

## INTERDISCIPLINARY APPROACH TO BIOLOGICAL THEORIES OF CRIME

<sup>a</sup>SLÁVKA DÉMUTHOVÁ, <sup>b</sup>VALENTIN BUCIK

*Department of Psychology, Faculty of Arts and Sciences,  
University of Ss. Cyril and Methodius, Nam. J. Herdu 2, 917 01  
Trnava, Slovakia*

*email: <sup>a</sup>slavka.demuthova@ucm.sk, <sup>b</sup>psychologia@ucm.sk*

**Abstract:** Current trends in biological conceptions of crime differ from their initial theories. Even though they still stress the fact that biological factors have the potential to affect behaviour significantly, they accept also other areas of aetiology. Such an approach brings new possibilities to the science development. Communication between disciplines and benefitting the mutual interconnections when solving the problem of crime leads to the new – interdisciplinary – theories. The paper shows the examples of these theories by introducing the Developmental theory of T. E. Moffitt, Biosocial theory of D. H. Fishbein, Somatic marker hypothesis of A. R. Damasio, and Evolutionary ecology of B. J. Vila. Further on, it presents the vertical and horizontal approaches to integration of different kinds of knowledge.

**Keywords:** interdisciplinarity, theories of crime, aetiology of crime, biology

The twentieth century in psychology was characterised by a boom of various theories, concepts, schools and new ideological streams. This tendency resulted in the formulation of dozens of theories also in the area of criminal aetiology. Intensive research and efforts to verify these theories by empirical studies has led (except the controversial results) to the finding that a specialized focus in examining the problem helps to analyze it in detail from the specific perspective, but at the same time such an approach is limited by its own boundaries (Klein 1990). Scientists came to a point where they were not able to explain the mechanisms within their specialization without the knowledge of the principles of functioning belonging to other areas/specializations. The need to use knowledge from other related scientific disciplines resulted not only in mutual communication and help, but also created new explanatory areas of studied problems.

Current trends in biological conceptions of crime differ from their initial theories. Even though the biological explanations of crime still stress the fact that biological factors have the potential to affect behaviour significantly (as well as its socially undesirable forms), they accept also other – psychological, environmental etc. aetiologies. This enriched view does not mean that they retreated from their positions in order to maintain its own existence in changing world and "collaborated" with competitive theories. Such an approach brings new possibilities to the science development. Some authors even state that axioms from one area of scientific research may successfully support the validity of statements from the other one by creating one unified net of propositions (Démuth 2013). Communication between disciplines and discoveries of interconnections when solving the common problem leads to new – interdisciplinary – theories of crime. The outcome can have a different background – it can be a result of a union of two equal points of view, a discovery of some integrating meta-level of two originally different views, or even a completely new concept, which uses knowledge from several scientific areas, but results in a brand new original theory.

Of course, these integrations and interdisciplinary communication are not always easy. They meet a lot of problems with communication based on the different language and terminology of scientific areas with terms denominating slightly or extremely different things. Also, the methodology used in various scientific disciplines is not always compatible and therefore the results gained in different areas can't be smoothly compared. There are also other complications (see e.g. Schleifer 2000), however, the growing body of new interdisciplinary approaches and theories proves, it is a very productive and efficient area of scientific approach nowadays.

### 1 Developmental theory of Terrie E. Moffitt

One of the theories of criminality that integrates elements from different perspectives is Terrie E. Moffitt's developmental

theory. The basic factors of development are maturing and learning – both of these aspects are interlinked and mutually influence the ontogenesis. While maturing is tied more to the internal environment of the body and is genetically determined, learning reflects influence of the external environment. Moffitt's crime theory assumes that based on these presumptions there are two taxonomically very different types of crime – one is dependent on the intrinsic characteristics of an organism and continues throughout life, while the second type is bound to a shorter period of ontogenesis and reflects the specifics of an individual's environment (Moffitt 1993).

Life-course-persistent antisocial behaviour (LCP) is based on the presence of neurological deficits that cause problems with the behaviour of an individual. These deficits manifest themselves already in early childhood particularly in boys (ratio of LCP boys and girls is 10:1 – Moffitt, Caspi 2001) and have typical behavioural symptoms e.g. infants tend to be restless, irritated, and inconsolable, they show more dissatisfaction and more intense crying. Parents often declare failures in efforts to reassure them, they handle their children with difficulties. Later on, the problems with their socialization emerge; children with LCP antisocial behaviour fail to fit into social groups and have problems establishing contacts with peers. During pre-school age they are already often being diagnosed with hyperactivity, or impulsivity. The frequency and severity of antisocial behaviours increases with age; at school they start to break rules, outside the school they gain their first police records. The typical feature is their inability to acquire socially desirable patterns of behaviour and inclination to problematic peer groups. Their repertoire of responses to environmental stimuli is limited and inappropriate. In adolescence first arrests appear and the severity and frequency of offences increases with age. In adulthood, the criminal activity is more severe, aggressive and chronic (Moffitt 1993).

Despite the apparent fatalism in the development of LCP, Moffitt notes that the dysfunctions of the central nervous system should not be regarded as purely deterministic. They should be considered as individual variants of the nervous system, and represent the basic material for the interaction between the individual and the environment during life. LCP antisocial behaviour is thus not purely caused by neurological deficits, but acquires its typical features in conjunction with a specific (in this case criminogenic) environment (Moffitt 1993). The interaction between the environment and genetic predisposition may be present on various levels. The inheritable character of this behaviour also means that the risk of an incidence in parents of having such a child is much higher than in the normal population. The consequence is that also parents will exhibit similar problems with coping with situations linked to CNS dysfunction. For such parents the upbringing of the child with CNS dysfunction therefore represents a greater burden than for those who do not suffer from these abnormalities. Furthermore, these parents are not likely to provide model behaviour for appropriate, non-pathological coping with problem situations. Raising a child with neurological deficits by parents suffering with dysfunctions often leads to failures and critical situations which worsen the family climate and represent a less favourable developmental environment than in intact families.

The second type of antisocial behaviour is called Adolescence-limited antisocial behavior (ADL) and is linked to the period of adolescence. It occurs mainly in the period between biological and social maturity and affects (compared to LCP) only slightly more boys than girls with a ratio of 1,5:1 (Moffitt, Caspi 2001). Adolescence is a turbulent developmental period typified by revolt against authorities, searching for own identity, rejecting parents' models and ideals, preferring peer groups and abandoning family, testing own abilities and limits and also curiosity about the reactions of others to behavioural provocations (Macek 2003). The transition from childhood to adulthood therefore characterizes also naturally increased tendency to break the rules of society and behave delinquently.

According to T. E. Moffitt, ADL antisocial behaviour occurs at this time and is characterized by the absence of previous antisocial tendencies during childhood. In its nature, such behaviour is temporary, learned and it occurs in the repertoire of reactions because of the principles of conditioning. Individuals with ADL exhibit antisocial tendencies only if they appear to be beneficial to them and – unlike the LCP – they are able to reject such behaviour if the prosocial tendencies lead to a better reward. ADL individuals are thus able to control and regulate their behaviour depending on benefits (Moffitt 1993). In LCP subjects the prosocial tendencies in the repertoire of behaviour are usually completely lacking or they are just minimally present. Another significant difference is that the in ADL subjects the vast majority of inappropriate behaviour disappears spontaneously after reaching adulthood. Also, during the period of adolescence the offences do not tend to progress - neither in frequency nor in severity and they have mostly a nonviolent character. There are also periods when adolescents do not commit offences at all. In addition, biologically conditioned LCP antisocial behaviour has close links to education and environmental factors; also ADL crime shows some potential to a genetic connection. Recent analysis revealed that ADL crime manifested through non-aggressive, rule-breaking behaviour is related to the occurrence of genetic polymorphism on His452Tyr and DAT1 (Burt, Mikołajewski 2008).

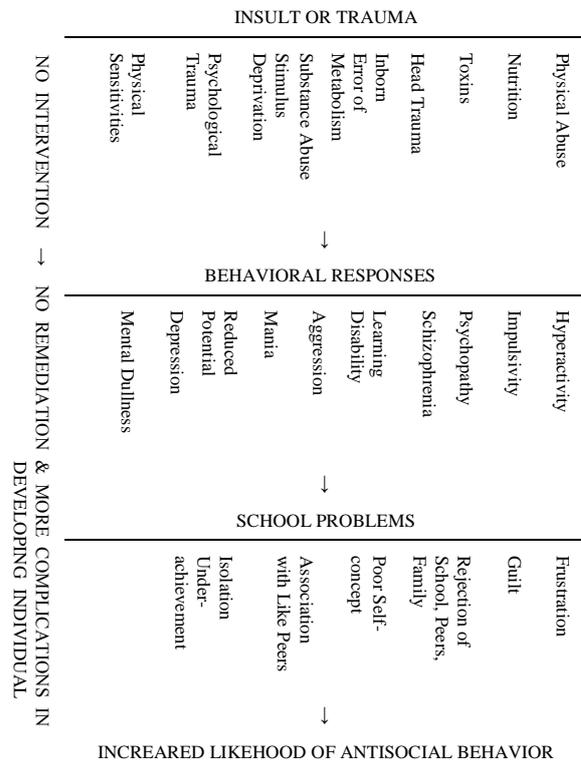
## 2 Biosocial theory of Diana H. Fishbein

Biosocial theories of crime basically connect two main approaches to the causes of crime - biological and social. Biological markers are considered to be (within the view of these concepts) the factors that either increase or reduce the tendencies to criminal behaviour, but are not able to neither evoke nor eliminate the criminality with full certainty (Beaver 2010). The process of formation of antisocial behaviour is also affected by other factors that have its roots in the social environment.

Diana H. Fishbein deals in her investigation of crime with several issues – she is studying the intersexual differences of antisocial behaviour, neurocognitive influences on delinquent behaviour but also the possibilities of prevention and treatment of criminals. However, the most remarkable is her concept of Biosocial theory, which principles were formulated in two key works (Beaver 2010) – in the article "Biological perspectives in criminology" (Fishbein 1990) and in the monograph "Biobehavioral Perspectives in Criminology" (Fishbein 2000). The main outcome resulting from reconsideration of biological influences of crime that previously absented in social theories was, that the customary strict differentiation between biological and social factors (nature vs. nurture/genes vs. environment) lost its meaning and the vast majority of experts dealing with crime have accepted the need to connect the biological and social elements when explaining antisocial forms of behaviour (Beaver 2010). The model of development of maladaptive behaviour (see Figure 1) shows the wide range of factors from both – biological and environmental areas that are included in the idea of formation of antisocial behaviour.

Fishbein considers the criminality and maladaptive behaviour as a result of inadequate handling of the problems occurring during ontogeny, especially in its early stages. Biologically relevant symptoms such as malnutrition, head trauma, metabolic disorders, damage due to toxins or other risk factors are compounded by suboptimal social and environmental conditions. These factors have a strong potential to cause excessive reaction of an individual – either in the form of increased irritability, aggressiveness, or weaker performance in school, etc. The problem is that these early „seeds“ of antisocial behaviour are often not recognized as complications that warrant intervention, or they are ignored/ inappropriately treated. The absence of appropriate intervention causes their further development and accumulation therefore their severity rises and becomes more serious in adolescence and adulthood. „According to this "developmental course" model of human behaviour, criminal behaviour is virtually always secondary to an underlying problem(s)“ (Fishbein 1990, p. 29).

Figure 1  
Developmental course model (The developmental stages of maladaptive behavior – Fishbein 1990, p. 31)



## 3 Somatic marker hypothesis of Antonio R. Damasio

A year after Terrie E. Moffitt published her groundbreaking work, Antonio R. Damasio introduced the Somatic marker hypothesis (Yang, Raine 2010). The key idea of Damasio's „somatic marker hypothesis“ is that decision-making is a process that is influenced by marker signals that arise in bioregulatory processes, including those that express themselves in emotions and feelings (Bechara, Damasio 2005). At its core, it is an integration of knowledge of the mechanisms of decision-making, functioning of emotions, learning principles and functioning of brain structures. It provides a „systems-level neuroanatomical and cognitive framework for decision-making and its influence by emotion“ (Bechara, Damasio 2005, p. 336). It enriches the theories of criminality with the explanation why criminals repeatedly commit crimes even if such behaviour is being punished and should be strongly associated with aversive actions of society.

One of the tasks of the nervous system is to elicit the responses to somatic states as reactions to certain stimuli (Damasio 1994). The consequence of this feature is that some set of stimuli (situations) is connected with specific (positive or negative) reactions. The creation of these "associations" as well as their functioning (arising in appropriate situations) may be accessible to consciousness, but can be also unconscious. Most people (and scientists) believe that when deciding rationally they weigh the options that are available and according to the expectations of their consequences they choose the best one (Bechara, Damasio 2005). But Damasio argues that in most cases such decisions are not so simple – the situation is either too complicated, the options are unclear or their consequences are unknown, or possible decisions result in ambiguous or conflicting outcomes (Yang, Raine 2010). The emotions generated by the nervous system in response to the situation become therefore an important element in the decision making. Feeling of pleasantness / inconvenience which we are experiencing when thinking about the particular solution represents a key element in

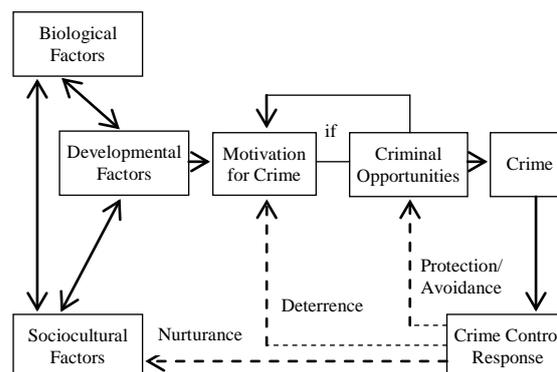
our decision making. The basis for creating these "keys" (Damasio called them somatic markers) are innate mechanisms leading the organism to avoid the pain or damage and to prefer those actions/reactions which bring the pleasure or rewards (Damasio 1994). Somatic markers are thus crucial keys that help us in the decision-making process by giving information about consequences (in the emotional sphere) of our previous decisions. For (psychically) healthy subjects this process allows them to categorize experiences, learn from past mistakes (Yang, Raine, 2010) and avoid those decisions which led in the past to negative consequences. The decision-making process is therefore not only a matter of rationality, but the emotions in it play an important role. This was the reason why Damasio called his groundbreaking work "Descartes' Error: Emotion, Reason, and the Human Brain" (1994) and spoke out against Descartes' idea of dualism with a strict separation of mind and body, rationality and emotions. Damasio understands emotions as a set of changes in arousal or activation of the body, or (alternatively) as the representations of these changes in the nervous system (Colombetti 2008).

The biological basis of this hypothesis lies in the importance of several brain structures in developing somatic markers. Damasio (1996) emphasizes mainly the function of the ventromedial prefrontal cortex, which is a substrate for the formation of associations between certain types of situations and physiological responses (including responses in the form of emotional states), but the overall process includes also other areas (Bechara, Damasio 2005). Numerous research proved that damages in the area of the ventromedial prefrontal cortex cause the dysfunctions of the whole process of assigning the somatic markers to relevant stimuli (Slavkovský 2013). Such affected individuals with intact intellect and undamaged other cognitive functions have problems with planning, choosing appropriate friends, partners and activities. The plans they carry out, the people that they choose for cooperation or life; activities they realize etc. often lead to financial losses, losses of status, friends, and family support. The choices they make are not beneficial for them; they are socially inadequate and different from those exhibited by individuals before the damage of certain brain areas (Damasio 1996). This defect is due to the failure to activate somatic states associated with reward or punishment which were previously associated with specific social situations (Damasio, Tran & Damasio 1990). Inability to anticipate the negative consequences of antisocial behaviour and negative decisions resulting from malfunction of somatic markers causes the repeating of antisocial behaviour and the criminality has a tendency to relapse. The importance of the ventromedial prefrontal cortex and consequences of its damage confirms several studies documenting the subsequent failure of moral judgment, perception of social rules (Anderson, Bechara, Damasio et al. 1999), sociopathy (Damasio, Tranel, Damasio 1990), social defects, loss of control over behaviour but also crime (Anderson, Damasio, Tranel et al. 2000). Damasio also stresses the fact the cause of antisocial behaviour may be not just the defective brain but the disturbances in associating the somatic markers can be caused also by a defective culture (e.g. by rewarding perverse individual reactions) (Damasio 1994). Assigning somatic markers to stimuli is in fact a learning process, which is undoubtedly influenced by the environment, too.

#### 4 Evolutionary ecology of Bryan J. Vila

Bryan J. Vila posits his Evolutionary ecological theory of crime on the foundations of Cohen & Machálek's Expropriative theory. However, within his concept it is possible to identify a number of other key ideas and theories of crime - it integrates the theories of pressure, control, labelling, and learning (Barak 2002). Through a specific approach of focusing on particular biological, developmental and environmental factors of criminal behaviour he seeks a holistic approach to the understanding of criminality (see Figure 2).

Figure 2  
Evolutionary ecological paradigm for understanding criminal behaviour (Vila 1997, p. 6)



The left part of figure represents the interaction between biological, socio-cultural and developmental factors that allow us to gain diverse experience, knowledge, skills, strategies, attitudes... during the life of an individual (Vila 1997). B. J. Vila admits that - on one hand - criminal behaviour can occur due to "chronic criminality of an individual", i.e. as a result of his/her personal characteristics and unique features that act as pathological factors of chronic offending. These characteristics may be partly the outcome of genetic transfer (biological factor). On the other hand, there is a great amount of evidence that crime is affected by a specific situation, characteristics of the community and the wider environment in which the individual grows up (socio-cultural factor) (Savage, Vila 2003). The influence of environment leads not only to behavioural changes at the individual level; environmental conditions, ecology, culture etc. interfere with human response in the same way as genes. Culture is the medium which allows transferring learned behaviour, attitudes, opinions etc. from one generation to another, especially those that appear to be important for survival. As a consequence, certain behaviours and strategies (successful in terms of survival) are extended and more frequent in the environment (ecological niche) in subjects, while others (less successful) are less frequent or disappear. The frequency of extension of certain behaviour in the population depends on previous success, the ability to face new challenges, but also on its relative abundance within the population (ibid). B. J. Vila also stresses an importance to gaining experiences and to environmental influences in childhood (developmental factor), especially those that have the potential to affect the expansion of biological characteristics and upbringing styles to future generations (Vila 1997).

This model of understanding crime continues with an assumption that mutual interaction between biological, socio-cultural and developmental factors affects not only an individual's ability to gain resources, but also the values that individual attaches to them. Therefore, the motivation of an individual to commit a crime is determined not only by mentioned factors, but also by the attractiveness of opportunity for illegal ways of acquiring resources. If the motivation is strong enough and there is an opportunity, criminal behaviour is very likely to appear. However, it is not accepted socially, and thus results in disagreement of individuals, groups or societies who try to intervene through various control mechanisms. They can be either successful - in this case the individual waives unlawful conduct and modifies his own behaviour, or they have only partial impact - an individual commits other crimes or uses other ways of criminality, or they may fail completely with no effect. Vila (1997) highlights two particular mechanisms of influence on crime - through intimidation (the deterrence strategy) or action on education (the nurturant strategies). Deterrent strategy influences mainly the motivation to commit a crime and uses punishment to prevent crime in individuals that act illegally. Educational strategies focus more on the prevention of crime and try to act in the way of preventing the development of illegal features in the behaviour.

The evolutionary ecological approach thus explains how biologically changeable individuals interact with the environment and other organisms, how they adapt to external changes, gain specific physical and behavioural characteristics, and how they spread them in the population through culture and genetics (Vila 1997). It also assumes that any outcome of human behaviour (including crime) is consistent with the tendency of humans to act in order to increase their chances for survival, reproduction and offspring support (Vila 1994). If such benefits can be acquired by illegal activities, then the occurrence of such behaviour is considered to be "natural". However, this does not exclude the fact that some (pathological) individuals due to various factors (heredity, education) tend to prefer unlawful strategies to a greater extent than others (Savage, Vila 2003).

## 5 Conclusion

The developmental theory of Terrie E. Moffitt, Biosocial theory of Diana H. Fishbein, Somatic marker hypothesis of Antonio R. Damasio, and Evolutionary ecology of Bryan J. Vila were just a few examples of successful and beneficial integration of different approaches to the explanation of criminal behaviour. This kind of integration is the outcome of very common recognition of the fact that the processes involved in forming behaviour leading to crime are so interconnected that it is not fully possible to understand the existence and functioning of one without the presence of the other. Nicole Hahn Rafter (2008) describes this "symbiosis" in the example of connection of environmental and biological factors using the picture of the river and the country - biological effects are seen as a strong stream, which form and shapes the country leaving indelible marks on it, but also - it is a country (acting as influencing factor of the environment) which allows (or disallows) the river to flow through a certain area, regulates the stream flow, its speed, and direction. The interaction of biological and social is obvious - in many cases they cannot be clearly separated from each other and it is not possible to decide whether a certain characteristic of behaviour was caused by genes or environment.

The interdisciplinary approach described in the previous theories represents the explanation of crime based on a combination of knowledge from several disciplines. It is a horizontal approach to integration - one problem (e.g. crime) is grasped by several disciplines at the same level and outputs of their research are combined into a new multi-disciplinary perspective. In this way, insights of e.g. sociology, psychology, psychiatry etc. can be combined. However, interdisciplinary theories of crime can be an outcome of a vertical approach to integration. In this case, knowledge about a certain problem from different levels of explanation is connected into the final complex view. A typical example of such an approach represents e.g. the demonstration of the presence of a specific genetic mutation, which at the next level needs to mention and describe the atypical level of neurotransmitters which subsequently give rise to functional changes in the brain regions that are followed by different reactions to stimuli, and thus change the behaviour. The whole model progresses from lower/deeper levels and continues with showing the implications for higher and higher levels. Finally, it integrates all findings from several levels of explanation into the conception describing the whole phenomenon. It is not even impossible to combine both - the vertical and horizontal model, too. The final knowledge gained from an integrative approach can be explained by biologists, neurologists and psychologists from their certain point of view and affiliation to a certain science discipline.

Similarly, the vertical approach can be applied on the timeline - when studying a crime the hereditary factors followed by intrauterine ones, those present at birth, or operating throughout life until the point when the crime manifests (so called the "concept of the lifepath") can be tracked. There are many ways how to combine different knowledge (see, e.g. works by Gregg Barak 2002, 2009); it even happens that the cooperation between disciplines creates a completely new framework. As an outcome, a new interdisciplinary approach is created that is not only the

connection of branches of knowledge, but a new separately functioning space for scientific investigation. Probably the most serious argument why the interdisciplinary theories are important for explanation of the crime is the fact they notably enriched the knowledge base with brand new findings. In this case the gestaltic phrase "The whole is greater than the sum of the parts" applies. The interdisciplinary approach leading to integrative concepts of crime does not connect only what is already known, but this connection enables us to bring new, original, and important knowledge.

Note: The contribution is based on and enriches the text: *Integratívne koncepcie* [Integrative conceptions] in Démuthová, S.: *Biologické koncepcie criminality* [Biological conception of crime]. Trnava, Univerzita sv. Cyrila a Metoda v Trnave 2012, 188 p. ISBN 978-80-8105-273-6.

## Literature:

1. Anderson, S. W., Bechara, A., Damasio, H., Tranel, D., Damasio, A. R.: Impairment of social and moral behavior related to early damage in human prefrontal cortex. *Nature Neuroscience*, 1999, 2 (11), p. 1032-1038, ISSN 1097-6256.
2. Anderson, S. W., Damasio, H., Tranel, D., Damasio, A. R.: Long-term sequelae of prefrontal cortex damage acquired in early childhood. *Developmental Neuropsychology*, 2000, 18 (3), p. 281-296, ISSN 1532-6942.
3. Barak, G.: Integrative theories. *Encyclopedia of Crime & Punishment*. Sage Publications 2002. [Online], Access: <<http://www.greggbarak.com/custom2.html>> [cit. 2011-06-20].
4. Beaver, K. M.: Fishbein, Diana H.: Biosocial Theory. *Encyclopedia of Criminological Theory*. Sage Publications 2010. [Online], Access: <[http://www.sage-reference.com/criminologicaltheory/Article\\_n92.html](http://www.sage-reference.com/criminologicaltheory/Article_n92.html)> [cit. 2011-07-04].
5. Bechara, A., Damasio, A. R.: The somatic marker hypothesis: A neural theory of economic decision. *Games and Economic Behavior*, 2005, 52 (2), p. 336-372, ISSN 1532-6942.
6. Burt, S. A., Mikolajewski, A. J.: Preliminary evidence that specific candidate genes are associated with adolescent-onset antisocial behavior. *Aggressive Behavior*, 2008, 34 (4), p. 437-445, ISSN 1098-2337.
7. Colombetti, G.: The somatic marker hypotheses, and what the Iowa gambling task does and does not show. *British Journal for the Philosophy of Science*, 2008, 59 (1), p. 51-71, ISSN 0007-0882.
8. Damasio, A. R.: *Descartes' Error: Emotion, Reason, and the Human Brain*. 1. issue. New York: Putnam Publishing 1994, 312 p. ISBN 978-0-399-1384-2.
9. Damasio, A. R.: The somatic marker hypothesis and the possible functions of the prefrontal cortex. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 1996, 351 (1346), p. 1413-1420, ISSN 1471-2970.
10. Damasio, A. R., Tranel, D., Damasio, H.: Individuals with sociopathic behavior caused by frontal damage fail to respond autonomously to social stimuli. *Behavioural Brain Research*, 1990, 41 (2), p. 81-94, ISSN 0166-4328.
11. Démuth, A.: *Philosophical Aspects of the History of Science*. 1. issue. Krakow: Towarzystwo Słowaków w Polsce - FF TU 2013, 96 p. ISBN 978-83-7490-599-2.
12. Démuthová, S.: Biologické koncepcie criminality [Biological conception of crime]. 1. issue. Trnava: Univerzita sv. Cyrila a Metoda v Trnave 2012, 188 p. ISBN 978-80-8105-273-6.
13. Fishbein, D. H.: Biological perspectives in criminology. *Criminology*, 1990, 28 (1), p. 27-72, ISSN 1745-9125.
14. Fishbein, D. H.: *Biobehavioral perspectives in criminology*. 1. issue. Belmont: Wadsworth 2000, 152 p. ISBN 978-0534547424.
15. Klein, J. T.: *Interdisciplinarity: History, Theory and Practice*. Detroit, Wayne State University Press 1990, 331 p. ISBN 978-0-8143-2088-0.
16. Macek, P.: *Adolescence*. [Adolescence]. 1. issue. Praha: Portál 2003, 142 p. ISBN 80-7178-747-7.
17. Moffitt, T. E.: Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy.

- Psychological Review*, 1993, 100 (4), p. 674-701, ISSN 0033-295X.
18. Moffitt, T. E., Caspi, A.: Childhood predictors differentiate life-course persistent and adolescence-limited antisocial pathways among males and females. *Development and Psychopathology*, 2001, 13 (2), p. 355-375, ISSN 0954-5794.
  19. Savage, J., Vila, B.: Human ecology, crime, and crime control: Linking individual behavior and aggregate crime. *Social Biology*, 2003, 50 (1-2), p. 77-101, ISSN 0037-766X.
  20. Schleifer, R.: The difficulties of interdisciplinarity: Cognitive science, rhetoric, and time-bound knowledge. *Stanford Humanities Review*, 2000, 4 (1) [Online]. Access: <<http://www.stanford.edu/group/SHR/4-1/text/schleifer.commentary.html>> [cit. 2010-10-10].
  21. Slavkovský, A.: *Rationality and Human Cognition*. 1. issue. Krakow: Towarzystwo Słowaków w Polsce - FF TU 2013, 88 p, ISBN 978-83-7490-598-5.
  22. Vila, B.: Human nature and crime control: Improving the feasibility of nurturant strategies. *Politics and the Life Sciences*, 1997, 16 (1), p. 3-21, ISSN 0730-9384.
  23. Yang, Y., Raine, A.: Neurology and crime. *Encyclopaedia of Criminological Theory*. Sage Publications 2010. [Online], Access: <[http://www.sage-reference.com/criminologicaltheory/Article\\_n184.html](http://www.sage-reference.com/criminologicaltheory/Article_n184.html)> [cit. 2011-03-25].

**Primary Paper Section: A**

**Secondary Paper Section: AN**