

Neuropsychological Fundamentals of Envy

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Abstract: *The article deals with psychogenetic and neuropsychological principles of envy. Its originality lies in the fact that envy is seen as an unpleasant emotion and feeling, and a negative attitude, projected onto another person who, compared to the object of envy, has certain advantages, opportunities, or is in a more favourable position (social, psychological, physical, financial). Besides, the article analyzes theoretical-empirical and experimental studies on envy, its neuropsychological aspects and influence on the functioning of the brain. It shows prerequisites (genetic and social) for envy as an emotional experience and analyzes the role of social comparison in generating and consolidating envy. The article discusses describes the neuropsychological localization of envy in brain structures and the role of mirror neurons in the formation of envious impulses. It also theoretically proves that envy as a mental reaction is a situational and short-term feeling of dissatisfaction aroused by someone else's possessions, qualities or luck, which is manifested in a strong desire to have them for oneself right away. Social comparison (not in one's favour) causes a profound drop in self-esteem, which the brain perceives as physical pain. This triggers specific mechanisms of imaginary psychological compensation when someone else's defeat is perceived as one's victory. Short-term envious reactions are based on the natural action mechanism of mirror neurons in the brain that come from "imitative desire", important for survival. Neuropsychologists have traced the overactivation of mirror neurons responsible for assessment and motivation in those people whose experience of envy is frequent and long-term. The article suggests possible ways of envy psychocorrection based on the neuropsychological mechanisms of its formation.*

Keywords: *envy as a reaction, envy, "pain from comparing", mirror neurons, impulsiveness.*

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Introduction

Envy is a perennial problem of rivals, competitors, friends, people with similar interests and values, and sometimes even relatives. However, the stimulation of envy is one of the most powerful motivators, and a manipulation mechanism, consciously or unconsciously used by politicians, producers of goods, services and advertisers to achieve their goals.

The phenomenon of envy is mentioned, however, in many personality theories of different areas in psychology: classical psychoanalysis (Freud, 2007; 2016; Klein, 1997; 1999); individual psychology (Adler, 1997); humanistic psychoanalysis (Fromm, 2003; 2012); socio-cultural theory (Horney, 2019). The international relevance of the article is as follows: depending on which scientific approaches are used, envy is theoretically considered as a competitive attitude towards others; hostile feelings or attitudes; the feeling of annoyance; special forms of anxiety and frustration; a form of personal aggression; a defensive reaction; manifestations of achievement motivation and unhealthy perfectionism; high levels of harassment and narcissism; manifestations of inferiority or immaturity. Available definitions of envy are somewhat similar since they describe it as an unpleasant emotion and feeling, and a negative attitude, projected onto another person who, compared to the object of envy, has certain advantages, opportunities, or is in a more favourable position (social, psychological, physical, financial) (Lisovenko, 2017; 2018).

Nowadays, it is crucial to analyze envy in the context of its century-old status as a significant component of interpersonal relationships. There are numerous studies on this very concept in European scientific discourse.

Despite the predominant negative connotation of envy, as noted by Suri et al. (2014), functional envy can play a positive role, stimulating the spirit of rivalry, competition, success, changes in one's social status. This fact helps to explain the causes of this phenomenon. Kleef (2010) justifies such duality with a positive or negative impact of envy on self-awareness and well-being, one's attitude to others and behaviour caused by different conditions. Schwaerzel et al. (2002) consider envy in correlation with jealousy, hatred, compassion and competition.

At the same time, all the mentioned researchers view this phenomenon as a personality trait, which validates the importance of this article.

Prerequisites (Genetic and Social) for Envy as an Emotional Experience

The first scientific attempts at theoretical-methodological analysis of the envy problem belong to the psychoanalytic school of thought. According to Freud's (2007; 2016) psychoanalytic theory of personality, envy is seen as an expression of death instincts and the earliest manifestation of aggression within object relations, in particular, in the insurmountable and ongoing Oedipus complex as a contradiction in child-parent relations affecting other periods of life and types of relationships. Freud (2007; 2016) expressed the idea of "male sexual jealousy" as the basis for shaping female sexuality. In adulthood, the conflict is resolved by a woman's attempt to compensate for her inferiority through the desire to give birth. However, the authors of this article cannot agree with this motive of motherhood.

Besides, Freud (2007; 2016) believed that envy is the real basis of many attitudes, such as "the spirit of community", which leads to the demand for "justice", solidarity and equality of all. What appears in society in the form of "public spirit" is caused by what was originally envy, i.e., no one should stand out, and everyone should be the same and have the same things. Freud (2007; 2016) noted that a social feeling is based on reversing what was originally a hostile feeling, in a positive connection with the nature of identification.

Adler (1997) relates envy to the feeling of inferiority and considers it "an aggressive personality trait". According to Adler's structural-theoretical approach (1997), envy means a reaction (when one has no self-esteem) to people's inequality that is associated with feelings of helplessness and infallibility and combined with one's desire for power and superiority. Thus, envy should be considered "as a factor in the current state of the human psyche", and the striving for superiority and overcompensation as the main motivating force in the life of each individual (Adler, 1997).

Fromm (2003; 2012) claimed that envy and jealousy are special forms of frustration, namely when one is denied the satisfaction of a certain desire. Envy arises when one cannot possess what one wants and, especially when someone else possesses it. The scholar believed that desires, aspirations and fears can manifest themselves as a reaction to certain living conditions. A lifestyle generated by the economic system becomes a major factor determining one's personality, given the leading need for self-preservation forces one to accept the conditions in which one has to live (Fromm, 2003; 2012). Besides, it was Fromm (2003; 2012) who introduced the concept of

“consumer society”, with which he associated the “prosperity” of envy. Horney (2019), together with Fromm (2003; 2012), argued that a market economy based on competitive relations negatively affects personality development and mental health. It is because people are faced with a choice: to have many advantages, join the pursuit of social success, or “become someone important”, that is to prove oneself (to find one’s talents).

Horney (2019), in contrast to Freud’s (2007; 2016) approach to women as “inferior” to men, stated that “men’s envy of pregnancy, childbirth, motherhood, women’s breasts and breast-feeding gives rise to an unconscious tendency to devalue them”. A woman threatens her husband with the humiliation of “masculine self-esteem”, because “women play their role by the very fact of their existence”, unlike men. Thus, men’s envy of women’s ability to create a new life is one of the factors that motivate them to create cultural values and achieve scientific success. A common cause of envy, as noted by Horney (2019), is basal anxiety due to the lack of security, love, and recognition.

Klein (1997) considers envy to be an innate destructive-aggressive feeling. People are born with different tendencies to envy, including the experience of fetal development and childbirth. Klein (1997) also notes that envy is not a mere lack of this or that object; it is a fundamental attitude, a way of viewing life as opposed to love. It is because envy is closely related to the primary insufficiency and the destructiveness of death instincts and love to the sufficiency and life instincts (Klein, 1997, p. 19).

As stated by Lacan & Miller (1990), the object of envy is not useful for an individual. It is not what he or she wants but rather what satisfies another individual with whom he or she compares or identifies himself or herself (watching how his or her brother is being fed, the child no longer feels the need for breastfeeding). Lacan & Miller (1990) emphasize that envy is a sin that leads one (who envies) to “behold” those who are satisfied or are enjoying something. However, the psychoanalysts claim that envy involves not two, as is commonly believed, but three subjects. The third one is someone invisibly present, whose recognition the envious person seeks (Lacan & Miller, 1990).

The concept of “envy” was also analyzed in the studies by Deryabin (2016). She considers envy along with pride, arrogance, flattery, insult and malice as a negative emotion generated by the social environment, rather than the body constitution (Deryabin, 2016, pp. 174–184). According to the scholar, envy is associated with dependence on the opinions of others. In

turn, this creates a desire to overshadow others and, at the same time, be no worse than others (Deryabin, 2016).

It must be noted that one's attitude towards reality, material and spiritual needs and aspirations are reflected in the brain, perceived as satisfaction or dissatisfaction and expressed in the form of emotions and feelings. Being reflexive psychophysiological processes, emotions and feelings act as a complex reaction of the body, which involves almost all parts of the nervous system. Therefore, from a psychophysiological point of view, envy can be considered as a mental reaction to certain stimuli (both internal and external), as well as to the dissatisfaction of intrapersonal and social needs (Lisovenko, 2018).

According to Heider's theory of equilibrium (1958), one can want a certain thing only because someone else has it, although he or she has never felt the need for it before and has not even thought about it. As noted by Berbets et al. (2021); Demchenko et al. (2021); Karasievych (2021); Kosholap et al. (2021); Lebreton et al. (2012); Prots et al. (2021); Sarancha (2021) the desirability of the stimulus increases if one sees that this stimulus is significant and is desirable for someone he or she is watching. Interestingly, advertising relies on "the effect of mimetic infection" and "the pursuit of someone else's goal". In this regard, envy engages people in current social values (both positive and false).

There are varied and ambiguous views on the origins of envy from a psychological point of view. Some scholars adhere to the genetic theory of envy and others to the social one. According to the genetic theory, envy is innate and belongs to complex instincts. It acts as a superstructure of self-preservation which contributes to the evolution of the species. The natural basis of envy is biological competitiveness that is one of the oldest mechanisms of individual survival (it can be observed everywhere, even in the most highly developed animals). The proponents of this theory believe that ancient people who envied their fellow tribesmen had more incentives for development and self-improvement. Consequently, were more likely to survive and pass on the "genes of envy" to their descendants. Others claim that envy serves as the basis of progress since it motivated primitive people to discover ways how to bypass their rivals. Envy may first seem absurd without a biological purpose since one does not obtain what he or she wishes. Acting as a kind of mechanism that objectifies the previously unconscious needs, envy can indeed be constructive for survival and evolution. After all, one is envious not only of the owners of certain objects

but also the owners of certain qualities, skills, talent, status. In this sense, envy is stimulated by the desire for self-fulfilment or superiority.

Importantly, envy is directed not only at those who have achieved a clear or subjective advantage in areas important to the envious person but also at those who seem to have more “value” than he or she does. The point is that human needs are socially determined (Leontyev, 1971). The growing desire to enjoy wealth, prestige, honours and power also generate new socially conditioned needs, because people imitate them in society. The possession of what is considered socially valuable is a certain criterion of the social hierarchy.

According to the social theory, envy, being not innate, emerges during social interaction. The mechanism of social comparison is central to the formation of envy. Envy is seen as repressed dissatisfaction with oneself compared to others. Comparison is one of the key procedures inherent in the process of one’s understanding the material world, oneself and other people, as well as in interpersonal communication. The term “social comparison” was proposed by Festinger (1954). According to his theoretical concept, people feel the need to assess their abilities to build an accurate idea of themselves, necessary for optimal functioning. People resort to comparing themselves with others when they lack some resources of the objective reality to assess their characteristics (Festinger, 1954). Therefore, the need to assess themselves, increase self-esteem and self-improve motivates people towards social comparison.

The set of negative emotional experiences that emerge because of social comparison (not in one’s favour) are called “the pain from comparing” (Salovey & Rodin, 1984). Envy occurs when one compares oneself with others under some significant indicators and leads to decreased self-esteem. In this case, social comparison can occur automatically, without a conscious desire or intention, inevitably imposed by social interaction, even against one’s will and in an uncontrolled form. Thus, the media show how people from all over the world (mostly “celebrities”) live and relax, or what they buy. Regardless of one’s desire, they expand the range of one’s social comparisons, often not for one’s benefit. Moreover, social comparisons can be made by others (parents, teachers, colleagues), who set up someone more successful as an “example”. People are social beings, who are extremely sensitive to each other’s reactions. They always know whether they meet or do not meet others’ expectations. This can be somewhat confusing since everyone wants to be socially accepted and approved

(Lisovenko, 2017). Therefore, the social theory of envy is also called the theory of “social learning”. It shows that there is no innate tendency towards envy, while its mechanism is triggered by parental and pedagogical comparison.

Describing the Neuropsychological Localization of Envy in brain structures and the Role of Mirror Neurons in the Generation of Envious Impulses

Schwaerzel et al. (2002) believe that the feeling of envy can act as a driving force of competition. However, this requires one to learn how to cope with it.

Smith et al. (2009) consider envy to be a deviation in the brain. After experimenting on envy, Kleef (2010) noticed the increased activity of mirror neurons in the parietal lobe and premotor cortex. Normally, these areas help one decide whether an object is worth attention which means that the systems of evaluation and imitation are linked in the brain. It follows that the more powerful this connection, the more envious the person. Therefore, it has been suggested that the brain function of envious people is somehow defected (Klein, 1999).

Suri et al. (2014) managed to trace the neural mechanism of envy in the case when the award is received by someone else. After experimenting on macaques that were taught to expect rewards after presenting a certain image, they found that primates valued their reward much higher than that of a competitor. Besides, the social context of rewarding modulates brain activity.

A social aspect is rather essential for the rewarding system, namely in assessing how one reacts to the reward received by others (Foster, 1972). On the one hand, one can feel joy, which requires a high level of empathy. Quite often, however, rewarding others makes one envious.

Boyer & Lienard (2006) studied the activity of 207 dopaminergic neurons in the midbrain during an experiment. These neurons play an important role in the rewarding system of the brain and are activated in response to a pleasant stimulus (a reward). In the case when one expected a reward, 52% of dopaminergic neurons turned out to be active. Only 32% of them were active when someone else received a reward. Also, the researchers tracked the activity of 319 neurons in the medial prefrontal cortex, a part of the brain involved in maintaining social connections (Boyer & Lienard, 2006). Of these, they identified neurons whose activity increased with a growing probability of receiving one's reward and partner's reward.

Social comparison (not in one's favour) causes a profound drop in self-esteem, which the brain perceives as physical pain. This triggers specific mechanisms of imaginary psychological compensation when someone else's defeat is perceived as one's victory. One can assume that people with low levels of endorphins (natural painkillers) are expected to be more prone to envy. Increasing the level of this hormone is likely to help the envious person feel better. Short-term envious reactions are based on the natural action mechanism of mirror neurons in the brain that come from "imitative desire", important for survival. Neuropsychologists have traced the overactivation of mirror neurons responsible for assessment and motivation in those people whose experience of envy is frequent and long-term.

A neuropsychological experimental study conducted by Takahashi et al. (2009) found that the human brain perceives the feeling of envy as physical pain, while malevolence triggers reward patterns. The researchers conducted functional magnetic resonance imaging studies to monitor the brain activity of 19 male and female students when reading two stories about other fictional students.

Story 1 described the success of three characters: (A) an A student of the same sex in the same field of study, (B) an A student of the opposite sex in another field of study and (C) an average student of the opposite sex in another field of study. After that, the respondents were asked to rate their level of envy towards the characters on a scale of 1 to 6. Character A induced stronger envy and stronger anterior cingulate cortex activation, which plays a key role in pain processing. The obtained results prove that the brain uses the same schemes to process both psychosocial pain (envy) and physical pain. It means that envy and pain act as physiological "twins".

In story 2, characters A and C experience a series of misfortunes, including food poisoning and financial problems. FMRI data show that the misfortunes of character A induced stronger activity in the corpus striatum, which is a part of the brain that is activated when receiving various "bonuses", social and financial rewards. Besides, the researchers managed to predict which characters would induce stronger malevolence (corpus striatum activity) when reading story 2 based on the level of envy (anterior cingulate cortex activity) they experienced when reading story 1. This suggests close links between the ways the brain processes these feelings and, most importantly, the malevolence mechanism: "when your gain is my pain and your pain is my gain" (Takahashi et al., 2009). This is similar to the situation when someone we know and "on the same level" with us begins to

“climb” the social “steps”. Consequently, we may have the illusory feeling that we are, on the contrary, “falling”.

There is a direct connection between chronic envy and atherosclerosis. Envy leads to anger which, in turn, increases cholesterol, heart rate and blood pressure. These changes contribute to a heart attack. Besides, there are psychological studies on the links between envy and depression (Lisovenko, 2017; 2018).

Lebreton et al. (2012) decided to test whether there are neurophysiological indicators of envy, or it is only a personality trait. Their research hypothesis relied on the mimetic theory, according to which human development is driven by “mimetic (imitative) desire”. According to this theory, people strive for something, not because of its form, quality, or usefulness, but, above all, because other people desire to possess it (its popularity and value in the surrounding society). This type of human preference is rather “contagious” and quickly spreads: the attractiveness of the target object increases the more likely the more people are interested in it. All this leads to the conclusion that human development is driven by envy. Consequently, we choose the same food, the same clothes as others, and almost all advertising gimmicks are based on the desire to have what another has (Dumouchel & Dupuy, 1979).

Lebreton et al. (2012) also studied the effect of “people’s opinion of one’s desire to obtain something”. They analyzed the behaviour and brain activity of 116 adults aged between 18 and 39 years old. During the MRI scan of the brain, the participants in the experiment were shown short videos on various objects (clothing, food, accessories) and different situations. In one case, the object appeared in a neutral context (e.g., candy on the table). In another case, the object was presented as the purpose of another person’s action: someone’s hand was reaching for the candy. After viewing each scenario, the participants rated the object on a scale of attractiveness of 1 to 10. The obtained results confirmed that the objects of interest to others were rated as high as possible (for most participants (60%), the candy chosen by the stranger from the second video turned out to be the most desirable) (Lebreton et al., 2012). That is, if someone has chosen this candy, most believe that it is the best, even if it is not. This logical chain is characteristic not only of envious people, but also of those who tend to always adhere to the opinion of the majority (conformists), and of jealous people. The results from the MRI scan have attracted the researchers’ attention with the increased activity of two areas of the brain. The first one

is the system of mirror neurons in the parietal lobe and in the premotor cortex, which is responsible for imitating and interpreting other people's actions. Another activated area in the prefrontal cortex and the corpus striatum is involved in the evaluation of any objects or actions, as well as in decision-making (whether to spend effort and time on this object). Even though the activation of these zones is natural, the researchers were surprised by how closely these zones are interconnected. When the participants in the experiment interpreted the observed object as an object of someone's desire, the system of mirror neurons activated the evaluation system, making this object more valuable. This means that mirror neurons motivate "values-related" neurons to evaluate what one can see around. Thus, the interaction of the two systems is a fundamental mechanism that explains how non-verbal behaviour spreads desire; how observing others' actions modulates ratings of value and desirability. Indeed, the more related the system of evaluation (significance) and the system of imitation in the brain are, the more one depends on the external pattern of behaviour, and, accordingly, the more envious he or she is (Lebreton et al., 2012). This pathological connection makes one over-dependent on external assessments and external patterns of behaviour because it encourages one to always meet the "standards", even if they are inappropriate and unattainable.

However, Lebreton et al. (2012) claim that the dysfunction of mirror neurons in these areas may explain the lack of interest among autistic children in the object, which is of great interest among healthy children, as well as the absence or decreased empathy. Thus, envy is a natural activity mechanism of mirror neurons in the brain that is based on mimetic desire. It has been experimentally proven that mimetic desire is contagious as it spreads extremely quickly (this characteristic of the psyche is actively used by advertisers, forcing people to want to buy something unnecessary). Still, mimetic desires can be characterized by some hidden positive moments that were evolutionarily important for survival (the desire to eat what relatives ate helped to avoid poisoning; copying protective behaviours and learning to work helped to survive; learning the language and culture of others ensured the interaction with them and social adaptation). Thus, imitation is one of the basic forms of learning, whose neurophysiological basis is a system of mirror neurons, which links the sensory, emotional and motor parts of the cerebral cortex encoding information about the same acts of behaviour (Lebreton et al., 2012; Ramachandran, 2000; Rizzolatti & Sinigaglia, 2012). It is also believed that the emergence of mirror neurons was a key moment in

human evolution (“a huge leap forward” as noted by Ramachandran (2000)). It is because they play a key role in learning (e.g., in the development of language, culture and civilization through imitation (Ramachandran, 2000)).

On the one hand, envy is a natural activity mechanism of mirror neurons in the brain that is based on “mimetic desire” and is fundamentally important for survival. On the other hand, MRI scan data indicate brain dysfunction in pathological enviers (the overactivation of mirror neurons in the parietal lobe and the premotor cortex, as well as stronger activity in the prefrontal cortex and the corpus striatum, responsible for assessment and motivation). One can assume that there is a conflict between the “primary” structure of the brain and the latest means of communication and the media. Thus, tabloids and celebrity reality shows are becoming more and more popular. It results in the contagious desire of today’s youth to meet the standards seen and promoted (beauty, success, power, wealth, freedom), as well as adopt the values of strangers. Moreover, these standards and values are often unattainable and inadequate.

Still, the origins of envy should be found in social relations, as well as the benefits they provided. Envy may have taken root since it was an indispensable tool for comparing oneself with relatives, on the one hand, and assessing competitors, on the other hand. It may have been a very effective tool for promoting common values in primitive society. It follows that envy could have been a regulator, i.e., an important mechanism to maintain unity in the tribal way of life (not to be an outsider who does not fit into the conventional framework) or stimulate competition with other “foreign” clans. This is fully in line with Freud's views (2007; 2016) on the role of envy in establishing solidarity, “public spirit” and social identification.

At the heart of the desire to consider good what others do is the original neurobiological need for reflection, resonance and a reliable social identity. What we observe in other people or experience together with them motivates us to have appropriate thoughts and impulses. Nevertheless, it is us who decide whether to ignore these thoughts and motivations or make them real.

Indeed, people are driven by the desire for certain things because of the media and pressure from the social environment. To change a way of life, however, one should decide what exactly his or her inner self seeks. It may turn out to be very different from the target objects or things.

Conclusions

Envy as a mental reaction is a situational and short-term feeling of dissatisfaction aroused by someone else's possessions, qualities or luck, which is manifested in a strong desire to have them for oneself right away. This reaction can be caused by both unmet internal needs (e.g., hunger) and certain external influences (social comparisons, excessive advertising, others' bragging) when what is considered valuable to others is perceived as a necessity.

Social comparison (not in one's favour) causes a profound drop in self-esteem, which the brain perceives as physical pain. This triggers specific mechanisms of imaginary psychological compensation when someone else's defeat is perceived as one's victory. One can assume that people with low levels of endorphins (natural painkillers) are expected to be more prone to envy. Increasing the level of this hormone is likely to help the envious person feel better.

Short-term envious reactions are based on the natural action mechanism of mirror neurons in the brain that come from "imitative desire", important for survival. Neuropsychologists have traced the overactivation of mirror neurons responsible for assessment and motivation in those people whose experience of envy is frequent and long-term. This may be evidence of one's dependence on the opinions of others, unstable self-esteem and values-needs sphere, as well as of one's unmet needs for approval, recognition, and self-realization.

If there is no strong activation of mirror neurons or the evaluation system is not activated in response to this, the object that triggers impulsiveness will not be highly valued and will not obscure consciousness. In this regard, the mechanisms that can help decrease envy are the following: decreased visual perception of stimuli (especially in social networks); switching to something more useful for oneself (knowledge and realization of one's needs, inclinations and abilities) and cognitive reconsideration of the stimulus (this process may be painful but conscious).

As shown by international experience, neuropsychological experimental studies confirm the legitimacy of psychoanalytic views on the mechanisms of envy formation and allow one to justify hypotheses on the ways of its psychocorrection.

References

- Adler, A. (1997). *Ponyat prirodu cheloveka* [Understanding the human nature]. Akademicheskii proyekt.
https://bookap.info/psyanaliz/adler_ponyat_prirodu_cheloveka
- Berbets, T., Berbets, V., Babii, I., Chyrva, O., Malykhin, A., Sushentseva, L., MEDYNSKII, S., Riaboshapka, O., Matviichuk, T., Solovyov, V., Maksymchuk, I., & Maksymchuk, B. (2021). Developing Independent Creativity in Pupils: Neuroscientific Discourse and Ukraine's Experience. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 12(4), 314-328.
<https://doi.org/10.18662/brain/12.4/252>
- Boyer, P., & Lienard, P. (2006). Why ritualized behavior? Precaution systems and action parsing in developmental, pathological and cultural rituals. *Behavioral and Brain Sciences*, 29, 595-650.
<https://doi.org/10.1017/S0140525X06009332>
- Demchenko, I., Maksymchuk, B., Bilan, V., Maksymchuk, I., & Kalynovska, I. (2021). Training future physical education teachers for professional activities under the conditions of inclusive education. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 12(3), 191-213.
<https://doi.org/10.18662/brain/12.3/227>
- Deryabin, V. S. (2016). *Psikhologiya lichnosti i vysshaya nervnaya deyatel'nost. Psikhofiziologicheskkiye ocherki* [Personality psychology and higher neural activity. Some psychophysiological essays]. LKI.
- Dumouchel, P., & Dupuy, J.-P. (1979). *L'Enfer des choses: René Girard et la logique de l'économie* [The Hell of Things: René Girard and the Logic of the Economy]. Seuil.
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, 7(2), 117-140. <https://doi.org/10.1177/001872675400700202>
- Foster, G. (1972). The anatomy of envy: A study in symbolic behavior. *Current Anthropology*, 13(2), 167-198. <https://doi.org/10.1086/201267>
- Freud, S. (2007). *Vvedeniye v psikhoanaliz* [Introduction to psychoanalysis]. Piter.
- Freud, S. (2016). *Psikhologiya mass i analiz chelovecheskogo "ya"* [Mass psychology and ego analysis]. Azbuka-klassika.
- Fromm, E. (2003). *Begstvo ot svobody* [Escape from freedom]. Harvest.
- Fromm, E. (2012). *Imet ili byt* [To have or to be]. Big Press.
- Heider, F. (1958). *The psychology of interpersonal relations*. John Wiley & Sons Inc.
- Horney, K. (2019). *Nevroz i lichnostnyy rost. Borba za samorealizatsiyu* [Neurosis and human growth: the struggle towards self-realization]. Piter.
- Karasievych, S., Maksymchuk, B., Kuzmenko, V., Slyusarenko, N., Romanishyna, O., Syvokhop, E., Kolomiitseva, O., Romanishyna, L., Marionda, I.,

- Vykhreshch, V., Oliynyk, M., Kovalchuk, A., Halaidiuk, M., & Maksymchuk, I. (2021). Training Future Physical Education Teachers for Physical and Sports Activities: Neuropedagogical Approach. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 12(4), 543-564. <https://doi.org/10.18662/brain/12.4/264>
- Kleef, G. A. (2010). The emerging view of emotion as social information. *Social and Personality Psychology Compass*, 4(5), 331-343. <https://doi.org/10.1111/j.1751-9004.2010.00262.x>
- Klein, M. (1997). *Zarist i blagodarnost. Issledovaniye bessoznatelnykh istochnikov* [Envy and gratitude. Exploring unconscious sources]. B.S.K.
- Klein, M. (1999). *Early stages of the Oedipus conflict*. Routledge.
- Kosholap, A., Maksymchuk, B., Branitska, T., Martynets, L., Boichenko, A., Stoliarenko, O., Matsuk, L., Surovov, O., Stoliarenko, O., & Maksymchuk, I. (2021). Neuropsychological bases of self-improvement of own physical health of future teachers in the course of university education. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 12(3), 171-190. <https://doi.org/10.18662/brain/12.3/226>
- Lacan, J., & Miller, J.-A. (1990). *Le Séminaire, tome 11: Les Quatre Concepts fondamentaux de la psychoanalyse* [The seminar. Volume 11. The four fundamental concepts of psychoanalysis]. Seuil.
- Lebreton, M., Kawa, S., Forgeot d'Arc, B., Daunizeau, J., & Pessiglione, M. (2012). Unraveling mimetic desires in the human brain. *The Journal of Neuroscience*, 32(21), 7146-7157. <https://doi.org/10.1523/JNEUROSCI.4821-11.2012>
- Leontyev, A. N. (1971). *Potrebnosti, motivy, I emotsii* [Needs, motives, and emotions]. MGU.
- Lisovenko, A. F. (2017). Envy and perfectionism: the interrelationship of the concepts. *Nauka i osvita* [Science and Education], 1, 67-71. <https://doi.org/10.24195/2414-4665-2017-1-11>
- Lisovenko, A. F. (2018). *Indyvidualno-psykholohichni osoblyvosti perezhyvannya pochuttya zazdroshchiv* [Individual psychological peculiarities of experiencing feeling of envy] [Unpublished doctoral dissertation]. South Ukrainian National Pedagogical University Namd after K. D. Ushynsky. <http://dspace.pdpu.edu.ua/handle/123456789/1199>
- Prots, R., Yakovliv, V., Medynskyi, S., Kharchenko, R., Hryb, T., Klymenchenko, T., Ihnatenko, S., Buzhyna, I., & Maksymchuk, B. (2021). Psychophysical training of young people for homeland defence using means of physical culture and sports. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 12(3), 149-171. <https://doi.org/10.18662/brain/12.3/225>
- Ramachandran, V. S. (2000, May 29). *Mirror neurons and imitation learning as the driving force behind "the great leap forward" in human evolution*. Edge.

- Rizzolatti, G., & Sinigaglia, C. (2012). *Zerkala v mozge. O mekhanizmakh sovmestnogo deystviya i soperezhivaniya* [Mirrors in the brain — how our minds share actions and emotions]. Yazyki slavyanskikh kultur.
- Salovey, P., & Rodin, J. (1984). Some antecedents and consequences of social-comparison jealousy. *Journal of Personality and Social Psychology*, 47(4), 780–792. <https://doi.org/10.1037/0022-3514.47.4.780>
- Sarancha, I., Maksymchuk, B., Gordiichuk, G., Berbets, T., Berbets, V., Chepurna, L., Golub, V., Chernichenko, L., Behas, L., Roienko, S., Bezliudna, N., Rassskazova, O., & Maksymchuk, I. (2021). Neuroscientific Principles in Labour Adaptation of People with Musculoskeletal Disorders. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*, 12(4), 206–223. <https://doi.org/10.18662/brain/12.4/245>
- Schwaerzel, M., Heisenberg, M., & Zars, T. (2002). Extinction antagonizes olfactory memory at the subcellular level. *Neuron*, 35(5), 951–960. [https://doi.org/10.1016/s0896-6273\(02\)00832-2](https://doi.org/10.1016/s0896-6273(02)00832-2)
- Smith, R., Caitlin, A., & David, J. (2009). Exploring the when and why of Schadenfreude. *Social and Personality Psychology Compass*, 3(4), 530–546. <https://doi.org/10.1111/j.1751-9004.2009.00181.x>
- Suri, G., Sheppes, G., & Gross, J. J. (2013). Emotion regulation and cognition. In M. D. Robinson, E. Watkins, & E. Harmon-Jones (Eds.), *Handbook of cognition and emotion* (pp. 195–209). The Guilford Press.
- Takahashi, H., Kato, M., Matsuura, M., Mobbs, D., Suhara, T., & Okubo, Y. (2009). When your gain is my pain and your pain is my gain: neural correlates of envy and schadenfreude. *Science*, 323, 937–939. <https://doi.org/10.1126/science.1165604>