

**Forensic Mental Health Association of California
March 25, 2011 – Seaside, California**

**Testimony Regarding Behavioral Genomics at Criminal Trials
William Bernet, M.D. (william.bernet@vanderbilt.edu)**

General Information Regarding Forensic Genotyping

Neuroscience and the Law

Testimony regarding behavioral genomics and brain imaging may be relevant for some legal issues. For example, the results of genotyping – of plaintiffs in personal injury cases, of defendants in criminal cases – may support the conclusions from traditional psychiatric and psychological evaluations. In criminal trials, a defense attorney might argue that a defendant did not choose to have a particular genetic make-up, which increased his risk for violent behavior, so that should be considered as mitigation in the sentencing phase of a trial. On the other hand, a prosecuting attorney might argue that a defendant is innately dangerous because of his genetic make-up, so that should be considered an aggravating factor when sentencing occurs.

Monoamine Oxidase A Gene

Monoamine oxidase A genotyping (for the *MAOA* gene) is based on the research of Avshalom Caspi and colleagues, “Role of Genotype in the Cycle of Violence in Maltreated Children” (*Science* 297:851, 2002). When there is a low activity of this gene, certain chemicals in the brain (serotonin, dopamine, and norepinephrine) are not properly metabolized. Caspi et al. found that when male subjects had a low activity of *MAOA* and also were maltreated as children, there was a much greater likelihood the person would manifest violent antisocial behavior in the future.

Serotonin Transporter Gene

Serotonin transporter genotyping (for the *SLC6A4* gene, also known as the SERT or 5-HTT gene) is based on the research of Avshalom Caspi and colleagues, “Influence of Life Stress on Depression: Moderation by a Polymorphism in the 5-HTT Gene” (*Science* 301:386-389, 2003). The “short allele” of the *SLC6A4* gene causes low activity of the transporter system, which means the serotonin system is not operating efficiently. It has been shown in research that individuals with the short allele are more susceptible to stress.

General Principles Regarding Forensic Genotyping

The following principles are important to keep in mind with regard to testimony regarding behavioral genomics:

- The genetic test all by itself usually means little or nothing regarding criminal responsibility. For example, the low activity allele of *MAOA* is significant only in the con-

text of a gene x environment interaction. That is, research indicates that individuals with the low activity form of *MAOA* who also were maltreated as children were more likely to manifest violent behavior as an adult.

- The genetic test is usually not meaningful all by itself, but it should be part of a comprehensive forensic evaluation. Typically, the evaluator should collect data and arrive at conclusions through psychiatric and psychological assessments. The genetic testing and the implications of gene x environment interactions may support the impressions that are based on traditional methods for mental health evaluations.
- In almost all cases, a person's genetic make-up does not force a person to behave in a particular way. Usually, there is no known direct causative link between a person's genes and his or her violent or antisocial behavior. The gene x environment interactions described in this document constitute risk factors, not a direct cause, for certain behaviors or emotional states.
- Most of the research regarding these two genes – the *MAOA* and the *SLC6A4* gene – has involved Caucasian subjects. There is limited research that indicates the gene x environment interactions described here apply to African Americans.

Very Short Bibliography

Bernet W., Vnencak-Jones C. L., Farahany N., Montgomery S. A. (2007). Bad Nature, Bad Nurture, and Testimony regarding *MAOA* and *SLC6A4* Genotyping at Murder Trials. *The Journal of Forensic Sciences* 52:1362-1371. (We believe this was the first peer-reviewed publication to describe the use of testimony regarding gene x environment interactions at criminal trials.)

Bernet, W., Alkhatib, A. (2009). Genomics, Behavior, and Testimony at Criminal Trials. In: *The Impact of Behavioral Sciences on Criminal Law*, edited by N. Farahany, pp. 291-315. New York: Oxford University Press. (This book chapter provides an overview of testimony regarding behavioral genomics in criminal trials.)

Farahany, N., ed. (2009). *The Impact of Behavioral Sciences on Criminal Law*. Oxford University Press. (This edited book has chapters that discuss the advantages and disadvantages of testimony regarding neuroscience, especially behavioral genomics.)

Rutter, M., Moffitt, T.E., Caspi, A. (2006). Gene-Environment Interplay and Psychopathology: Multiple Varieties But Real Effects. *Journal of Child Psychology and Psychiatry* 47(3/4):226-261. (This is an article by distinguished scientists who have nothing to do with the forensic use of their research, but they give a good summary of the underlying science.)