasks, by a general factor of somewhere around 10%. That was not observed which has implications for greater left hemisphere frontal dysfunction. These test results are shown in **Figure 4** and in the powerpoint, I show where the frontal lobe is in Mr. Bower's brain and graph out the differences, in reference to the FSIQ. I merely show how this information is extracted from Dr. Moberg's data and how to use that information to go back to the Bell Curve in **Figure 1**, especially in reference to the FSIQ general factor discussed above.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MOTOR FUNCTIONING

Finger Tapping Test

Dominant (R): 56, 56, 50, 49, 49, 49, 50 — Mean: 49.4 — T-Score: 45 — SS=9

Non-dominant (L): 50, 47, 47, 45, 44, 43 — Mean: 45.2 — T-Score: 49 — SS=10

Grooved Pegboard Test ✓ 12-17-19

	Time	Drops	T-Score	
Dominant (R)	1'18"	11	41	SS=7
Non-Dominant (L)	1'23"	1	40	SS=7

Grip Strength Test ✓ 12-17-19

Dominant (R)	Trial 1: 36	Non-Dominant (L)	Trial 1: 37
	Trial 2: 40		Trial 2: 34
	Mean: 38		Mean: 35.5
	T-Score: 37		T-Score: 37

Figure 4

Now, if you have that "g" factor that is at or above the 91st percentile as was the FSIQ, then the discrepancy between where these motor test scores are and the performance by Mr. Bowers is an indication of diminished motor ability and as well as frontal lobe dysfunction. Note Dr. Nadkarni in his physical examination of Mr. Bowers found also that his finger tapping speed was diminished. In the PowerPoint, I have pointed to the motor cortex of Mr. Bowers' brain. Taken together these motor findings are indicators of frontal lobe dysfunction, in my opinion. These and other soft neurologic signs, and their association with schizophrenia, were discussed in my prior report.

The other distinct finding in Mr. Bowers' case is uneven performance in terms of memory test scores. He was administered the Montreal Cognitive Assessment Battery (MOCA) by Dr. Nadkarni and the only area where he had difficulty was in memory recall. Dr. Darby's MOCA indicated a score of 28/30, reflecting that Mr. Bowers missed one of five items on delayed recall. Dr. Moberg administered the California Verbal Learning Test (CVLT) as did Dr. Martell, except Dr. Moberg administered the CVLT-2 and Dr. Martell the CVLT-3. There are differences between those three, but they are very comparable, and what one can see is that when Dr. Martell administered the CVLT, the time that he got to the 4th and 5th trials (this is a measure where the individual has to remember 16 words), his scores were dropping off. This is a sign of proactive inhibition and some elements of disrupted memory processing. Also, there were some other retention issues. Dr. Martell, when he administered the CVLT-3, Mr. Bowers did somewhat better but had the same pattern, where proactive inhibition likely interfered with retention by Trial 5. This will be shown in the powerpoint.

There is also some practice effect, in the CVLT once it is initially given even though there was a couple of years in between when Dr. Martell administered it and Dr. Moberg did his assessment. The Warrington Recognition Memory Test (WRMT) that was given by Dr. Moberg, Mr. Bowers obtained a 7 scaled score on the Faces component. The WRMT is divided into recalling 50 words and 50 faces. From a neuropsychological standpoint, it also has lateralization implications because language-based retention tends to tap more left hemisphere function and face recall taps more right temporal lobe function. The discrepancy between word retention and face retention is quite substantial, as can be seen with Dr. Moberg's handwritten scoring. Also, part of the temporal lobe work-up was Mr. Bowers' ability to recall the Rey Complex Figure. His scores for immediate recall were at the 8th percentile and for delayed recall, the 5th percentile. These are substantially impaired, in particular related to the "g" factor that I spoke of earlier in this report. Here we have two neuropsychological memory indicators that have some lateralized implications for right temporal lobe dysfunction and we have EEG that suggests there is also right temporal lobe dysfunction. All of this will be shown in the powerpoint.

In terms of executive control, Dr. Moberg administered the Wisconsin Card Sorting Test (WCST) but Mr. Bowers was only able to complete two of the six sorts. This is an abnormal score. This test is considered to be one of the longstanding measures of executive function, with some implications for frontal lobe ability. Recall that Dr. Moberg observed consistent impairments in motor functioning across multiple tests, also indicators of frontal lobe dysfunction. Dr. Martell examined

some other measures of executive functioning, where Mr. Bowers was able to perform adequately. However, an executive function test was also administered by Dr. Rogers. This was the Delis Kaplan Executive Function System (D-KEFS) identified as the "proverb" test. Dr. Rogers' administration of this measure, while Mr. Bowers did well on a number of the tasks, his scaled score on abstraction was at a scaled score of 7. This is, again, right at the lowest range of average and a significant discrepancy from a FSIQ score of 120. Dr. Martell had administered some other elements of the D-KEFS where Mr. Bowers performed within normal limits. The point to be made here is that Mr. Bowers displays areas of intact function but also impaired and that variability is what is observed neuropsychologically in those with impaired neurological functioning.

Academic testing by Dr. Martell demonstrated average to above average scores, but Dr. Moberg administered writing fluency and math fluency measures that distinctly were not. These measures have a component of processing speed. There is research that indicates achievement deficits in individuals with schizophrenia and Mr. Bowers never finished high school, but did complete a GED. This will be shown in the powerpoint.

Dr. Martell administered measures that assess what neuropsychologists refer to as 'Social Brain Function.' Impairments in social brain processing are reflective of deficits in frontotemporolimbic systems involved in social processing. As will be shown in the powerpoint he was at the 1st percentile on a prosody measure where he was unable to match emotion-laden speech inflections with the appropriate affective state. He could not understand the emotion of how someone was feeling based on the intonation of their voice. This is another indicator that things were not being normally processed in all aspects of social brain function, a common problem in individuals with schizophrenia. Some aspects of fontotemporlimbic dysfunction has been a finding in many studies on the neurobiology of schizophrenia.

Additionally, processing speed. If you look back at **Figure 1**, it shows reduced processing speed in comparison to all other index scores of intellectual functioning. He has some low academic fluency measures, also dependent on processing speed. Processing speed is dependent upon white matter integrity and as indicated in my June 21, 2022 report, there are MRI indicators of diminished white matter integrity in Mr. Bowers brain MRI as explained in the original report. As I have indicated at page 55 of the Lezak text, "white matter lesions are common features of many neurological and neuropsychiatric disorders, and are often associated with slowed processing speed and attentional impairments." I have prepared some additional slides showing the white matter hyperintensities, the corpus callosum and the cavum septum pellucidum.

Finally, I noted in my prior report that I reviewed the objective, quantitative analysis of the PET imaging performed by Dr. Newberg. I have been informed that the government may call Dr. Helen Mayberg to testify about the PET interpretation. I am also informed that Dr. Mayberg has previously testified in capital cases that the threshold significance for interpreting quantitative PET data should be set at 2 standard deviations below the mean. As her report reflects no such opinion being offered, let me simply state that in my opinion in a clinical and forensic setting this is not an accurate or adequate approach. While such a standard may be an *a priori* statistical set-point in a research study seeking a peer-reviewed publication, it is not how test information is used in the

clinic. When attempting to best understand clinical correlations and relationships, one examines trends, elevations and deviations that are not only beyond a 2 standard deviation statistical level, whether examining neuropsychological test data and/or neuroimaging. Many quantitative neuroimaging analysis methods set clinical indicators at ±1.5 – 1.65 standard deviations from the mean. In clinical neuropsychology, absolute, mandatory deviations from the expected mean are not how clinical data are analyzed and, in my opinion this also applies to how integrating quantitative neuroimaging with neuropsychological findings should be done

You have also informed me that during the testimony, Dr. Rogers expressed an opinion contrary to Dr. Nadkarni on the possible brain development significance of very high fever and hallucinations documented in Mr. Bowers medical records at the age of 5 and a half. I agree with Dr. Nadkarni's characterization of this illness as developmentally important and relevant to understanding later life functioning and symptoms. High fever can injure the brain, especially frontotemporolimbic circuitry.

You have asked me to comment on one large-scale normative database used in neuroimaging. About two decades ago, the National Institutes of Health here in the United States along with European research agencies have required that all kinds of test results, including neuropsychological and neuroimaging go into large databanks. The larger the sample sizes the better the normative data. In neuroimaging while the brain does change with age, after childhood and before the senescence years, annual brain changes are relatively slow. As I understand from the cross-examination of Dr. Solomon, there was some criticism by the government concerning Mr. Bowers' age and the UK Neuroimaging biobank and the comparisons that Dr. Solomon was making. Even though there may not be exact overlap in the use of biobank data and Mr. Bowers age, the age differences are minimal and surrounding confidence intervals justify the comparisons.

You have asked me to address discussion in the courtroom about the definition of epilepsy as stated in the Lezak et al. textbook, an issue discussed during the cross examination of Dr. Nadkarni. The suggestion was made that the text sets forth inconsistent definitions of epilepsy. As I will explain during my testimony, the text does not set forth inconsistent definitions of epilepsy.

As discussed in my 2022 report and shown in the powerpoint, I will emphasize how white matter integrity relates to brain neural networks, where understanding network neuroscience reflects one of the major advances in understanding neuropsychiatric disorders like schizophrenia (Bassett et al. Understanding the emergence of neuropsychiatric disorder with network neuroscience. Biological Psychiatry: Cognitive Neuroscience and Neuroimaging September 2018; 3:742–753 https://doi.org/10.1016/j.bpsc.2018.03.015

In the powerpoint I include references to the National Library of Medicine articles on the neurobiology and neuropathology of schizophrenia. The high frequency of these articles reflects the importance of these different domains of schizophrenia clinical research which includes memory, moto function, executive control and social brain along with processing speed impairments, which were all areas where Mr. Bower’s neuropsychological test results reflected impairments.

Sincerely,

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