

The Origin of White Collar Criminality? – Exploring a Gene x Environment Interaction Hypothesis

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Abstract: The aim for this article is the elementary question: why does white collar criminals become white collar criminals? The answer is a hypothetical syllogistic constructed hypothesis for further empirical exploration in the agenda. The hypothesis takes its point of departure in biosocial criminology, especially the gene-environment interplay, focused on white collar criminality. The hypothesis proposes a link between criminal attitudes and criminal behavior based on how biological (e.g. intergenerational heredity, MAO-A), neurological (e.g. executive functioning, cortical thickness) and social-psychological/sociological factors (e.g. peer-group, rationalizations, social stress, loss of class status) correlates to each other as a system of mechanisms.

Keywords: White collar crime, biosocial criminology, mechanisms, formal logic.

Human behavior is mediated by a set of biological factors (basically genetics) and a set of environmental factors (basically social relations). On an aggregated scale the two sets explains around 50 per cent each of criminal behavior (Tuvblad, 2014). These two sets are integrated into a complex set of interactions in the central nervous system (brain), the peripheral nervous system (control of movements and autonomic internal functions), and the endocrine system (organs responsible for hormone secretion). These complex set of interactions has continuously over the past decades been acknowledged among criminologists as a point of departure to understand the nature of crime. A topic which concern especially the explanation of interpersonal variation of criminal behavior in a random population (Rebellion, Barnes & Agnew, 2014).

In this article I follow up a track which I already have outlined (Alalehto, 2015), mainly focused on psychopathic and sociopathic white collar criminals. In this article I focus more on the average white collar criminal, known as crises responders (Piquero & Weisburd, 2009; Morris & Sayed, 2013), or low-rate or medium-rate white collar criminals (Soothill, Humphreys, & Francis, 2012) or conformists, pragmatists and partly intolerants (Alalehto & Larsson, 2015) involving approximately 60 to 80 per cent of the white collar criminal population. The purpose is to give a theoretical explanation of why white collar criminals become white collar criminals? The answer will be given in a main hypothesis directed to be testable for empirical research.

What is the origin of the white collar criminal? A standard explanation among sociologist, given already by Edwin Sutherland (1940) is the position of power. Even among biosocial inspired criminologist this is a given structure of explanation. For example, Wiebe (2012), points out a classic Machiavellian thesis in his competitive advantage model: if you are powerful enough then you can get away with anything. It's based on the assumption that a certain kind of sociopath (or even psychopath) will have high egocentric self-control and feel little empathy, guilt, and remorse to others. He may rationalize his criminality to himself and to others by neutralization techniques and account-giving. Wiebe does not give any further explanation what the mechanism behind this process are, more than it is "...individuals in possession of inadequately checked power." (Wiebe, 2012: 355).

The etiology behind Wiebe's description of the white collar criminal are more clarified through Cohen & Machalek (1988:471) concept resource holding potential. Resource holding potential refers to the organism's chances of producing offspring which survive to reproductive age, by the exercise of power as a potential resource. An exercise that is more precisely described through Charles Tittles (1995, 2004) concept imbalanced control ratio: If the offender experiences an imbalance between his ability to control the environment (control surplus) relative to the amount he feels controlled, he will have an imbalanced control ratio of 2:0 and is predicted to commit crime. The imbalance is explained to reduce the amount of humiliation that the offender feels through being controlled, which at the same time serve as a legitimate reason to get autonomy as a resourceful individual. This mechanism of 'way of thinking' is common among criminals and especially among white collar criminals

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known as entitlement (the offender stands above the law, demanding special treatment accompanied by misidentification of what he wants) and power orientation (control over interpersonal relations to put others down and feeling better for himself) (Walters, 2014; Shover, Hochstetler, & Alalehto, 2012; Goossen, Sevä, & Larsson, 2016).

As the reader can see, the explanation of the white collar criminal's motivation is power oriented. A power orientation based on the traits of egocentrism, superiority and non-empathy identified as the common traits for the criminal elite in the society. This explanative view has influenced the agenda of white collar crime research from the beginning of the 20th century to nowadays (see BONGER, 1969; Braithwaite, 1985; Coleman, 1998; Ross, 1973; Sutherland, 1985). But as empirical investigations show, the image of the common white collar criminal is less dramatic and more everyday like than what the predecessors in the agenda suspected. White collar crime is mainly committed by middle class and self-employed than the society's elite (Alalehto & Larsson, 2008; Lewis, 2002; Soothill, Humphreys, & Francis, 2012; Weisburd, 1991; Wheeler, Weisburd, Waring, & Bode, 1988).

The common white collar criminal is not just different toward the elite; they are also different toward the common street criminals socio-demography. That is, they are married, well-educated with a high income, regular employed, homeowners and possessing relatively good assets regardless of time-era and context (Alalehto & Larsson, 2008, 2012; Benson & Simpson, 2009; Weisburd *et al.*, 2001; Weisburd, 1991; Wheeler, Weisburd, Waring, & Bode, 1988). And they show a higher intelligence than street criminals comparable with the general population (Raine *et al.*, 2012). But as a social category they differentiate from the general population and street criminals in two directions. First, the common white collar criminals personality traits are relatively homogenously distributed to be extroverted, hedonistic, neurotic, non-agreeable and Machiavellian egocentric (Alalehto, 2003; Blickle, Schlegel, Fassbender, & Klein, 2006; Feeley, 2006; Listwan, Piquero, & Van Voorhis, 2010). Whereof some of this traits (hedonistic, non-agreeable and Machiavellian egocentric) are to some degree linked, but not fully confirmed, to basic human values as 'power', 'achievements' and 'hedonism' (Goossen *et al.*, 2016). Secondly, and more important, the peak age is 41-42 year with no particular criminal history (Alalehto & Larsson, 2008; Benson, 2002; Busmann & Werle, 2006; Gottschalk, 2013; K. Holtfreter, Van

Slyke, & Blomberg, 2005; Kardell & Bergqvist, 2009; Kerley & Copes, 2004; Onna, Geest, Huisman, & Denkers, 2014; Poortinga, Lemmen, & Jibson, 2006; Soothill, Humphreys, & Francis, 2012; Weisburd, 1991; Weisburd *et al.*, 2001). Compared to the mean age of street criminals 15-19 year (Farrington, 2003) the common white collar criminal is thus an anomaly in criminology, which in general perform as a late bloomer. How come?

As an active researcher of white collar crime for more than 20 years, I believe that the explanative focus of power orientation is just a proxy for something more immanent laying behind the motivation for white collar criminals. Especially the distribution of personality traits and the exceptional mean age with no particular criminal history is very hard to explain by an approach of power orientation based mainly on environmental factors. I don't think this is a productive way to find out the answer to why this particular social category makes white collar crime. Instead I suggest from the approach of biosocial criminology that the main hypothesis is the interaction behind biological and environmental factors.

The Gene-Environment Association

I propose that white collar criminal's personality traits and the late mean age indicate roughly an explanative structure which has its point of departure in behavioral genetics or more specifically gene-environment correlation (rGE). That is, when the individual has inherited its genotype from the parents and the environmental traits given by the parents characteristics in childhood affects his temperamental behavior (the passive rGE); the second correlation, which applies throughout the lifespan, occur when the individuals behavior (e.g. negative emotions as a product of his heredity and environment) evokes correlative reactions from others (the evocative rGE) and the third correlation, during the adulthood occur when the individual select, because of his heritable propensity, a specific environment to expos his traits (active rGE) (DiLalla & Bersted, 2014).

This gene-environment correlation gives us an explanative clue to what is happening when unique individuals confronts with specific environmental conditions. This is a field known as the gene-environment interaction (g x e) were for example an evocative individual shows up an aggressive behavior in an environment of chaos and over-stimulation but not in a calm and non-threatening environment (DiLalla & Bersted, 2014). Because of this evocative genotype the

individual has a biological risk factor combined with a threatening environment to increase involvement into criminality (Mealey, 1995; Tuvblad, 2014). This is more currently understood as differential susceptibility. That is, when the individual has a certain kind of allele¹ which develop to a higher risk for criminal behavior in a negative environment, or develop to a 'positive' or reinforcement allele in a positive environmental milieu. Thereof differential susceptibility (DiLalla & Bersted, 2014).

Recently research in molecular genetics show then that there is a genetic variety of risk alleles among the population (Beaver & Connolly, 2013; Simons & Lei, 2013). There is a continuum of individuals who hold an amount of risk alleles to individuals who shows none or just a few risk alleles, where the majority of the population harbor a normal distribution of risk alleles. The issue of risk alleles has a specific significance toward criminality if the risk alleles is concentrated to the following genes correlated to antisocial behavior: MAO-A, DRD2, DRD4, COMT, DAT1 (genes connected to the neurotransmitter Dopamine which stimulate reward and sensations seeking); 5-HTT, 5HTTLPR (genes connected to punishment and dissatisfying, low impulsivity and aggression) and GABA (GABRA2, GABRG1, genes impacting the general condition of disinhibition and excitability in the brain) (Beaver & Connolly, 2013; DiLalla & Bersted, 2014). In terms of differential susceptibility, the specific individual who holds an amount of risk alleles shows a variation in behavior depending on what kind of good or bad environment condition the specific individual is exposed of. If the individual is exposed of good environment condition (e.g. loving and caring parenting, caring siblings, disposal and encouraging friendship, etc) it responds positive by not triggering the risk alleles (which is then reversed to positive) so the individual responds with conformity (Simons & Kit Lei, 2013).

What we can suspect is that the variation in environmental conditions who potentially triggers/none triggers the risk alleles, can be the etiological structure behind why specifically white collar criminals perform as late bloomers with no particular criminal history. The suggestion is that late bloomers in general is confronted by bad environmental conditions at their

middle age trigger a latent risk alleles for example loss of supportive family bonds, failed marital relationship, fired from a job and subsequent unemployment, etc (Krohn, Gibson, & Thornberry, 2013). A latent risk allele which up to this point in the individual's life-course has a function as a reinforcement allele, according to the hypothesis of different susceptibility. We do know that there are some specific bad environmental conditions which correlate with white collar criminality on the individual level. Those are a higher divorce rate than among street criminals and the general population (Alalehto & Larsson, 2008; Klenowski, Copes, & Mullins, 2010; Walters & Geyer, 2004; Weisburd, 1991), especially among female white collar offenders (Daly, 1989; Haantz, 2002; Shechory, Perry, & Addad, 2011; Zukowski, 2015). And suffering from at least one emotional, marital, or substance abuse problem over the course of their lives (Weisburd, 1991; Soothill *et al.*, 2012; Zukowski, 2015). Where around 7% of low-frequency offenders have problems with drug abuse and around 5% have alcohol abuse problems (Onna *et al.*, 2014; Weisburd m.fl., 2001), which is a higher rate of substance abuse than the general population (Poortinga m.fl., 2006). A connection that is associated to a short allele of 5-HTTLPR (Kretchmer, Dijkstra & Veenstra, 2014).

From the perspective of molecular genetics we know, so far, from just one study by Beaver & Holtfreter (2009) of white collar criminals², that the MAO-A³ has in itself a significant negative association to fraud. But if the individual has a criminal father (passive rGE) there is a significant positive association to fraud. In addition, if this individual also has a high-functioning MAO-A (3.5, 4 and 5-paired allele⁴) the regression odds increase significantly for crime. By a split-sample model, Beaver & Holtfreter (2009) apply a high- and low-delinquent peer sample. The results show that none of the covariates (race, age, family situation, or parents' experience of crime) were statistically associated to the potential for someone to commit fraud for the low-delinquent peer sample, and that MAO-A had a negative significant association to fraud even for the high-delinquent peer sample. However,

²Their database contends only relatively young white collar criminals of low complexity scale (misappropriation, credit card or check fraud, etc.) without any offenders of high-profile status.

³That is, monoamine oxidase A, which regulate the neurotransmitters of serotonin, dopamine and norepinephrine which have been found to be linked to delinquency and criminal behavior.

⁴See Beaver *et al.*, (2013) which is an opposite result compared to violent offenders, see Caspi *et al.*, (2002) who shows that individuals with low-functioning MAO-A (2 or 3-paired alleles) have an increased odds ratio for violence.

¹Every gene consists of specific set of allele constituted by RNA and proteins which in its whole constitute the individual and gives the unique properties of the individual.

involvement in high-delinquent peer sample (active rGE) with a high-functioning MAO-A show a significant risk for fraud which means that an individual with high-functioning MAO-A conditioned by high-delinquent peers becomes a fraudster.

A related study to Beaver & Holtfreter is the behavioral genetic study conducted by Kendler *et al.* (2015) of same-sex versus opposite-sex pairs of monozygotic (MZ) and dizygotic (DZ) twins concerning violent, white collar and property criminal behavior. Kendler and his team investigated the distribution between heredity and environment between the three subtypes of criminal behavior. The twin pairs who was registered as white collar criminals⁵ showed a total heritability of 53.7% (highest of the three criminal subtypes); 17% in shared environment (lowest among the three subtypes) and 29.3% in non-shared environment⁶. They did not specify any specific gene or gene x gene correlation to the rather high level of heritability for the white collar criminals. But they specified that one-third of the genetic influence was unique for the white collar criminals, and only one-fifth of the shared environment was unique for the white collar criminals. And they also concluded that the inter-correlation in and between the twin pairs were consistently higher for MZ twins than DZ twins, which means that the heritability factor was higher for MZ twins.

This is certainly a good starting point to understand the mechanism behind white collar crime.

But it is still too shorthanded. We do know that genes respond to the impact of environmental information, and it those so by the information processing by the brain. Where the brain is just a central nervous system constructed by billions of neurons, specified in regions of neurological structures and functions. This is a simple fact that has been investigated by just one study, to my knowledge, of how a group of white collar criminals information processing work compared to a control group of street criminals (Raine *et al.*, 2012). Raine and his team found that white collar criminals⁷ showed a significant

higher executive functioning (concentration, planning, organization, cognitive flexibility, memory and inhibit impulsivity) than the control group. Further, the white collar criminals showed also significant high scores on electrodermal arousal at rest (ongoing cognitive processing and sustained attention) than the control group.

White collar criminals showed, additionally, increased cortical thickness in several regions of the brain, with no tendency to reduced thickness. That is, increased activation of the ventromedial prefrontal cortex (good decision-making, sensitivity to the future and consequences of one's action) especially associated to abstract rewards as money (Raine *et al.*, 2012), and proved to be implicated in antisocial behavior among adults (Portnoy *et al.*, 2013). Cortical thickness is contrasted to cortical thinning which is correlated to frontal abnormalities (right middle frontal, right orbitofrontal and posterior cingulate cortex) at psychopathic adults (Yang, 2014). Further, white collar criminals have an increased activation of the temporal-parietal junction (social cognition, processing social information, perspective-taking, theory-of-mind and directing attention to external events of interest), which is connected to supramarginal gyrus and amygdala giving in sum an increased attentional processing to external stimuli. Which means they show higher scores on thoughts and actions to generated goals, to changes in task demands, to inhibit a dominant response for example others pain, and to resolve conflictual reasoning (Raine *et al.*, 2012).

Beaver and Holtfreter (2009) suggest as a hypothetical explanation of fraudulent behavior that fraud demands more investments in time and planning in contrast to other antisocial behaviors, which are more impulsive and relatively unplanned. The high-MAOA activity allele among white collar criminals provide the neural hardware of planning, coordinating and executing criminal enterprise. This is a hypothesis which certainly meets up the results from Raine *et al.* (2012). The executive functions of planning, concentration, coordinating, etc in ventromedial prefrontal cortex and temporal-parietal junctions connected to supramarginal gyrus and amygdala gives us a clue where to find the kind of genes located in the brain as working mechanism of the information processing behind white collar criminality.

But as Beaver & Holtfreter already points out indirectly. Singular genes in itself or gene x gene correlation is not enough to give a full scale explanation

⁵Contending mostly fraudsters of low complexity scale type (fraud, forgery and dishonesty) but also one more high profile crime type (embezzlement).

⁶That is, shared environment between the siblings/twins concern common experiences, and non-shared environment between the siblings/twins concern different parent caring, raising strategies, peer-group experiences, sex differences, etc.

⁷Most of the white collar criminals had a mixed history of street and white collar crime. Everybody had done a white collar criminality of low complexity scale (used computers illegally, used a stolen check or credit card, etc), with no high profile status.

of white collar criminality. There is an ongoing gene x environment interaction. Environmental factors as association to delinquent peer-group and intergenerational similarities are two strong candidates for the interaction to gene-type. Obviously an individual's choice of association to a delinquent peer-group indicate an active rGE and the influence of intergenerational similarity indicate a passive rGE also confirmed by Kendler et al. (2015) were the offspring is to a greater extent predicted to develop white collar criminality in intact families (raised by biological parents) if the parent has done a white collar crime in comparison if the parent has done a violent or a property crime. This prediction does not concern for families were the offspring has not-lived-with one or both of the biological parents or lived with stepparents.

As an interaction, there is no causality behind this process of gene-environment, it's more of a circuit. The gene factor is relatively constant over time, if we overlook epigenetic arguments, while environmental factors are more variable. In accordance with the thesis of differential susceptibility an allele can develop to be a risk allele if the environmental conditions are unhealthy, but the same allele can also develop to be a protective allele if the environmental factors are healthy. So the environment impacts the gene, but the gene must carry on specific properties so it can respond to the information given by the environment. Which means that the allele 'interprets' what specific kind of environmental information triggers the risk buttons or the protective buttons of it.

Obviously this mystical 'interpretation', so far we know today, takes place in the ventromedial prefrontal cortex and temporal-parietal junctions connected to supramarginal gyrus and amygdala. But in what way are this neurological regions with its sets of high-functioning MAO-A genes connected to association with delinquent peer-groups and intergenerational similarities, related to values and attitudes of entitlement, resilience, ethical flexibility⁸, self-restraint, sensation-seeking and arrogance⁹ (Shover, Hochstetler, & Alalehto, 2012)?

Some of this values and attitudes are specifically expressed in one of the most known social-

psychological common traits among white collar criminals, namely they will not acknowledge their crime and will continuously deny it (arrogance), until the opposite is proven. And once it is proven they will argue with excuses (self-restraint) or by justifying (entitlement, resilience, ethical flexibility) their crime (Benson & Walker, 1988; BENSON, 1985; Copes, 2003; Jacobsson, 2011; Klenowski, Copes, & Mullins, 2010; Minor, 1981; Rothman & Gandossy, 1982; Shover, Coffey, & Hobbs, 2003). And how is all this set of genes, brain functions, psychological and social-psychological structure/functions then related to the most common institutional reaction among white collar criminals of crisis responding caused by liquidity problem creating personal problems of different kind (Soothill *et al.*, 2012; Weisburd, 1991; Weisburd *et al.*, 2001; Zukowski, 2015)?

We don't know. But further on I will present a hypothesis how the things are connected together.

The Hypothesis

We have to remember that the object we talking about is middle class adult performing as late bloomers in the field of criminality. One way to open up the black box behind these puzzling phenomena is to grasp the theoretical consequences of differential susceptibility. The allele is activated as a risk or as a reinforcement depending on the information given by the environment. For the late blooming adult the environmental information must be apprehended as negative, either in the shape of material conditions or experience (e.g. humiliation, Tittle, 1995), which gives a reaction of stress processed by classic and/or operant conditioning giving a negative reinforcement (Akers, 2009; Burgess & Akers, 1966) which ends up in a state of negative emotions (Vaske & Boisvert, 2014).

In Vaske & Boisverts review of the field, the HPA (hypothalamic-pituitary-adrenal) axis¹⁰ (activating cortisol and other glucocorticoids which directly affect the brains response to environmental contingencies) is pointed out as a critical area for the stress reaction over the life course. A hyperarousal HPA axis leads to the death of neurons in the hippocampus and prevents the growth of synapses giving multiple changes of brains cell structure especially on the hippocampus at late adulthood. In combination with raised dopamine

⁸Zukowski (2015) did not find any statistical support of ethical flexibility at white collar offenders.

⁹Kendeler *et al.* (2015) show that arrogance is a highly genetic trait among white collar criminals. But Zukowski (2015) did not find confirmation for this in her investigation, comparing white collar offenders toward business professionals. Instead it was the business professionals who significantly were more hostile than the offenders.

¹⁰Activating more thoughtful responses in contrast to the autonomic nervous system (ANS), which instead reacts by fight-and-flight responses.

activity and decreased serotonin activity in amygdala and frontal cortex, the overstimulated individual loses the inhibitory mechanisms to regulate his hyperarousal reaction (ibid: 130). However, empirical research in this area does not give a unite result. But the majority of the investigations points out that if an individual carrying the 5HTTLPR serotonin gene with short risk alleles (in contrast to those carrying a long allele), especially the S and Lg allele, he is expected to increase the sensitivity for stress (higher activity of amygdala and medial prefrontal cortex corresponding to higher levels of anxiety) which impact his self-regulation, internationalization of moral and narcissism.¹¹

Regarding the MAO-A gene the results are much more puzzling compared to the results for 5HTTLPR. Molecular genetics show that low-activity alleles (or low expressive MAO-A) leads to an increase of negative emotions which cause aggression, and the other way round if the gene has high-activity alleles (Winiarski, Smearman & Brennan, 2014). The puzzle is that fraudsters has high-activity alleles and should not perform as fraudsters because they lack low-activity allele (Beaver & Holtfreter, 2009). My suggestion is that the high-activity allele of MAO-A correlates in some way to the OXTR gene which activate the oxytocin hormone. We do know that the oxytocin hormone stimulates social interaction, especially to members belonging to the same group in contrast to members belonging to other groups (Winiarski, Smearman & Brennan, 2014). This is a promising explanation of white collar criminals characterized by high-activity allele in MAO-A connected to peer-groups (Beaver & Holtfreter, 2009). The connection could be explained by the activation of the criminal's oxytocin hormone. And in a context of threat (e.g. recession) triggering social stress, the white collar criminals strengthen its ties (active rGE) into the group (e.g. company) and increase the levels of aggression toward other groups (e.g. agencies, competitors). The increase of aggression is then the reason to why white collar criminals in general deny that they ever have done a crime. And when they finally are convicted, they justify their crime by neglect.

Peer-group activity is obviously a socialpsychological process. Investigations of this area shows that individuals who identify themselves belonging to a certain group conform their behavior into

the group (in extreme way as group-thinking) (Braithwaite, 1984, 1985), which can take the performance of an advanced risk-taking if the companies or the groups common financial outcome is negative (Shover, *et al.*, 2012). Then the members of the group (individually or collectively) reacts by crises responding mediated by criminal role models, social learning and stress (Akers, 2009; Morris & Sayed, 2013; Sutherland, 1985; Weisburd *m.fl.*, 2001). This social-psychological processes is generally understood as human agency (the integration between constraining institutional conditions and the individual's way to cope the situation through his choices) which can be understood by macro-sociological dimensions of institutional nature (Farrington, 2003; Laub & Sampson, 2003; Wikström, 2006).

Biosocial criminologist has cautiously proposed, but so far disputed, that a change of an individual's socioeconomic status is an environmental risk factor to trigger stressful life events leading to negative emotions among potential criminals (Vaske & Boisvert, 2014). But, among criminologist and sociologist this idea is not so far-fetched and disputed as it may seem. The key concept here is relative deprivation in the middle class, experienced as a threat to downward social mobility. The point of departure is the identity crisis in the West European middle class. The middle class has lost its productive status of exclusivity (skill, experience and professionalism). It has become replaceable as labor force (like the experience of the working class), where business cycles, changes in ownership, mergers, privatization of government operations, etc. undermine their employment conditions, and in the worst case to be fired. This gives unsafe conditions over their social status, marital relationship and the ability to secure middle class life-style standards for the family (Laub & Sampson, 2003; Willott, Griffin, & Torrance, 2001). To keep defending its position of middle class the individuals maintain a sufficiently high consumerism and appetite for acquisition (Dunaway, Cullen, Burton, & Evans, 2000; Engdahl, 2015) by positional 'arms race' in the category, where the meaning of one's position is determined of what the individual can afford in relation to what others can afford (Coleman, 1987; Frank, 2007, 2008; Reay, Crozier, & James, 2011). That is, relative deprivation (threat to lose resources relative to comparable counterparts), leading to frustration, which in turn leads to promoting crime (Agnew, 2004). Because finally someone will lose its patience (caused by situational factors e.g. lack of money or criminal

¹¹The short allele of 5-HTTLPR is linked to neuroticism which in its turn is associated to substance abuse (Kretzmer, Dijkstra & Veenstra, 2014).

propensity e.g. lack of temperament, Piquero & Weisburd, 2009) and perform as a white collar criminal as a solution to the problem, while others perform legal because of higher levels of income, better capital savings or a milder competitive status pressure in their local context (among colleagues, neighbors, acquaintances, etc.).

CONCLUSION

The purpose for this article was to deliver a hypothesis why well established late blooming middle class adult does white collar crime. The theoretical strategy was to formulate a hypothesis which link the micro-macro relationship from genetic dimensions up to institutional dimensions.

So far I have argued from a standpoint of gene x environment interplay, based on the fact that around 50% of criminal behavior is genetic/biological and 50% is caused by environmental factors. Where the interaction gives the full explanation of criminality

because the two dimensions are intertwined to each other. From this point of departure intergenerational heritability and high-functioning MAO-A and behavioral genetic correlations should impact the executive functions of the brain. The impact of the brains cell structure caused by specific neurological functions of the white collar criminals executive functions (planning, social cognition, processing social information, etc) and normal intelligence level should impact social interaction to network building, especially the search of peer-group. The effect of the peer-group belonging and holding too and the activation of oxytocin hormone combined with the threat of negative financial outcome should then impact the level of stress. And finally the level of stress and the threat of downward social mobility (because of the negative financial outcome) should result in white collar crime.

This hypothesis can then be formalized by predicate logic, following the inference rules of hypothetical syllogism:

1	$\exists x (Ix \ \& \ Mx \ \& \ Bx \ \rightarrow \ Ex)$			
2	$\exists x (Ex \ \& \ Nx \ \rightarrow \ Px)$			
3	$\exists x (Px \ \& \ Ox \ \& \ Tx \ \rightarrow \ Sx)$			
4	$\exists x (Sx \ \& \ Dx \ \rightarrow \ W-Cx)$			
5	$Ia \ \& \ Ma \ \& \ Ba \ \rightarrow \ Ea$	$E\exists^{12}$	Row 1	holding a as a constant
6	$Ea \ \& \ Na \ \rightarrow \ Pa$	$E\exists$	Row 2	
7	$Pa \ \& \ Oa \ \& \ Ta \ \rightarrow \ Sa$	$E\exists$	Row 3	
8	$Sa \ \& \ Da \ \rightarrow \ W-Ca$	$E\exists$	Row 4	
9	Ia	HP	Row 5	Hypothetical premise
10	Ea	$E\&$	Row 5	Simplification ¹³
11	Pa	$E\&$	Row 6	"
12	Sa	$E\&$	Row 7	"
13	$W-Ca$	$E\&$	Row 8	"
14	$Ia \ \rightarrow \ W-Ca$	$I\rightarrow^{14}$	Row 9-13	Hypothetical syllogism
15	$Ia \ \& \ Ma \ \& \ Ba$	$I\&$	Row 5	Conjunction
16	$Ia \ \& \ Ma \ \& \ Ba \ \rightarrow \ W-Ca \ I\rightarrow$	Row 5-8	Hypothetical syllogism	
\therefore	$\exists x (Ix \ \& \ Mx \ \& \ Bx \ \rightarrow \ W-Cx)$	$I\exists$	Row 1-4	"

¹²Elimination of existential quantificator.

¹³According to the inference rules a conjunction can be simplified to one of the premises since if the conjunction is true then all of the premises is true, thus we can choose one of the premises from the existing conjunction.

¹⁴Integration of material implication.

Read: It applies for some x^{15} , if x has an intergenerational heritability and x has a high-functioning MAO-A and x has a behavioral genetic correlation (e.g. active rGE), then x has an executive functioning brain.

It applies for some x , if x has an executive functioning brain and x has a normal intelligence level, then x has a social capacity to be involved in peer-groups.

It applies for some x , if x has a social capacity to be involved in peer-groups and x activate oxytocin hormone and x are threatening of negative financial outcome, then x is stressed.

It applies for some x , if x is stressed and x is threatening of downward social mobility, then x will develop white collar criminality.

Given the transitivity of the hypothetical syllogism, the conclusion of white collar criminality follows in strict order from the given premises meaning that the action of white collar criminality is implicated in the first premise (row 1) mediated through a couple of premises to the dependent variable of white collar criminality. Since the first premise (row 1) include the interplay between gene and environmental factors, the gene x environment interaction is already immanent in the hypothetical syllogistic argument. I suggest, for the possibility to falsify this hypothesis, the syllogism contend necessary and sufficient conditions which are mixed up to result in white collar crime as a dependent variable. But irrespective if each premises are necessary or a sufficient condition, each of them have to precede before white collar crime occur. And white collar crime cannot occur if not everyone of the premises precede. That is in sentential logic (if every necessary and sufficient premises are aggregated to one value, p , and the dependent variable is q , it will be):

$$(p \rightarrow q) \leftrightarrow (q \rightarrow p).$$

That is the rule of contraposition: if p then q if and only if, if not q then not p . This is my prediction for future research too why (and why not) white collar crime happens.

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¹⁵Because not everyone of adult middle-class position will develop white collar criminality. The hypothesis concerns only the sample who does it.

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