

THE ROLE OF PLAY IN JUVENILE DEVELOPMENT FROM THE EVOLUTIONARY PERSPECTIVE

Ioan TRIFA*

Universitatea din Oradea
Corresponding author: nelu.trifa@gmail.com

Dan DELIU

National University of Physical Education and Sports
anjvb@hotmail.com

Abstract: The evolutionary approach suggests the juvenile period exists precisely in order to facilitate play, and its length will be proportional to the complexity of behaviors and the time necessary for the development and maturation of the nervous system. Play, as a specific form of behaviour manifestation, represents the expression of the way the nervous system was structured during the evolution of the species, which will have an automatic expression depending on the degree of development or maturation of some systems and the conditions of the social and physical environment. From this perspective, play fulfills during the stages of juvenile development many functions meant to facilitate adaptation to environment conditions and increase chances of survival in conditions of autonomous existence.

Key words: play; juvenile development; adaptation; survival.

Rezumat: Abordarea evoluționistă sugerează că perioada juvenilă există tocmai pentru a facilita jocul, iar lungimea acesteia va fi direct proporțională cu complexitatea comportamentelor și timpul necesar pentru dezvoltarea și maturizarea sistemului nervos. Jocul, ca formă specifică de manifestare comportamentală, reprezintă expresia modului în care a fost structurat sistemul nervos de-a lungul evoluției speciei, ce va avea o exprimare automată dependentă de gradul de dezvoltare sau maturare al unor sisteme și de condițiile din mediul fizic și social. Din această perspectivă, jocul îndeplinește în stadiile dezvoltării juvenile numeroase funcții menite să faciliteze adaptarea la condițiile de mediu și să sporească șansele de supraviețuire în condiții autonome de viață.

Cuvinte cheie: joc; dezvoltare juvenilă; adaptare; supraviețuire.

* * * * *

INTRODUCTION

The evolutionary theory and future developments in the field of ethology, psychology and neurology, are based on the assumption that the body adapts and evolves by natural selection, under the pressure of physical and social environment. These adaptations are meant to respond to vital issues for the survival and reproduction of the individual and of the species, and to understand the structure and functions of such an evolved biological system as the brain we will need to discover what challenges were subjected our ancestors in the course of the evolution.

Charles Darwin used the phrase “the hostile forces of nature” to describe the elements that will impose the greatest challenges to the survival of the organism. Thus, the survival of the body

* Corresponding Author

presumes: *struggles with the physical environment*, represented by some extreme conditions that may occur; *struggles with other species*, where we can include species of predators or hunting or different species, like parasites; and *struggles with conspecifics* (Buss, 2005, p.175). In such confrontations a big part of the immediate energetic and mental resources will be assigned (emotional-cognitive), that go beyond the event it self (cognitive-motivational) in order to overcome the situation and to be better prepared for such events. Repeated confrontations with these recurring problems, from the *environment of evolutionary adaptations* (EEA), will “shape” the brain, in the most proper sense, and with each generation of these transformations will become more profound. In this view, different *adaptive psychological mechanisms* will be activated only in certain specific contexts of the environment (Friedenberg, Silverman, 2006; Buss, 2005).

The evolutionary psychology argues that understanding the psychological mechanisms will require understanding the adaptive functions for which they were created, reflected by certain traits or different patterns of behavior. However, due to the fact that not all these properties (traits or behaviors) are the products or effects of some adaptations, it is necessary, like an engineer who works in reverse, to determine whether a property of a body is an element of “construction”, i.e. an adaptation (adaptations), a secondary function of that product (*by-product*) or a random effect (*noise*), (Buss, 2005; Bjorklund, Pellegrini, 2000).

John Tooby and Leda Cosmides say that “of the three kinds of properties, adaptations are the most important and illuminating because they explain why a system has certain parts, why these participate in certain cause-and-effect relationships with one another, and why they interact with the world in the way that they do. Adaptations are problem-solving machines and can be identified using design evidence” (2005, p.26), while the other two are produced by epigenesis by the interaction of the genotype with the environment in the course of individual development (Buss, 2005, 2008; Gottlieb, 1992). The variations of some behaviours within the same species can show how certain conditional aspects may be affected by experience or by historical circumstances of the whole period of the life cycle, that define personal history or “life history” (Buss, 2005).

Life History was established as an integrated theory of psychology and provides the analytical framework used to see how in front of these transactions with the environment, the body must assign time and energy to various tasks in a manner that will maximize its potential (Kaplan, Gangestad, 2005). Kaplan and Gangestad will argue that “optimal allocations vary throughout life therefore what is particularly interesting are the evolutionary forces that shape the calendar of involved events during the periods of growth, development, reproduction and aging” (2005, p.69).

The juvenile period has acquired a special importance due to the implications that the length and events that pertain to this period will have on the chances of survival and reproduction. A central aspect of these preoccupations is identifying the different conditions in which the delay in sexual maturation or an extended juvenile period can have adaptive properties for certain species (Pereira, 2002). The juvenile period is conceived as being the time interval in which the offspring are considered too old to receive direct nurture (having some chances of independent survival), but haven’t yet reached sexual maturation or are too young to reproduce (Pereira, 2002). Humans, as opposed to non-humans, present a longer period of immaturity, exhibited between birth and maturity, extended across four stages of development: infant, childhood, juvenile and adolescence. The infantile period and the juvenile period are shared with other species of mammal and especially of primates. However, childhood and adolescence are stages of development that are specific to humans. These specifically human stages have evolved due to the advantages they confer, such as “increasing the fertility of the parents and reducing the mortality of their offspring” (Bogin, 2010, p.379). The juvenile period or the period of extended immaturity is often interpreted as being necessary for “modulation of growth and the onset of reproduction” (Pereira, 2002, p.26) and for the development of sophisticated cognitive capacities, necessary in complex social ecologies (Walker et al., 2006).

In the same way, Karl Gross stated that “this period of human immaturity exists precisely to facilitate the play” and that “there is a correlation between the length of the play period and the possible complexity of the organism” (Rathunde, Csikszentmihalyi, 2006, p.508). Sergio Pellis and the collaborators, having undertaken numerous studies related to the play, come to the conclusion that primates have a more developed brain, the juvenile period is longer absolutely necessary to acquire more practical and social skills (Pellis, Iwaniuk, 2002; Pellis, Iwaniuk, 2004; Bekoff, Pierce, 2009). Kerrie Lewis (2005) finds that there is a significant positive correlation between the social play of the primates and the size of the neocortex, which is not found in other forms of play. Comparative studies carried out by Lewis and the collaborators, on different species of primates, suggests that the level of development of the neocortex, cerebellum, hypothalamus and the amygdala nucleus, can be good predictors for the frequency of social play. Also, Jaak Panksepp (2004) will argue that the abundance of play fighting during the childhood development, but mostly between three and six years, may facilitate the maturation of the frontal cortex and of the cortical executive processes.

THE PLAY AS EVOLUTIONARY ADAPTATION

In the evolutionary approach, the play behaviour includes three main categories of manifestations: the locomotion play, the play with objects and the social play. In reality, these distinctions are often blurred by the fact that the play behaviour includes almost always several categories of events. For example, the specialized literature shows a form of play called *rough-and-tumble play*, which includes play chasing and play fighting (Carvalho, Smith, 1996; Sheets-Johnstone, 2003; Fry, 2005), manifestations that are ubiquitous and represent the most common form of interaction in young mammals (Fry, 2005; Pellis, Pellis, 2006). This form of play is associated with a high consumption of energy and time, which will affect the resting time or the one intended for feeding (LaFreniere, 2011; Bjorklund, Pellegrini, 2000), plus the possible risks of exposure to attacks from predators, or to suffer some injuries which in nature may also be incompatible with the survival (Smith, 2010; Burghardt, 2005; Biben, 1998). Robert Harcourt finds that the risk of falling victim to predators during the play can be surprisingly large (Brown, 2009). In a field study regarding the seals (*Arctocephalus australis*) from South America, Harcourt notes that the time spent by the pups on playing is just 6% and however approximately 85% of them, namely 22 babies of a total of 26 were captured by sea lions while playing (Lewis Graham, Burghardt, 2010; Brown, 2009). Because of these “costs” the play should be an evolutionary adaptation, aimed to bring great benefits as long as animals or the species which have a higher rate of play are not disadvantaged, and the action of natural selection either has not been oriented towards the removal of these manifestations either has favored those behaviours whose benefits clearly outweigh the associated costs (Campbell, 2005; Bateson, 2005; Smith, 2010; LaFreniere, 2011).

The play is often seen as a means of refining the skills needed in adulthood. Karl Groos's vision, that the child has the tendency to exercise the skills needed in adult life, remained for a long time the central aspect for understanding the contribution of play fighting in the behaviour's development. As a result, the play will be seen as an immature version of an adult's behaviour, and the main function of the play will be understood as “the scaffold” for building the behaviour, which falls apart once the construction will be completed (Bateson, 2005). According to Patrik Bateson (2005) this vision provides only a partial picture on the functions of the play while the half-constructed behaviours are not reliable, and the living being needs to survive and to find resources for the continuation of the “construction”.

In nature we can find enough behaviors that can be seen as adaptations and can fulfill functions which correspond to particular stages of development experienced by certain species (Burghardt, 2005). Among the best known behaviours of this kind is the *impinting*, presented by Konrad Lorenz, whereby goslings will follow almost any moving object (their own mother, a duck

or people) and to which they will develop a form of attachment. Lorenz believed that this behaviour is an adaptation that increases the chances of survival, because in this way the goslings find food and protection (Shaffer, Kipp, 2010; Björklund, Hernández Blasi, 2005). Many of the behaviours that animals or people carry at a time, can be understood more as adaptations to the stage of development where they can be found than as behaviours of preparation for adult life (Burghardt, 2005), but this fact does not preclude the possibility that in childhood to be set the basis for behaviours that will become viable only in adulthood (Björklund, Pellegrini, 2000; Björklund, Hernández Blasi, 2005).

The play is an activity that has the highest incidence in childhood, but may extend until quite late in the adult stage in most mammals, and especially in humans. Some manifestations of the play may appear quite early, and after achieving a peak, they dwindle (or may disappear), while other forms of play can appear, which suggests that the play serves to some functions that are closely related to the degree of maturation of systems (Burghardt, 2005). The acquisitions that occur in the play activity can bring some immediate benefits, but sometimes it takes multiple transformations before the result to be visible or to become fully functional (Burghardt, 2005; Smith, 2010). Today, we know enough cases in which early experience is essential for the expression of some later behaviours (Wiedenmayer, 2010) and which can be hardly recovered if they exceed the critical period of development or that optimal window of accomplishment (Byers, 1998). In fact, a prolonged period of immaturity can make on the one hand that the privation of certain specific experiences for a limited period, not to lead to such a great retard in development, and on the other hand to allow ample transformations that will contribute to a higher effect of adaptation (Björklund, 1997; Björklund, Bering, 2003).

The biological phenomenon by which certain evolutionary effects are induced through the extension of the period of development of an animal or organism is known as *neoteny* (Lewin, 2005; Björklund, 1997). Neoteny is translated like “extended youth” and determines the retention of some juvenile characteristics into adulthood (paedomorphism), (Gottlieb, 1992; Wesson, 1997; Björklund, 1997; Brown, 2009). These transformations will be reflected into a higher degree of phenotypic plasticity, which favors the construction of some adaptations that will respond to changes in the environment in which it must survive (Hochberg et al., 2010; Björklund, Bering, 2003; Burghardt, 2002) and can be even more important as the ecological environment is more variable or more unstable (Burghardt, 2005; Pellegrini et al., 2007). As a result of a comparative analysis, Sergio Pellis and Andrew Iwaniuk (2004) have found that rodents that present a more complex form of play fighting present at birth a lower level of maturation of the brain. This association is supported also by the acknowledgment that adults of primate species in which a large proportion of the brain grows after birth engages in a considerably higher number of fight rounds in the form of play (Pellis, Iwaniuk, 2004).

The prevalence of the play and the forms of manifestations from juvenile stages, suggest that this is used to build and to evaluate the behaviours that are necessary in this sensitive period, but which can be subjected to multiple transformations in order to respond better to the changes in the living environment. According to David Björklund the play can be seen as “a vehicle through which the neoteny influences the development” (1997, p. 157), the play providing a great behavioural flexibility constituting a permanent source of development and innovation. One can find enough edifying examples in specialized literature or even in personal life, but I was strongly influenced by a particular story, presented by Stuart Brown in the book *Play: How it Shapes the Brain, Opens the Imagination, and Invigorates the Soul* (2009). Brian La Doone will surprise a meeting between a polar bear raised in the wild and one of the sled dogs used by it to move in the vast region of Northern Canada. La Doone relates that it was relatively easy to predict what was going to happen when a specimen of half a tone of a ferocious species, which seemed pretty hungry, walked in a hurry to this tethered dog whose name was Hudson. Surprisingly, Hudson

won't use the anticipated reaction of "fight or flight", instead it bends, bowed and wagged his tail, movements that are apparently recognized by other dog as signs of play. Even more surprising is that the bear responds to these signals, and the two will launch in this kind of play in which the combatants make wide movements and completely harmless, they fight, roll, and change positions, instead of an expected dispute on life and death. After about fifteen minutes of play, the bear and the dog split up, but the bear would return every night for a week for other rounds of play with its new friend (Brown, 2009). Outstanding in this story is how this dog proves the ability to manage its own interest in a limit situation in which any misunderstanding or unsynchronization, can have fatal consequences.

In the absence of conclusive proofs related to the contribution of the play behaviour to the increasing chances of survival, we might be tempted to see this case as a simple incident. Studies undertaken by Robert Fagen and Johanna Fagen (2004, 2009) show that at least in the case of brown bears (*Ursus arctos*), the play can increase the survival rate in the first year of life and in independence conditions. The resulting data after ten seasons and over six hundred hours of observations have revealed the existence of a positive correlation between the frequency and the time spent playing by the bear cubs and their survival rate. After a complex statistical analysis that controls the potential contribution of other factors such as the physical condition, the frequency of play, the abundance of food and the maternity care, it is found that the time spent playing is a remarkable contribution to increasing the survival rate. Into a concise model that eliminates the effect of the main factor (physical condition) over the play time and the survival rate, and thus for an increase of 1% of the play time it can be produced an expected increase of 18% of the survival rate in independence conditions (Fagen, Fagen, 2009). Even if one cannot highlight a direct link or a causal link between the time spent playing and the survival rate, these discoveries indicate that the play brings special benefits during different stages of development, benefits that are ultimately designed to maximize what we call *inclusive fitness*. The survival rate of bear cubs will directly depend on the personal attributes of each of them, such as the ability to detach and use some relevant information in specific situations they experience, the capacity to adapt their behaviour to situational context and the flexibility of behaviour, the ability to co-operate or co-exist with other bears (Fagen, Fagen, 2009).

CONCLUSIONS

The evolutionary perspective changes completely the way the play has been seen over the time (see Trifa, 2013). The play is no longer regarded only as a practice for necessary behaviours in adulthood because it brings particular benefits during the various stages of development and for the survival under autonomous conditions of life. Many researches bring irrefutable evidences on the contribution of the play in the development of cortical regions and subcortical structures of the brain (see Panksepp, 2004; Lewis, 2005; Bell, Pellis, Kolb, 2010). At the same time, the deprivation of play in certain stages of juvenile development can have fatal consequences on the development of cognitive and emotional capabilities or for the expression of social behaviours, which can hardly be recovered if they exceed the critical period of development or that optimal window accomplishment (Byers, 1998).

The play is considered an evolutionary adaptation, and the manifestations of the play are designed to facilitate those experiences that are essential for the individual's adaptation to environmental conditions of life. The events during the play can be extremely different and tend to reflect the most important adaptation problems encountered by an individual in the development stage that is at a time.

CONFLICT OF INTERESTS

Nothing to declare.

REFERENCES

- Bateson P. (2005), The Role of Play in the Evolution of Great Apes and Humans. In Pellegrini A. D., Smith P. K. The nature of play. Great apes and humans. New York: Guilford; 13-24.
- Bekoff M., Pierce J., (2009), Wild Justice: Honor and Fairness among Beasts at Play. *American Journal of Play*; 1 (4): 451-475.
- Bell H., Pellis S. M., Kolb B. (2010), Juvenile peer play experience and the development of the orbito-frontal and medial prefrontal cortices. *Behav Brain Res*; 207(1): 7-13.
- Biben M. (1998), Squirrel monkey playfighting: making the case for a cognitive training function for play. In Bekoff M., Byers J. A. (eds.), *Animal Play: Evolutionary, Comparative, and Ecological Perspectives*. Cambridge: Cambridge University Press; 161-182.
- Björklund D. F. (1997), The Role of Immaturity in Human Development, *Psychological Bulletin*; 122(2): 153-169. <http://dx.doi.org/10.1037/0033-2909.122.2.153>
- Björklund D. F., Bering J. M. (2003), Big brains, slow development, and social complexity: The developmental and evolutionary origins of social cognition. In M. Brune, H. Ribbert, W. Schiefelhoevel (Eds.), *The social brain: Evolutionary aspects of development and pathology*. New York: Wiley; 133-151.
- Björklund D. F., Pellegrini A. D. (2000), Child Development and Evolutionary Psychology, *Child Development*; 71: 1687-1708.
- Björklund D. F., Hernández Blasi C. (2005), Evolutionary Developmental Psychology, In Buss D. M. (Eds.), *The Handbook of Evolutionary Psychology*. New Jersey: John Wiley & Sons; 828-850.
- Bogin Barry (2010), Evolution of Human Growth. In Michael P. Muehlenbein (eds.), *Human Evolutionary Biology*, Cambridge: Cambridge University Press; 379-395.
- Brown Stuart with Vaughan Christopher (2009), *Play : How It Shapes The Brain, Opens The Imagination, And Invigorates The Soul*, New York: Penguin Group.
- Burghardt G. M., (2002), Genetics, Plasticity, and the Evolution of Cognitive Processes. In M. Bekoff, C. Allen, G. M. Burghardt (eds.), *The cognitive animal: empirical and theoretical perspectives on animal cognition*, Cambridge: MIT Press; 115-122.
- Burghardt G. M. (2005), *The Genesis of Animal Play. Testing the Limits*. MIT Press, Cambridge: Bradford Books.
- Buss D. M., (2005), *The handbook of evolutionary psychology*, New Jersey: John Wiley & Sons.
- Buss D. M., (2008), *Evolutionary psychology: the new science of the mind*, 3rd ed., Boston: Pearson Education.
- Byers J. A., (1998), Biological effects of locomotor play: getting into shape, or something more specific?. In Bekoff M., Byers J. A. (eds.), *Animal Play: Evolutionary, Comparative, and Ecological Perspectives*. Cambridge: Cambridge University Press; 200-220.
- Campbell A. (2005), Aggression. In Buss, D. (eds.) *Handbook of Evolutionary Psychology*. New Jersey: John Wiley & Sons; 628-652.
- Carvalho A. M. A., Smith P. K. (1996), Playfighting, playchasing and affiliation in 5 years old children: a contribution to the discussion of functional implications of play behaviour, *Biotemas*; 9 (1): 19-37.
- Fagen R., Fagen J. (2004), Juvenile survival and benefits of play behaviour in brown bears, *Ursus arctos*. *Evolutionary Ecology Research*; 6: 89-102.
- Fagen R., Fagen J. (2009), Play behaviour and multi-year juvenile survival in free-ranging brown bears, *Ursus arctos*. *Evolutionary Ecology Research*; 11: 1-15.
- Friedenberg J., Silverman G. (2006), *Cognitive science : An Introduction to the Study of Mind*, London: Sage Publications.
- Fry Douglas P. (2005) Rough-and-tumble social play in humans. In A. D. Pellegrini & P. K. Smith (Eds.), *The nature of play: Great apes and humans*. New York: Guilford; 54-88.
- Gottlieb Gilbert (1992), *Individual development and evolution: The genesis of novel behavior*. Oxford: Oxford University Press.
- Hochberg Z., Feil R., Constancia M., Fraga M., Junien C., Carel J. C., Boileau P., Le Bouc Y., Deal C. L., Lillycrop K., Scharfmann R., Sheppard A., Skinner M., Szyf M., Waterland R. A., Waxman D. J., Whitelaw E., Ong K., Albertsson-Wikland K. (2011), Child Health, Developmental Plasticity, and Epigenetic Programming. *Endocrine Reviews*; 32(2):159-224.
- Kaplan H. S., Gangestad S. W. (2005), Life History Theory and Evolutionary Psychology. In D. Buss, *The handbook of evolutionary psychology*, New Jersey: John Wiley & Sons; 68-95.

- LaFreniere P. (2011), Evolutionary Functions of Social Play. Life Histories, Sex Differences, and Emotion Regulation, *American Journal of Play*; 3 (4): 464-488.
- Lewis Graham K., Burghardt G. M. (2010), Current Perspectives On The Biological Study Of Play: Signs Of Progress. *The Quarterly Review of Biology*; 85(4): 393-418.
- Lewis Kerrie P. (2005), Social Play in the Great Apes, In A. D. Pellegrini & P. K. Smith (Eds.), The nature of play: Great apes and humans, New York: Guilford; 54-88.
- Panksepp Jaak (2004), *Textbook of biological psychiatry*. New Jersey: Wiley-Liss.
- Pellegrini A. D., Dupuis D., Smith Peter K. (2007), Play in evolution and development. *Developmental Review*; 27: 261–276.
- Pellis S. M., Iwaniuk A. N. (2002), Brain system size and adult–adult play in primates: a comparative analysis of the roles of the non-visual neocortex and the amygdala. *Behavioural Brain Research*; 134: 31–39.
- Pellis S. M., Iwaniuk A. N. (2004) Evolving a Playful Brain: A Levels of Control Approach, *International Journal of Comparative Psychology*; 17(1): 92-118, <http://www.escholarship.org/uc/item/23d5q25x>.
- Pellis, S. M., Pellis, V. C. (2006), Play and the development of social engagement: A comparative perspective. In Marshall P. J., Fox N. A. (Eds.), The Development of Social Engagement: Neurobiological Perspectives. Oxford University Press: Oxford; 247-274.
- Pereira E. M. (2002), Juvenility in Animals. In Michael E. Pereira, Lynn A. Fairbanks (eds.), Juvenile Primates: Life History, Development and Behavior, London: Oxford University Press; 17-27.
- Rathunde K., Csikszentmihalyi M. (2006), The Developing Person: An Experiential Perspective. In Damon W., Lerner R. M. (eds.), Handbook of child psychology, New Jersey: Wiley & Sons; 465-515.
- Sheets-Johnstone M. (2003), Child's Play: A Multidisciplinary Perspective, *Human Studies*; 26: 409-430.
- Shaffer D. R., Kipp K. (2010), *Developmental Psychology: Childhood and Adolescence*, Eighth Edition, Published by Wadsworth, Cengage Learning, Belmont.
- Smith P. K. (2010), *Children and Play: Understanding Children's Worlds*, Oxford: Wiley-Blackwell.
- Tooby J., Cosmides L. (2005), Conceptual Foundations of Evolutionary Psychology. In D. Buss, The handbook of evolutionary psychology, New Jersey: John Wiley & Sons; 5-67.
- Trifa, I. (2013), Abordarea jocului din perspectivă istorică, *Analele Universității din Oradea, Fascicula Educație Fizică și Sport*, Editura Universității din Oradea; 149-155;
- Walker R., Burger O., Wagner J., Von Rueden C. R. (2006), Evolution of brain size and juvenile periods in primates. *J Hum Evol*; 51(5):480-489.
- Wesson R. G. (1997), *Beyond Natural Selection*, Cambridge: MIT Press.
- Wiedenmayer C. P. (2010), Plasticity of defensive behavior and fear in early development. *Neurosci Biobehav Rev*; 33(3): 432–441. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2671008/>