

On the compatibility of control theory to biosocial criminology

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Biosocial Criminology

- Biosocial criminology has signaled a paradigm shift in criminology that utilizes data and methods from the biological sciences, medical sciences, and neuroscience to study and understand antisocial behavior across the life course.
- The paradigm has shown how nature *and* nurture interact to produce behavior rather than viewing nature *or* nurture as adversaries or foils.

Genetics Jargon

- Mendelian
Single gene causes disorder
- Pleiotropic
Single gene affects multiple endophenotypes or phenotypes
- Oligogenic or epistatic
Gene x gene interaction
- Polygenic
Multiple genes affect single phenotype
- Polymorphisms
Genes having multiple variants or forms
- Gene x environment correlations (rGEs)
Passive, evocative, active

Current Focus

- Here, the compatibility of control theory to biosocial criminology is examined in four ways:
- 1) Self-control has been shown to be moderately to strongly heritable with most of the remaining variance attributable to nonshared environmental factors, not shared environmental factors (e.g., parental socialization) as theorized.
- 2) Self-control is a downstream outcome of many likely candidate genes in the dopaminergic and serotonergic neurotransmitter systems.

Current Focus Continued

- 3) Self-control can be understood as a neurological disorder.
- 4) The formation and maintenance of social bonds are consistent with gene-environment correlations (rGEs) especially active and evocative (rGEs) types.

I. Heritability (h^2) of Self-Control

- Based on twin data from the Add Health, Beaver, Wright, DeLisi, and Vaughn (2008) reported that between 52% and 64% of variance in self-control was heritable. At wave 1, h^2 approached 80% and was about 50% at wave 4.
- 82% of the stability of self-control over time was attributable to genetic factors.
- Covariation between low self-control and crime is due almost entirely to genetic factors (Boisvert, Wright, Knopik, & Vaske, 2012).
- Barnes and Boutwell (2012) found that genetic factors accounted for 97% of the stability in offending behavior over a 13-year span from adolescence to adulthood.
- Drawing on data from the Fragile Families and Child Wellbeing Study, Boutwell and Beaver (2010) conducted a propensity score matching design to examine the effects of broken homes/parenting on self-control and found none of the six measures of being reared in a broken home were associated with self-control.

Heritability Continued

- Reduced amplitude of the P300 brain potential response is a neurophysiological indicator of liability for externalizing behaviors.
- P300 response is a positive brainwave deflection that occurs in response to infrequent stimuli within a sequence that reflects coordinated neurological activity in multiple regions.
- Yancey et al. (2013) analyzed data from University of Minnesota Twin Registry and found that 85% of covariance between disinhibition-externalizing behaviors, 77% of covariance between disinhibition-P300, and 100% of covariance between externalizing behaviors-P300 was attributable to genetic influences.

II. Candidate Genes for Self-Control

- The 7-repeat allele of the dopamine receptor D4 gene (DRD4) has significant pleiotropic effects on multiple constructs relating to self-control. A variable number tandem repeat (VNTR) located in the third exon of the gene codes for the receptor protein. The 7-repeat allele exhibits decreased signal efficiency for neural circuits that are associated with effortful control (Smith et al., 2012).
- Sheese, Rothbart, Voelker, and Posner (2012) reported an interaction between the DRD4 7-repeat allele and parenting quality in the prediction of effortful control among a sample of children ages 3 to 4 years.
- Smith et al. (2012) found DRD4 7-repeat allele interacted with negative parenting in the prediction of effortful control among children age 3 years.
- There is also evidence that the DRD4 exon III polymorphism is associated with behavioral examples of low self-control, such as binge drinking (Vaughn, Beaver, DeLisi, Howard, & Perron, 2009).

Genetic Findings

- Watts and McNulty (2016) found that plasticity alleles of MAOA and DAT1 interacted with negative parenting and were associated with both lower self-control and higher criminal offending.
- Catechol-O-methyltransferase (COMT) is an enzyme that metabolizes dopamine and norepinephrine in the frontal areas of the brain and is implicated in the modulation of aggressive impulses.
- Polymorphisms in the COMT gene have been linked to disorders of self-regulation/control, including ADHD. Geneticists recently linked the rs6269 SNP with childhood-onset aggressive behavior and provided suggestive evidence that rs6269 and rs4818 SNPs were associated with callous and unemotional traits among children who scored at or exceeding the 90th percentile on a parent-report of aggression (Hirata, Zai, Nowrouzi, Beitchman, & Kennedy, 2013).

Serotonin Transporter Gene

- Kochanska et al. (2009) examined the polymorphism in the serotonin transporter gene (5HTTLPR) and its interaction with maternal attachment at age 15 months on self-regulation among children at 25, 38, and 52 months.
- Among children at genetic risk, which is the short ss/sl allele of 5HTTLPR who were insecurely attached had poor regulatory capacities.
- Children at genetic risk but secure attachment had normal self-regulatory capacity.

III. Self-Control as Neurological Disorder

- Cummings and Miller (2007, p. 15):
- The orbitofrontal cortex, particularly the right-hemispheric orbitofrontal regions, mediates the rules of social convention. Patients with orbitofrontal lesions are socially disabled, manifesting interpersonal disinhibition, poor social judgment, impulsive decision making, lack of consideration for the impact of their behavior, absence of an appreciation for the effect of their behavior or comments on others, and lack of empathy for others.”
- Very similar to depiction of low self-control in Gottfredson and Hirschi (1990).
- ADHD Subtypes are also analogous to self-control.

Neural Substrates in Action

- Buckholtz and Meyer-Lindenberg (2008) developed an explanatory model for how MAOA alters the neurogenetic architecture of aggression.
- MAOA in particular alters serotonin and norepinephrine levels during development of the corticolimbic circuit which results in impairments in social decision-making and affect regulation. This compromises the ability to interpret ambiguous social interactions and perceptions of potential threat.
- This explanatory model squares with links of MAOA to impulsive, reactive aggression (e.g., the warrior gene).

Phineas Gage

- September 13, 1848, Phineas Gage was injured in a railroad accident where a tamping iron blasted through his face, skull, and brain and exited his head.
- The accident caused a personality transformation of Gage from a responsible, intelligent, prudent, and socially well-adjusted person to an irreverent, capricious, bellicose, irresponsible person whose life devolved into that of a drifter.
- Gage had been transformed from a man of self-control to a man of low self-control.

Gage Continued

- In 1994, Hanna Damasio and her colleagues resurrected the case and examined Gage's skull with modern neuroimaging techniques to ascertain the brain areas which affected Gage's decision making and emotional processing.
- They determined the affected areas were the anterior half of the orbital frontal cortex, the polar and anterior mesial frontal cortices, and the anterior-most sector of the anterior cingulate gyrus in the left hemisphere. In the right hemisphere, Gage's lesion included the anterior and mesial orbital region, the mesial and polar frontal cortices, and the anterior segment of the anterior cingulate gyrus. Overall, frontal lobe white matter damage was more extensive in the left hemisphere than in the right.
- Gage's injuries were consistent with persons with similar injuries who evince impairments in rational decision making, emotional processing, or simply, self-control.

IV. Social Bonds and Biosocial Interplay

- Attachment, commitment, involvement, and belief are more likely to be achieved by those with high self-control versus low self-control.
- Persons with high self-control elicit opportunities for social bonds that is consistent with evocative gene-environment correlations.
- Oxytocin (and vasopressin) has been shown to be associated with affiliation and sociality.
- Polymorphisms in oxytocin receptor gene (OXTR) have been linked to parenting, empathy, using social relationships to manage stress, autism, depression, and schizophrenia.

Conscientiousness

- *Competence* refers to the sense that one is capable, sensible, prudent, and effective. High scorers are characterized by an internal locus of control and feel prepared to deal with the challenges of life. Low scorers are characterized as inept and unprepared.
- *Order* refers to the sense of order than an individual imposes on their life. High scorers are neat, tidy, and organized and low scorers are disorganized and unmethodical.
- *Dutifulness* relates to the degree with which one is governed by their conscience. High scorers are highly ethical and morally scrupulous. Low scorers are more causal, unreliable, and undependable.

Conscientiousness Continued

- *Achievement striving* relates to the aspirations and work ethic that an individual displays. High scorers are diligent, purposeful, and have a sense of direction whereas low scorers are not driven to succeed and are lackadaisical.
- *Self-discipline* is the ability to execute tasks to completion despite barriers and distractions. High scorers are self-motivated and driven to accomplishment whereas low scorers are easily discouraged and quit easily.
- *Deliberation* is the tendency to think carefully before acting. Whereas high scorers are cautious, deliberate, and contemplative, low scorers are hasty and spontaneous.

Social Bonds

- Attachment, commitment, involvement, and belief are more likely outcomes for those whose personality features (e.g., Conscientiousness) are compatible with such responsibilities.
- This “niche picking” is consistent with active gene-environment correlations where individuals seek out environments that suit their genetically-mediated traits.
- h^2 of Conscientiousness is $\sim .40-.50$.
- Most of the covariance between conscientiousness, intelligence, and academic achievement is genetic (Luciano et al., 2006).

Conclusion

- DeLisi, 2014, pp. 180-181, “In the end, the brain-basis of low self-control is mostly good news. Despite occasional forgetfulness, despite occasional lapses in judgment, despite sometimes failing to pay attention, and despite a lack of perseverance in exercise programs and diets, most people function and function well in society despite what nature provided in the area of self-control.
- For a smaller proportion of fortunate souls whose self-regulation is so extraordinary that they are almost machine-like, life is characterized by multiple, overlapping positive outcomes.
- And for another small proportion of the self-control distribution, the opposite is true. Life is a series of bad decisions, wrong choices, and accidents just waiting to happen. They too have nature to thank.

Conclusion

- Control theories can serve as a guide to provide a theoretical framework for biosocial criminological research and biosocial criminological research can locate control theory in contemporary research agendas.
- Indeed, self-control theory has been the most-studied theory among biosocial criminologists precisely because its theoretical constructs are so closely allied with research in behavior genetics, molecular genetics, psychiatry, and neuroscience.

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