

## Policy Implications of Biosocial Criminology Toward a Renewed Commitment to Prevention Science

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It has become almost passé to state that there are substantial genetic inputs into human behavior. A recent landmark meta-analysis of the heritability of human traits based on 50 years of twin studies encompassing more than 17,000 traits, nearly 3,000 publications, and greater than 14 million twins indicates that approximately half (49%) of the variance is a result of heritability (Polderman et al., 2015). Greater attention to the links between biosocial science and prevention is important and much welcomed. Along with most criminologists, biosocial criminologists have largely neglected prevention science. Criminologists conduct few prevention trials for several reasons, one of which is a lack of funding and training necessary to carry out complex field-based designs. But perhaps another reason is that traditionally applied work has not been valued as much as theory building and testing. Ironically, however, applied experimental designs are some of the best methods from which to draw causal inferences about behavioral mechanisms.

Genetics is as much about the environment as it is about the genes. In theory, having a better idea of what environmental factors matter while genes are in the equation allows for better specification of risk via evidence-informed prevention. This is the promise of gene–environment interaction research that the Jamie Gajos, Abigail Fagan, and Kevin Beaver (2016: 683–701) article nicely articulates. Despite this promise, research on gene–environment interactions often comes up empty with regard to replicating findings, which represents a challenge to basing prevention programming on the environmental factor. Although I wholeheartedly support research on gene–environment interplay, my goal in this policy essay, is to draw attention to other avenues and issues surrounding the value and diversity of biosocial criminological findings for advancing prevention science. The avenues and issues highlighted here include temperament and its natural links to early prevention,

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nongenetic biosocial processes with direct prevention science implications such as nutrition and heavy metals (e.g., lead), political considerations, and future needs for criminology to move forward.

But, first, I would like to direct attention to the underlying policy assumption or proposition that I take with respect to biosocial research and intervention: *Most, if not all, prevention is essentially biosocial.* Why do I think this is the case? Simply because every preventive intervention I can think of, at some level, involves or is mediated by the brain and specifically by neural substrates that subserve key emotional and cognitive process resulting in decision making, judgment, activation and reaction, habituation, and inhibition or disinhibition. I realize this may come across as neurocentric, but it does not leave out in any way substantial input from the social or built environment.

### Temperament and Prevention

Temperament, the relatively stable and mostly innate tendency with which an individual experiences and regulates his or her response to a given environment is a construct that is identifiable early in the life course and thus possesses potentially enormous possibilities for crime prevention. In many respects, temperament is a quintessential biosocial construct. Temperament has good predictive validity. For example, observations of temperament at 3 years of age have been found to predict adult behavioral outcomes (Caspi, Moffitt, Newman, and Silva, 1996; Horner, Reynolds, Braxter, Krisci, and Tarter, 2015).

The study of temperament has deep scholarly roots with such notable ancient thinkers as Hippocrates (460–377 B.C.E.) who put forth distinct temperaments such as melancholic (moody or anxious), sanguine (cheerful and good natured), choleric (angry and irritable), and phlegmatic (slow to arouse). Much of the contemporary study of temperament has stemmed from the work of Thomas and Chess (Chess and Thomas, 1999; Thomas and Chess, 1977, 1984). During the 1950s and 1960s, Thomas and Chess executed the New York Longitudinal Study that examined infants over many years. Their view was that temperament was largely innate but highly interactive with the environment. Based on numerous years of study, Thomas and Chess developed a typology of three relatively distinct temperament patterns in children composed of *easy children*, who were well regulated and had positive emotionality; *difficult children*, who were most likely to challenge their caregivers and later engage in various conduct problems; and the more cautious and inhibited *slow-to-warm children*.

Although there are many aspects to temperament, two interrelated constructs stand out as possessing omnibus power for behavioral problems and crime across the life course: effortful control and negative emotionality. Effortful control is the capacity to focus attention; regulate one's conduct via executive functions; and the capacity to suppress deleterious or unneeded thoughts, emotions, or actions. Negative emotionality is the tendency to experience others and situations in a generally negative way, leading to frustration, anger, irritability, fear, and a slow recovery from these negative emotions (Rothbart, 2007).

DeLisi and Vaughn (2014), in their temperament-based theory of antisocial behavior and criminal justice involvement, have argued that variation in effortful control and negative emotionality not only generates behavioral problems across the life course but also explains the lack of success that some persons have when interacting in the criminal justice system (e.g., disputes with practitioners, other inmates, sentence completion, and recidivism). Temperament-based prevention science is nicely situated among biological liability, contextual factors, and distal criminal justice system involvement. It offers promise for redirecting potential criminal careers. Prevention proceeds then from the assumption that higher levels of self-regulation and positive emotionality can be protective. Because difficult temperaments manifest early on in the life course and are likely most malleable for deflecting an antisocial trajectory, evidence-informed preventive interventions that teach self-regulation skills (e.g., delaying gratification) and properly handling negative emotions, especially anger and hostility, can be brought to bear. Linking prevention to an etiology model is important because knowledge gained about these causal processes can aid in the specificity and efficiency of preventive interventions and in turn be used to inform etiologic research on causes in a virtual feedback loop.

One key question for prevention is whether effortful control can be increased and negative emotionality decreased. A meta-analysis conducted by Candelaria and Fedewa (2012) found that interventions targeting anger and self-control are malleable with an effect size of 0.27 favoring the intervention. Most of the skills training involved are relatively low cost to implement, and even if achieving a small effect size, if scalable to the wider population, the effect becomes large. It remains to be seen whether early prevention programs may positively affect children evincing serious temperamental problems such as the combination of low effortful and high negative emotionality. Based on differential susceptibility theory, a unique study tested whether infant negativity moderates the relationship between a soothe-sleep intervention on parenting competence and self-regulation. Results at 1 year found mothers of infants displaying negative emotions to have greater parenting satisfaction from the intervention (Anzman-Frasca, Stifter, Paul, and Birch, 2013). Also, the soothe-sleep intervention had a main effect on improving self-regulation. Although the neuropsychological deficits that many children with difficult temperaments possess may be difficult to moderate, studies such as these have suggested that gains can be made. It is also important to assess these temperament constructs over time within the context of current prevention and intervention efforts (e.g., Big Brothers Big Sisters of America, Multisystemic Therapy, Multidimensional Treatment Foster Care, The Incredible Years, and others) that have achieved a degree of credibility as effective. One program that is directly tied to temperament is Promoting Alternative Thinking Strategies (PATHS), a school-based intervention designed to promote emotional competence and regulation of emotions. However, the downward extension of PATHS-like strategies to preschool children has not been meaningfully tested. In addition to continued experimental tests in toddlers

and children, future temperament-based prevention research needs to examine the effects of pre-, peri-, and postnatal interventions on temperament dimensions. Not only would this be more cost effective (especially if added to ongoing studies), but it also would aid in understanding what active ingredients of prevention “get under the skin” and achieve positive benefits. For criminologists and other behavioral scientists, this means an increase in not only the use of experimental designs and longer term follow-ups but also working with researchers in health science fields such as nursing, pediatrics, and epidemiology. As opposed to universal prevention that attempts to reach all children, temperament-based prevention is of the selective or indicated prevention programming type, which focuses on reaching infants and children either who are likely at elevated risk or who evidence early symptoms.

### **Nutrition and Toxic Lead Removal as Biosocial Preventive Agents**

As shown by the temperament construct, the biometrics of crime and prevention science is more than genetics and includes many topics. Here I highlight two, nutrition and toxic lead removal, which have direct implications for prevention science and broad policy support. Nutrition and related topics such as food insecurity have an important and diffuse impact on early development. In fact, proper nutrition is basic to survival. Malnutrition at age 3 has been found to predict behavior problems as far as age 17 (Liu, Raine, Venables, and Mednick, 2004). Macronutrients, such as protein, fats, and carbohydrates, are necessary for just about every physiological process including the developing central nervous system. One type of fat that may be particularly important for behavioral problems is essential fatty acids or Omega III fatty acids. Omega III fatty acids, composed of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are mostly derived from fish or are commonly referred to as “fish oil.” Fish oil is critical to early brain development in that it aids in healthy neuronal growth and communication resulting in improved cognitive function (Igarashi, Santos, and Cohen-Cory, 2015). In a double-blind randomized controlled trial (RCT) assessing the effect of EPA and DHA among young adult prisoners, there were fewer offenses committed by the treated group relative to placebo (Gesch, 2002).

Although there have been numerous RCTs conducted testing the effects of fish oil on behavior, nutrients often work in concert with one another. Other nutrients, such as amino acids, some of which that have inhibitory effects on neurotransmission, could be useful as natural calming agents alongside B-complex vitamins (e.g., thiamin [B1], riboflavin [B2], and niacinamide [B3]) and the mineral magnesium. Inhibitory neurotransmitters are vital to behavior, emotions, and pain. Inhibitory amino acids include tryptophan, taurine, GABA, and glycine. Some of the major symptoms of neurotransmitter deficiencies are ADD, ADHD, brain fog, mood swings, increased stress, anxiety, depression, insomnia, irritability, and aggression (Pellman, Solomon, and Barnard, 2011). Magnesium plays an integral role in biochemical reactions throughout the human body. Long ago, Wacker and Parisi (1968)

found that magnesium deficiency can cause a variety of behavioral disturbances that are reversible with repletion. As opposed to nutrients that are vital, lead, a toxic heavy metal, is well known to impair brain function. Blood lead levels are associated with increased impulsivity and conduct problems in children (Marcus, Fulton, and Clarke, 2010). Several studies have found links between lead exposure and crime (Wright et al., 2008). Lead toxicity (there are no “safe” blood lead levels) can be prevented by removing lead from household products, mainly paint, and from home interiors in older homes. Lead can also be removed from the body through a process known as chelation, which is accomplished usually by taking an oral pharmacologic such as 2,3 dimercaptosuccinic acid (DMSA; Lowry, 2012). More severe cases require intravenous drips of edetate calcium disodium (CaNa<sub>2</sub> EDTA; Lowry, 2012).

### **Other Considerations**

There are several strategic considerations involving political feasibility and future needs of the field. I would argue that criminologists and other social scientists should embrace biosocial research approaches because the logical extension is an emphasis on early prevention, specifically, pre-, peri-, and postnatal and early childhood environments. In theory, early prevention is cost effective and should appeal to conservatives and liberals alike. For example, the Maternal, Infant, and Early Childhood Home Visiting Program (MIECHV), which provides evidence-based coaching and supportive services to parents and their young children at elevated risk has bipartisan support. Monetization studies have indicated that prevention provides substantial economic benefits with respect to high-risk individuals (Cohen, 1998; Wickramasekera, Wright, Elsey, Murray, and Tubeuf, 2015).

There are many future needs so criminology does not get left behind. Prevention research is often team-based, and criminologists will need to be a part of transdisciplinary team science. All that is really required is being willing to work with others who may not have had the same disciplinary training and who may have a different perspective. Although at times this can lead to miscommunication, it also offers the advantage of being able to learn new information, theories, and methodologies. To some, this can be daunting as there is a certain degree of disciplinary insularity that is comforting, and traditionally, there has been considerable discomfort incorporating knowledge from the natural sciences or biomedical sciences into the social sciences. It might be encouraging to know that most behavioral scientists that self-identify as biosocial criminologists have had little formal training in biology and related fields. After all, isn't one of the major skills imparted by having a Ph.D. the ability to learn and master new material? Predoctoral and postdoctoral training and exposure to topics such as translational science, implementation science, intervention research, and National Institute of Health (NIH) funding mechanisms would be especially advantageous. Additional areas worth exploring are employment of Bayesian statistical

simulations and newer research designs using increasingly popular Mendelian randomization (Smith and Ebrahim, 2003).

Additional ethical issues are raised by biosocial prevention research. These include potential ethical issues such as those related to participant recruitment, disclosure of information to study participants (especially in studies involving pregnant mothers, infants, and toddlers and their guardians), and storage of bio-specimens and their disposal (Fisher and Harrington, 2013). These ethical issues are difficult enough when dealing with common medical problems, but biological-based susceptibility to behavioral risk heightens the need to mitigate stigma and other potential harms.

In conclusion, while biosocial criminology marches forward, a stronger relationship with prevention science and evidence-based criminal justice is needed. As the term “evidence-based practice” has become more and more entrenched in criminological and criminal justice circles, it is important to remember that for a biosocially informed prevention science that evidence-based practice is *not* just to do what the empirical evidence suggests. Rather, research evidence is mated with stakeholder wishes and practitioner experiences to form a three-legged, evidence-based policies and practices strategy. One of the major attributes of biosocial research is that it can spur forward a renewed commitment to prevention science in criminology, which in turn can have important implications for public policy.

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