TEME, г. XXXIX, бр. 4, октобар – децембар 2015, стр. 1515–1531

Прегледни рад
Примљено: 8. 8. 2014. UDK 316.66.37.01 : 374.31
Ревидирана верзија: 5. 12. 2014.
Одобрено за штампу: 23. 11. 2015.

EVOLUTIONARY-NEURODEVELOPMENTAL BASES OF RISK BEHAVIOUR AMONG YOUTH: SOCIAL-PEDAGOGICAL IMPLICATIONS

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Abstract

Adolescence is an evolutionarily-preserved developmental stage which is characterized by dramatic physical, hormonal, neurological, and behavioral changes. One of the basic characteristics of adolescence is an increased tendency towards participation in reckless and risk behavior. However, greater youth involvement in risk-taking, in comparison with adults and children, cannot be entirely explained by reckless disregard of risk, irrationality, the illusion of own invulnerability, or rather by the wrong perception of risky situations.

In this paper, the risk behavior in adolescents is discussed from the perspective of two theoretical-empirical frameworks – social neuroscience and evolutionary biology. The first part of the paper explicates the necessity of de-dramatization of adolescence. In the second, central, part of the paper, the basic findings of neurobiological research on adolescence are presented, as well as the basic postulates of the evolutionary model of risk behavior in adolescents. Finally, the authors elaborate on the potential social-pedagogical implications of modern knowledge of adolescence. The presented conceptual framework enables the interpretation of what is already known about risk behavior in adolescents and, at the same time, provides new assumptions, suggests new research directions, and presents a unique platform for the creation of comprehensive preventive interventions.

Key words: adolescence, risk behavior, brain, prevention

ЕВОЛУЦИОНО-НЕУРОРАЗВОЈНЕ ОСНОВЕ РИЗИЧНОГ ПОНАШАЊА МЛАДИХ: СОЦИЈАЛНОПЕДАГОШКЕ ИМПЛИКАЦИЈЕ

Апстракт

Адолесценција је еволуционо сачувана развојна фаза коју карактеришу драматичне физичке, хормоналне, неуролошке и понашајне промене. Једно од основних својстава адолесценције је повећана склоност ка учествовању у непромишљеном и ризичном понашању. Међутим, веће учествовање младих у преузимању ризика, у односу на одрасле и децу, не може бити искључиво тумачено непро-

мишљеним игнорисањем ризика, ирационалношћу, илузијом о властитој рањивости, или пак погрешном перцепцијом ризичних ситуација.

У раду се из перспективе два теоријско-искуствена оквира - социјалне неуронауке и еволуционе биологије - дискутује о ризичном понашању адолесцената. У првом делу рада се експлицира неопходност де-драматизације адолесценције. У другом, централном делу рада представљени су основни налази неуробиолошких истраживања адолесценције, као и основни постулати еволуционог модела ризичног понашања адолесцената. Коначно, аутори елаборирају потенцијалне социјалнопедагошке импликације савремених сазнања о адолесценцији. Представљени концептуални оквир омогућава интерпретирање онога што се већ зна о ризичном понашању адолесцената, и истовремено нуди нове претпоставке, сугерише нове правце истраживања и представља јединствену платформу за креирање свеобухватних превентивних интервенција.

Кључне речи: адолесценција, ризично понашање, мозак, превенција

INTRODUCTION

One of the most intriguing questions when it comes to studying adolescent behavior is why teenagers are more inclined to behave in a risky manner. Most of the preventive programs, based on the assumption that adolescents are irrational and reckless, have failed, so further scientific and practical research ensued (Steinberg, 2008). While the researchers attempt to realize the role of social-emotional correlates in the risk behavior of adolescents, practitioners aim to find more effective preventive interventions.

This paper is explicitly dedicated to studying the phenomenology of adolescent risk behavior. The risky behavior of adolescents will be discussed from the perspective of two theoretical and empirical frameworks – social neuroscience and evolutionary biology. The analysis of social-pedagogical implications of the evolutionary neurodevelopmental model is intended for everyone interested in prevention of negative outcomes and in encouragement of positive youth development.

DECONSTRUCTING STEREOTYPES ABOUT ADOLESCENCE

The term “adolescence” is defined as the period of life which begins with puberty and ends with maturity. However, adolescence is more than just the process of growing up; it is also a period of transition. The social life of adolescents is specific. When compared to children, adolescents spend more time with their peers than they do with their parents (Somerville, Jones, & Casey, 2010). Digital communication between peers also reaches its peak; internet, text messages, and social networks are used more frequently. This increase in communication between peers does not occur only in the human society: “adolescent” rats also spend more time playing with their peers than adult rats do (Doremus-Fitzwater, Varlinskaya, & Spear, 2010). In other words, the development of numerous mammal

species goes through the ontogenetic transition from being young and dependent to becoming independent adults.

Since the beginning of the 20th century the implicit and/or explicit goal of scientific studies of adolescence was to describe, explain and predict problematic behavior of adolescents (Steinberg & Morris, 2001). Studies on problems in adolescent behavior are still dominant, despite the appeals for adolescence to be "de-dramatized", despite constantly emphasizing that adolescence is not the period of "normative incidents" and despite the empirical evidence that most teenagers overcome the challenges of this period without major social, emotional, or behavioral difficulties (Arnett, 1999). We are accustomed to seeing adolescence as a problem. The negative consequences of perceiving adolescence in such a way are reflected in authoritarian parenting, on one hand and paying insufficient attention to the teenagers with serious problems who require professional help, on the other hand. However, the more we know about the uniqueness of that period in life, it becomes clearer that adolescence might be an adaptive or even a highly functional period. One of the examples that can support this is the process of human evolution.

Humans have fewer offspring when compared to many other mammals, which results in their taking more care about their children. It also takes them more time to reach maturity. The feature of extended learning period and achieving maturity (adolescence) later than other mammals has persisted through evolution and it is favored by the natural selection, because it is obvious that humans were given a certain advantage when compared to other species. After all, different human species lived and died during the evolution process, but the ones with superior mental capability survived, even though they might have been physically weaker. From the evolutionists' point of view, adolescence is a crucial period for achieving physical, mental, and physiological maturity. The biggest neurohumoral changes happen in the period of growing up, so it is time for scientists to start reconsidering their assumptions about the period of "raging storms and stress".

Adolescents really do take risks. Some authors point out that the youth who are not prone to antisocial behavior during the adolescent period start to behave in the same way as their delinquent peers, in order to gain a prestigious position in the group (Moffitt, 1993). Adolescence is also the period of new social challenges such as greater academic stress, increased sensitivity to social evaluation, and establishment of balance between immediate pleasures and long-term goals. Under the influence of sex hormones adolescents reach a period of social reorientation, which motivates them to form friendships, to attract romantic partners, and to gain a prestigious position in the group (Forbes & Dahl, 2010). Activation of the above mentioned motivational tendencies can have positive effects: exploration of new social environments leads to acquisition of new skills and abilities. The emotional intensity during adolescence intertwines not

only with social and romantic interests, but also with the passion for art, sport, and music. On the other hand, stronger social and romantic tendencies, alongside the increased need for sensation seeking, may contribute to a wide range of risky behaviors.

The behavioral changes that characterize adolescence, such as enhanced interaction among peers, risky behavior, and a search for new experiences, are evident among different species (Doremus-Fitzwater et al., 2010). It seems that these characteristics have evolved in order to make finding new territories, sexual partners, and food easier. Considering that adolescence is a period when we acquire new skills, increased sensation and experience seeking was evolutionally preserved because of its adaptive value (Spear, 2000).

Adolescence is characterized by an increased tendency towards risky behavior such as: use of psychoactive substances, unprotected sex, and inflicting of injuries upon others. Why do adolescents exhibit risk-taking tendencies? Risky behavior of adolescents cannot be explained by their inability to realize potential consequences of such behavior (Reyna & Farley, 2006). Contrary to conventional belief, Steinberg (2008) states that adolescents are completely aware of their vulnerability and harmfulness of such behavior. Therefore, if teenagers are aware of the risk they are taking, why are they so prone to taking it? It seems that they take risks because their value of risk versus reward is different, not because they are not aware of the danger.

The presented facts certainly suggest that adolescence is a period full of conflicts with parents, negative emotions and risky behavior (Arnett, 1999). However, it is important to emphasize that the majority of adolescents are not unhappy and that they go through this period comfortably and without any major problems (Arnett, 1999; Steinberg, 2008). The fact that most adolescents make rational decisions and that they have no problems in controlling their emotions is easily neglected. A frequent mistake which is made when adolescent behavior is analyzed is that we tend to neglect processes which take place in the center which coordinates all other activities (social behavior, emotions, sexual behavior, and motivation), the brain. In addition to the brain, the endocrine system also plays an important role, specifically the hypophysis as the central endocrine gland, which is connected to the hypothalamus via a small tube called the pituitary stalk. The hypothalamus is the most important integrative center of the nervous and endocrine systems.

NEURODEVELOPMENTAL MODEL OF ADOLESCENT BEHAVIOR

Each period of individual human development is specific in its own way. However, it seems that adolescence causes the most significant changes in behavior, when compared to any other period in life. Although the

social behavior of adolescents might seem strange and often unacceptable, it is quite understandable when all the facts, which point to physiological changes that are happening in the body of adolescents, are taken into account. These changes are not another western "invention", as they have a firm foothold in the evolution of the human race, since these were happening thousands and millions of years ago.

A group of researches in New York (Somerville et al., 2010) developed an influential neurobiological explanation of typical adolescent behavior. The fundamental premise of this model is that adolescence is a period of neurological imbalance is caused by relatively early maturity of subcortical regions of the brain and relatively late maturation of the prefrontal cortex. Based on these neurophysiological characteristics of adolescence, in the emotional context, the more mature limbic system will win over the relatively immature prefrontal cortex. Of course, if the cognitive control and immature prefrontal cortex were the sole cause of risky behavior, children would be even more inclined to behave in this way. However, we know that this is not the case. Rapid maturing of the limbic system and hormonal imbalance are the primary causes of the increased presence of risky behavior in adolescence. This model does not imply that adolescents are incapable of making rational decisions. In fact, the truth is that the benefits of risky behavior, e.g. approval by peers, are valued over the risk that was taken (Steinberg, 2008).

Important parts of the central nervous system which affect the way we perceive the environment and our behavior are the limbic system and the prefrontal cortex of the forebrain. The limbic system includes the limbic cortex (the oldest part of the forebrain cortex), and associated structures such as the amygdaloid nuclei (amygdalae), the hippocampus, the septal nuclei, parts of the thalamus (anterior nucleus of the thalamus), and the hypothalamus. Even though each component of the limbic system performs a certain role, they are connected by pathways and they influence each other. The limbic cortex participates in imitating emotions, shaping motivational tendencies, learning, and memory. The amygdaloid nuclei act as "an alarm in our body" because they are responsible for aggression, fear, rage, and anger. If the amygdaloid nuclei are destroyed, the sense of fear is lost. Monkeys are a good example because they are very afraid of snakes, but this fear disappears with an amygdala nucleus lesion (Kovačević, Kostić, Andrić, & Zorić, 2005). In addition to these roles, amygdaloid nuclei are important for social interaction. In another experiment with monkeys whose amygdaloid nuclei were destroyed, it was confirmed that they reacted the same towards inanimate objects and living beings, so this syndrome was named "psychic blindness" (Uljarević & Nešić 2008). The septal nuclei have a role in experiencing pleasant emotions, and if they suffer a lesion, the person suffers many emotional disorders, including apathy and emotional instability. The hypothalamus is responsible for emotional and reproductive

behavior. It is very important because it controls the pituitary gland that produces hormones which control other endocrine glands, which is of crucial importance for normal functioning of the metabolism and for emotions.

The prefrontal cortex plays an important role in our memory. For a long time the prefrontal cortex was considered to have an important role in short-term memory, but some more recent studies have shown that the prefrontal cortex plays a role in different types of memory, including long-term memory (Luna, Padmanabhan, & O'Hearn, 2010). The prefrontal cortex is also known as the "executive brain". The information that our body collects with all the senses, partially processed and interconnected, reaches the prefrontal region of the brain via nerve fibers. Owing to the complex two-way communication between the prefrontal cortex and the lower parts of the brain, we receive information crucial for our ability to make decisions, to plan, to think logically, and to feel and experience what we call personality, as well as the features and abilities which make us social, communicative beings (Somerville et al., 2010).

It seems that among adolescents, different trajectories of the amygdaloid and septal nuclei, in relation to the control regions in the prefrontal cortex which mature later, result in inappropriate self-regulation of behavior. The difference between the maturation of the emotional system (limbic system) and control systems (prefrontal cortex) is probably the key neurological disharmony that leads to the unique behavioral profile of adolescents.

Human brain goes through intense development before birth and a few years after birth, but its development does not stop there, as it was previously thought. Brain scans show changes in the prefrontal cortex in the thirties and even in the forties. This may explain why adults sometimes act like teenagers, why they get angry or make a scene if something does not go the way they wanted, and why some people remain socially maladjusted even after their teenage period (Blakemore, 2008).

The volume of gray matter of the cortex, including the prefrontal cortex, increases in early childhood and reaches its peak in early adolescence. Boys reach that peak slightly later than girls, probably because boys reach puberty several years later than girls. During adolescence, the volume of gray matter suddenly decreases, which is a very important developmental process. Gray matter of the brain contains the bodies of nerve cells and the connections between nerve cells (synapses), so this decrease in gray matter volume is seen as elimination of unwanted and superfluous synapses, which is called synaptic pruning (Blakemore, 2008).

This process is not completely autonomous and it partially depends on the person's environment. After this process, the synapses which are used become stronger, and those which are not used in that particular environment are removed. It is a period in life when the brain is particularly

adaptable and easy to form, so it is a good period to express creativity and to learn. What is sometimes seen as a problem with adolescents (increased risk-taking, impulsiveness) should not be stigmatized. In fact, it reflects the changes that are happening in the brain, which provide an excellent opportunity for education and social development.

Adolescents are far more likely to use psychoactive substances, change sexual partners, partake in violent behavior, or be in a fatal car accident than people who are older than twenty-five. Such behavior does not represent a caprice, but the discrepancy between the different centers in the brain, which is particularly evident in this period of life. The experiments conducted on monkeys showed that around 35% of the brain structure is the so-called centers for reward, and about 5% of the brain consists of centers for punishment. Other parts of the brain (about 60%) are unrelated to these systems. If the electrodes stimulate the centers for reward, the person feels happiness and delight and will be very happy to have this stimulation repeated; if the electrodes stimulate the centers for punishment, people feel fear or panic, and they will try to avoid the re-stimulation of these centers however they can (Kovačević et al., 2005).

It is interesting that psychoactive substances stimulate the centers for reward, so, even though they know that these substances are harmful to their health, people have a need to take them again and thus become addicted to these narcotics. With adolescents this problem is even more evident, because the prefrontal cortex is not yet fully matured, hence the absence of "the voice of reason", which most adults have.

From the standpoint of physiology, puberty begins with the awakening of the diffuse neuronal network with gene expression for the precursor of the gonadotropin-releasing hormone (GnRH). The protein encoded with this gene is secreted and torn apart in order for the luteinizing-releasing hormone and inhibiting prolactin-releasing hormone to appear (Nešić, Kostić, Nešić, & Čičević, 2013). The luteinizing-releasing hormone stimulates the release of luteinized hormones (LH) and follicle-stimulating hormone (FSH), which are important for reproduction, whereas GnRH stimulates the growth of gonadal hormones, i.e. testosterone, estrogen, and progesterone during different stages in the process of maturation of the eggs, ovary, and uterus of women. These hormones are the end point of the hormonal cascade, which begins in the brain with the release of GnRH, which stimulates the release of FSH and LH (Nešić et al., 2013).

Continuous hormone release is characteristic of men and cyclic release is typical of women. In addition to sex determination and primary characteristics of the male sex, testosterone affects the production and maturation of sperm and the behavior of individuals. Testosterone is also present in women, but in considerably smaller quantities. This hormone increases the sexual libido, and since it is intensively secreted during puberty, it can be partially held responsible for risky behavior (unprotected

sex) and aggressiveness in adolescents. The general attitude of the majority is that men are more aggressive than women. The influence of culture and the expectation of how each gender should show aggression vary in relation to whether someone is male or female. However, these expectations are based purely on biological differences between the sexes. Experiments conducted on castrated rats, which became calmer after the intervention, have shown that aggression and sexual activity return to normal if they are injected with testosterone. On the other hand, the opposite happened when the rats were injected with the female sex hormone (estrogen) (Kovačević et al., 2005). In contrast to testosterone, the female sex hormone progesterone affects romantic feelings. Watching romantic movies, for example, raises the level of progesterone in the body by multiple times. The overall conclusion would be the following: male sex hormones increase the expression of aggressive behavior, while female sex hormones have the opposite effect. Of course, this rule does not always apply, especially not for humans, where the factor of experience or learning can greatly modify aggressive behavior.

In addition to sex hormones, many other hormones affect the social behavior of adolescents. Oxytocin, which stimulates the uterine muscles to contract during childbirth, also affects social bonding. Prolactin, a hormone which enables women to produce milk, has also been found in greater quantities in men who have a good bond with their children. Lower levels of cortisol, known as the "stress hormone" were found in boys with severe antisocial behavior. Two thyroid hormones (thyroxine and triiodothyronine) affect our mood, so people who have low or high levels of these hormones can have major problems with their temper (Andrić et al., 2006).

Another endocrine gland plays a very important role in the behavior of adolescents – the pineal gland. It secretes the hormone melatonin, which has a sleep-inducing effect. This gland is well developed in the young, which explains their need to sleep longer. Later in life, due to calcification, this gland starts to collapse and that explains why adults need less sleep than children.

In addition to the pineal gland, other endocrine glands also affect the circadian rhythm, which gives adolescents some additional abilities which adults do not have. The pituitary gland secretes the adrenocorticotropic hormone (ACTH), which affects the secretion of adrenal hormones – glucocorticoids (primarily cortisol). On the other hand, the core of the adrenal gland secrets increased levels of adrenaline. When it comes to humans, the intensity of ACTH secretion is the highest early in the morning (4 a.m. to 10 a.m.) and the lowest in the evening. Circadian rhythm of ACTH secretion is accompanied by secretion of cortisol. If the day (waking state) is extended to more than 24 hours, which is not a rare occasion when it comes to adolescents, the adrenal cycle and secretion of glucocorticoids

is also extended, but ATCH still retains the same pattern of secretion (Andrić et al., 2006). This partially explains their need for excitement, because they are much more exposed to adrenaline than adults, which causes new stressful situations.

THE EVOLUTIONARY BASIS OF ADOLESCENT RISK BEHAVIOR

Adolescence represents an evolutionarily preserved stage of development of the individual, characterized by specific changes, which may represent ontogenetic adaptation which enables independent survival. From the evolutionary perspective, the main function of adolescence is to reach the reproductive ability in order for genetic information to be transferred to our offspring. Sexual desire culminates in this period so adolescence is a period of competition with the aim of attracting a partner.

Even though risky behavior of adolescents poses a problem, pointing to the dysfunction of risk-taking cannot be considered an adequate basis for effective preventive activities (Frankenhuis & Del Guidice, 2012). In other words, the tendency to ignore the expected benefits of risk-taking prevents us from understanding why adolescents behave in that way. Moreover, it is clear that some types of social behavior which may result in long-term losses (unemployment, disability, or death) at the same time lead to quick "rewards" (popularity, more partners, sex at an earlier age). Aggression, early sexual activity, delinquency, and other types of risky behavior may have their evolutionary function.

Evolutionary biologists have developed a theory of life history (Life History Theory) in order to explain how and why living organisms, including humans, distribute their inherently limited resources (Ellis, Figueredo, Brumbach, & Schlomer, 2009). In the meantime, this theoretical concept has become very useful in explaining social behavior of people (Ellis et al., 2012). The basic idea of this theory is that all organisms are faced with trade-offs, because there are limited resources available, so the focus can be only on the most important goals. For example, the time spent on the job cannot be devoted to sleep; energy invested in parenting cannot be spent on meeting new partners. When and how a person distributes the resources at their disposal is their own life strategy. Analogous to the bank account, slow life strategies focus on saving money, while fast ones are focused on spending the money in a way which enables the transfer of the investor's genes. However, saving money is not a goal in its own right, meaning that slow life strategies are not focused on growth, development, and learning. Investing is an investment in future reproduction.

From the evolutionary perspective, faster life history strategies are primarily the result of the readiness of our brain (due to natural selection) to react to the relevant signs from the environment. According to Boyce and Ellis, conditional adaptation is a mechanism which recognizes and

responds to the specific characteristics of the environment, characteristics that have proven themselves reliable in predicting the nature of the social and physical world in which the children will grow up and which leads developmental trajectories which reliably correspond to those characteristics during the history of natural selection of our species (Boyce & Ellis, 2005). There were numerous examples during the process of evolution which support this idea. Thus, for example, an animal whose lifetime is short or whose living conditions are unfavorable (lack of food, frequent illnesses, and unstable climatic conditions) has a high reproductive potential, because the possibility of survival is small. High reproductive potential prevents the species from becoming extinct.

These rules also apply to humans, and when it comes to adolescents, the basic hypothesis is that negative environmental conditions contribute to the development of faster life history strategies (risky behavior). In this regard, the relevant environmental signs are living in poverty, exposure to violence, authoritarian parenting, and going to funerals several times during adolescence (Ellis et al., 2012). In other words, in unpredictable and dangerous environments, planning and investing in a secure future will not ensure the final goal, which is reproduction. Investing energy in the long-term goals is not profitable if the person is growing up in an environment where people do not live very long. In this regard, from the evolutionary point of view, faster life history strategies such as conceiving a baby during adolescence, risk behaviors, and discarding the future are reliable developmental responses to environmental signals that life is short and that future outcomes cannot be controlled or predicted.

Unlike traditional diathesis – stress theory, the theory of biological sensitivity implies that increased vulnerability to negative environmental impacts is at the same time a great opportunity for the achievement of developmental benefits in environments which are stimulating and rich in resources (Ellis, Boyce, Belsky, Bakermans-Kranenburg, & Van Ijzendoorn, 2011). Stressful environment does not hinder development as much as it directs and regulates it in the direction of strategies which are adaptive in stressful situations (or at least the ones which were adaptive during the evolutionary history of the humankind). Conditional adaptation is the basis of survival and reproductive strategies, so it enables competent functioning in different environments. For example, according to the theory of life history, the child's brain and body tend to respond to dangerous environments with faster development and life-style "here and now" (Ellis et al., 2009). From this perspective, adolescents who respond to dangerous environments through various forms of risky behavior (smoking, sex, drugs, and alcohol) are not less functional than adolescents who grow up in supportive environments and develop completely different behavioral patterns (Ellis et al., 2011).

The evolutionary approach to human development implies that gender differences in risk behavior culminate in adolescence. Gender differences in adolescent aggressive behavior can be explained by the principles of sexual selection. Within intrasexual selection (competition between individuals of the same sex, usually males, because the female is the limiting factor) there are different competitive confrontations, which represent all forms of behavior when the two individuals of the same sex meet (males fight for females) and competitive exploitation, and when there is no direct contact between the males, i.e. when they compete for the female by producing different sounds or performing a dance (mating dance). The most successful male will gain access to the female. These rules also apply to humans. During adolescence men resort to similar strategies in order to attract the attention of the opposite sex (competition in different sports and being witty); likewise, physical conflicts are not rare.

Intersexual selection is the interaction between individuals of different sexes, where the female usually plays a more important role, because in most cases she is the one who chooses. In the direct selection of partners, the females choose big, strong, and aggressively looking males, since they leave the strongest impression of good health. In the indirect selection of partners, females resort to different strategies to make sure that the male they choose is the right choice for their offspring. One strategy is to alert the dominant male in order to show that they are ready to mate. In this process, the females often resort to the strategy of playing hard to get in order to test the durability and the determination of the male. Women resort to similar strategies of indirect aggression such as gossiping, spreading rumors, and showing intolerance of their sexual rivals (Vaillancourt, 2013).

According to these facts, the conventional explanations of adolescent behavior are not sufficient for understanding this period of development. Seemingly, adolescent behavior is often irrational, reckless, and sometimes even extreme. However, the evolutionary perspective reveals the deeper motives and functions of risky behavior. Evolutionary biology does not imply that certain types of behavior are "good" or "bad", just as it does not imply that the slower life strategies are necessarily superior. Simply put, social behavior associated with different life strategies reflects the mechanisms designed to "get the most" out of one's circumstances.

SOCIAL-PEDAGOGICAL IMPLICATIONS

The paradox of adolescence – in the healthiest period of our life we develop a tendency towards endangering our own health – creates campaigns whose goal is to inform young people about the harmful consequences of risky behavior (Dahl, 2004). There are numerous educational programs throughout the world and all of them have the same goal, which is to make young people wiser. Although it is true that the situation would be

significantly more difficult if there were no educational interventions, there is a growing corpus of empirical evidence which indicates that educational programs are effective in improving knowledge, ineffective in improving the behavior of adolescents (Steinberg, 2008). The paradoxical fact that young people are usually aware of the risks they are exposed to leaves practitioners and scientists with no other choice but to continue in their efforts to design effective preventive interventions.

From the evolutionary perspective, early sexual activity, dropping out of school, or spending time with antisocial peers constitutes the development of reliable answers to environmental conditions (Ellis et al., 2012). The evolutionary approach can be contrasted to the developmental psychopathological model, which interprets socially undesirable and/or individually harmful behaviors as dysfunctional and deranged (Frankenhuis & Del Guidice, 2012). Instead, from the evolutionary perspective, an effective intervention means understanding the function of risk behavior in the context of adolescents' life.

Risky behavior can be adaptive, depending on what the person has experienced earlier in life, as well as on what they are likely to experience in the future. It is known that exposure to stress paradoxically affects the increased secretion of hormones which cause early puberty (Boyce & Ellis, 2005). Puberty usually starts earlier if the parents are often ill, they are addicts, or if they are divorced. The theory of evolution offers an explanation: our ancestors, who lived in a stressful environment, had to increase their reproductive success and they did it by accelerating physical maturation and initiation of sexual activity. In Western societies, the main indicator of severity and unpredictability of the social environment is the low socioeconomic status of the family (Ellis et al., 2009). The mechanisms which connect the low socioeconomic status of the family with the risky behavior of adolescents are conflicting family relationships, parenting quality (parents do not have time for their children), divorce of parents, and the type of neighborhood. Early prevention programs, which strengthen the family bonds, are a prerequisite for the prevention of fast and risky adolescent life strategies.

It is important to say that numerous changes in the social environment can have an iatrogenic effect. We will mention only two examples: the negative effect of juvenile detention centers and the influence of the media on the youth. Although the re-socialization role of juvenile detention centers is fully justified, their impact is often reduced to labeling and stigmatization of juvenile offenders (Gatti, Tremblay, & Vitaro, 2009). In this sense, any intervention which places a juvenile delinquent in that kind of environment risks inducing deviant peer socialization. Another striking example is the messages from the media to which they are exposed. Evolutionary logic implies that exposure to media content which places an emphasis on danger and uncertainties in the social environment can

influence adolescents to develop faster life strategies, which will be manifested through early sexual activity and orientation towards immediate rewards, not through investing in the future

According to the postulates of the evolutionary model of adolescence, preventive interventions must focus on the adaptive function of adolescent risk behavior. Like no other current theoretical perspective, evolutionary biology explains why adolescents do what they do. For example, it is known that aggressive behavior is an effective way to gain social status and power. Contrary to conventional stereotypes, in most cases violent pupils are more popular within the peer group and they use an appropriate balance of antisocial and prosocial behavior, which allows them to be dominant (Popadić, 2009). Some authors point out that the youth who are not prone to antisocial behavior during the adolescent period, start to behave in the same way as their delinquent peers in order to gain a prestigious position in the group (Moffitt, 1993). This hypothesis is supported by studies which show that female adolescents who use indirect aggression are more intensely involved in romantic relationships (Vaillancourt, 2013).

The effectiveness of socio-pedagogical interventions is conditioned by their congruence with the motivational tendencies of adolescents. An illustrative example is a Finnish school-violence prevention program (Kärnä, Voeten, Little, Poskiparta, Kaljonen, & Salmivalli, 2011), which is based on two basic theoretical and empirical theses: bullying is at least partially motivated by the promise of high status and power, and violent behavior is a group process and peers exert a strong influence over its sustainability in the school environment. The goal of this program is to make changes through the positive behavior of peers, which will reduce potential rewards for violent students and therefore their motivation to behave is such a way. The results of the survey, which was conducted in 78 schools, show the effectiveness of the program (Kärnä et al., 2011). On the other hand, the zero tolerance policy towards violent behavior of pupils, with no changes in the school environment, can push the students to behave antisocially outside the school.

The dominant hypothesis, based on recent neurobiological findings, is that the full maturity of the prefrontal cortex (responsible for the conscious control of behavior) is not reached until the age of thirty, which is why we cannot expect adolescents to always maintain control over their actions. One of the researchers (Dahl, 2004) uses a metaphor of a car with a turbo engine (stronger emotions and the need for excitement), which belongs to an inexperienced driver (adolescent with underdeveloped skills of self-control). However, the researchers who deal with the resilience and the positive development of the youth urge schools to put the primary focus on developing social and emotional competence of their students (Ninković, 2010). Social and emotional learning is the process through which we learn to recognize and control our emotions, to care for others, to make good

decisions, to act responsibly, to develop positive relationships and to avoid negative behavior (Zins & Elias, 2007). The key abilities developing through social and emotional learning are self-awareness, social awareness, responsible decision-making, self-regulation, and relationship management. It is necessary to invest in the professional development of teachers in order to coordinate between academic, social, and emotional learning in schools.

Different theoretical and empirical perspectives provide different insights into the complexity of the phenomenology of risky behavior among young people. We believe that evolutionary biology and social neuroscience emphasize that the social behavior of the youth is caused by the reciprocal influence divided between adolescents, their biology, family, school, community, and culture. Moreover, their implicit message is that it is necessary to make the shift from the defects and pathology of individuals towards their strengths and the resources of their social environment. On the other hand, it is necessary to design better interventions, which should be based on goals and tendencies of adolescents.

CONCLUSION

Neurobiological interpretation of adolescent risk behavior was enthusiastically adopted by many scientists who continue to popularize the recent discoveries about the brain of adolescents. However, caution is advised because adults should not use the incomplete development of the adolescent brain as an explanation for everything that that they see as troubling among young people, from prolonged sleep to risky activities. In this regard, it is necessary that this two-component model of adolescent risk behavior does not become something that is set in stone.

Although the research in the field of social neuroscience has made a big step forward in describing the neurobiological processes present in the basis of social behavior of adolescents, we believe that it is not enough to create a comprehensive intervention which will lead to a more responsible adolescent behavior. Additional answers to this problem may be found in the postulates of evolutionary biology, which provide a new perspective of what is already known about adolescence, raise new questions, and offer a unique platform for the creation of potentially effective preventive interventions.

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ЕВОЛУЦИОНО-НЕУРОРАЗВОЈНЕ ОСНОВЕ РИЗИЧНОГ ПОНАШАЊА МЛАДИХ: СОЦИЈАЛНОПЕДАГОШКЕ ИМПЛИКАЦИЈЕ

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Резиме

Рад анализира различите теоријске приступе проблему ризичног понашања младих. Аутори констатују да је неуспех већине досадашњих програма превенције, заснованих на стереотипној претпоставци да су адолесценти ирационални и непромишљени, условио нова концептуална и практична разматрања тог питања. У супротности са таквом позицијом, еволуциона биологија и социјална неуронаука се према социјалном понашању младих одређује на суптилнији начин, апострофирајући чињеницу да су адолесценти обично свесни ризика и потенцијално штетних последица својих поступака, али му ипак прибегавају и због тога не брину превише.

Адолесценција је период који карактеришу различите понашајне промене које обликују младу особу све до момента када она улази у свет одраслих, зрелих људи. Ову животну фазу одликују чести конфликти са родитељима, борба за статус у друштву, тенденција за привлачење партнера, а све то углавном на начин који подразумева неки вид ризика. Очито је да, чак и тако буран период у

сазревању младих има неку еволуциону предност, јер је остао сачуван до данас. Иако ризик са собом носи потенцијално штетне последице, он уједно пружа могућност за бројне бенефите које адолесценти далеко више вреднују од самог ризика.

Ризичном понашању младих доприноси несклад у сазревању различитих делова мозга. У раду се посебно истиче касније сазревање префронталног кортекса, који представља извршни мозак јер је одговоран за процесе логичког мишљења, планирања и одлучивања, у односу на лимбички систем који је највећим делом одговоран за емоције. Хормоналне промене, које карактеришу пубертет, такође доприносе ризичном понашању младих. Посебно треба истаћи промене које се односе на излучивање полних хормона. По правилу мушки полни хормони су одговорни за агресивно понашање, док женски полни хормони имају супротан ефекат. Међутим, код људи веома важну улогу игра и окружење, односно искуство које у великој мери може да модификује ове видове понашања.

Са аспекта еволуционе биологије, главни циљ је репродукција, односно преношење гена на потомство, како би се продужила врста. Стратегије за остварење овог циља су различите и зависе од социјално-економских услова у којима особа одраста. Уколико су периоди детињства и адолесценције испуњени несигурностима, сва је прилика да ће особа пре ступити у сексуалне односе, биће склонија проблемима у понашању и чешће ће преузимати ризик, како би испунила циљ о репродукцији. Међутим, ако су услови живота бољи и угоднији, доминантно ће се примењивати спорије, мање ризичне животне стратегије .

Имајући на уму изнете карактеристике у раду обрађених приступа, као суштинске социјалнопедагошке импликације означене су: 1) превентивне интервенције морају бити усклађене са емоционалним и мотивационим тенденцијама младих; 2) програми превенције ризичног понашања адолесцената морају бити обележени јачим координисањем академског, социјалног и емоцијалног учења; 3) неопходно је померити фокус на свеобухватне интервенције које ће промовисати позитиван развој младих, а не само спречавати негативне исходе.