ST. PETERSBURG STATE UNIVERSITY



EKATERINA I. FEDIUKOVICH

# Features of emotion regulation and emotion recognition by facial expressions in people who use psychoactive substances

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**Anna V. Trusova**

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# INTRODUCTION

## Relevance of the research

The use of psychoactive substances (PAS) remains a relevant problem in modern global healthcare. The effects of the COVID-19 pandemic have exacerbated the problem: systematic substance use increases physical and emotional stress levels between episodes of substance use, and when combined with emotional stress, social isolation, financial instability, and reduced access to specialist care, leads to a natural increase in substance use, a deterioration in the emotional state of people who abuse these substances, and the development or worsening of chemical dependence (Koob et al., 2020). The consequences of substance use are diverse and include both somatic and mental illnesses, which reduce life expectancy and quality of life (Pogosova et al., 2012). Statistics for 2019–2020 have shown that Russia is among the countries where alcohol is a leading risk factor for infectious diseases, injuries, and, moreover, mortality (Shield et al., 2020; Ritchie, Roser, 2019). In addition, substance abuse among the population has a significant negative impact on the economy. For example, S.S. Soshnikov et al. pointed to the economic losses from the criminalization of PAS (up to 417 billion rubles) due to years spent by patients with the use and possession of illegal PAS in prison without considering their content (Soshnikov et al., 2020).

The abuse of psychoactive substances (PAS) can lead to cognitive impairments, although it is not yet considered addiction according to clinical criteria (Lees et al., 2020). According to a meta-analysis, abnormal or delayed development of key executive control regions of the brain may predispose people to excessive alcohol consumption (Lees et al., 2019). The impact of substance use on the emotional sphere has recently attracted the attention of researchers.

Most of our social interactions involve recognising the emotions, actions, and intentions of other people in general. Much of this information is available through the facial expressions they make. Facial expressions are powerful nonverbal displays of emotions that convey crucial information in a complex social world. Emotional recognition by facial expressions allows us to determine another person's emotional state and provides information on how to react in various social interactions (Frank and

Stennett, 2001). There are some basic emotions that humans find easier to recognise than others (such as fear, disgust, anger, happiness, and sadness) (Adolphs, 2002).

P. Ekman refers to the recognition of emotions as a system of facial action coding, which is a complex anatomically determined system for describing all visually distinguishable facial movements. He divides facial expressions into individual components of muscular movement called action units (Ekman and Friesen, 1978).

Emotional recognition also refers to the ability to perceive, understand, and correctly process information about emotions, both in oneself and in others (Green et al., 2015). The recognition of another person's emotional state by facial expressions is the basis for establishing and maintaining interpersonal relationships (Niedenthal and Brauer, 2012), a key factor in empathy (Gery et al., 2007), and many other important social behaviours.

Impairment of emotion recognition by facial expression is included in the deficits of the Research Domain Criteria (RDoC) social process system (2021) and has been studied as one of the characteristics of the transdiagnostic phenotype of several psychiatric and behavioral disorders, including personality disorders and addictions (Hanegraaf et al., 2021). The diagnosis of borderline personality disorder (BPD) is characterised by unstable emotional states, interpersonal relationships, and self-esteem, as well as heightened impulsivity, beginning in early adulthood and present in different contexts (APA, 2013). Moreover, patients with BPD usually fear rejection by other people (WHO, 1999). A decrease in self-control and the experience of strong emotions often leads to alcohol and drug abuse, self-harm, and interpersonal communication problems, because of which the patient's social and work adaptation is reduced (Gunderson et al., 2018). In both borderline personality disorder and alcohol use disorder (AUD), patients experience interpersonal communication problems, which can affect their social functioning and quality of life (Euler et al., 2021; Hoffman et al., 2019). Furthermore, there is a link between interpersonal miscommunication and emotion recognition (Kornreich et al., 2002; Lewis et al., 2019).

**The degree of scientific development of the research issue**

Studies have shown that individuals with psychoactive substance dependence (PSD) may have difficulties recognising negative emotions. However, the data is inconsistent regarding which specific emotions are affected. For example, M. Foisy and colleagues reported a decrease in the accuracy of recognising sadness among alcohol-dependent individuals (Foisy et al., 2007). In individuals with co-occurring substance use disorders, difficulties in recognising not only sadness but also anger, disgust, and fear have been observed (Fernández-Serrano et al., 2010). Our pilot study showed only impaired sadness in patients with the syndrome of dependence (Fediukovich and Trusova, 2023 (b)).

The fundamental question of whether impaired emotion recognition is one of the causes of addiction or a consequence of illness remains open. For example, impaired recognition of facial emotional expressions may precede the development of alcohol addiction (Donadon and Osório, 2017). On the other hand, there is evidence that emotion recognition characteristics are disrupted after alcohol abuse (Eastwood et al., 2020), particularly the recognition of fear and sadness.

Furthermore, it remains questionable whether the misperception of facial expressions is a key psychopathological marker of BPD. Swedish colleagues have tried to answer this question and found that the degree of BPD symptoms is associated with impaired anger recognition (Vestergaard et al., 2020). However, there are other findings in this regard. Emotional recognition in BPD has been shown to be no different from a healthy sample (Herr et al., 2021). Misrecognition of emotions in BPD has often been linked to the theory of mentalization. Mentalization is the ability of the imagination to reflect on the mental states of oneself and others and is the central mechanism behind much social cognition and interpersonal interactions (Allen et al., 2008). P. Fonagy and P. Luyten et al. state that the diagnosis of BPD is associated with low-threshold attachment system activation and deactivation of controlled mentality, associated with impaired ability to discern mental states of self and others, resulting in hypersensitivity and increased sensitivity to the emotions of others (Fonagy, Luyten, 2009). K. Sharp and colleagues have proposed a model of hypermentalization to

understand the unique socio-cognitive challenges faced by people with borderline personality disorder (Sharp et al., 2013). Hypermentalization is the excessive attribution of intentions and thoughts to others (Ballesp et al., 2019). For example, if a person looks sad, a hypermentalized interlocutor may think, "She doesn't want to spend time with me". These attributes of the mental state lead to a further increase in hyperactivated emotions, which in turn further increases hypermentalization. A recent meta-analysis showed that hypermentalization is characteristic not only of the diagnosis of BPD but also of psychopathology in general (McLaren et al., 2022).

The recognition of emotions by facial expression is characterised by cultural differences (Elfenbein, 2013; Cordaro et al., 2018); hence, the task was set to verify the results in Russia and to complement them in the global community. No domestic studies on this topic indexed in the Russian Science Citation Index (RSCI) were found. Remarkably, most previous research on emotion recognition by facial expression has been conducted using static images, where static emotional stimuli correspond only to identifiable peaks of facial emotion expression (Atkinson et al., 2004). The assessment of emotion recognition by facial expression in dynamic deployment used in our study is, in our opinion, of higher experimental relevance, as it is closer to the perception of another person's facial expressions in real social interaction.

Existing theoretical models of addictive disorders consider addictive behaviour to have an inseparable connection with characteristics of emotion regulation and its disturbances. However, available data suggest an ambiguous relationship between the ability to recognise emotions from facial expressions and mechanisms of regulating one's own emotional state in the context of substance abuse and addiction formation (Trusova, Fediukovich, 2020).

There are numerous studies on emotion regulation strategies in addiction and BPD. It has been shown that emotional dysregulation and interpersonal communication problems are characteristic of patients with personality disorders (Deckers J.W. et al., 2015; Herr et al., 2013; López-Pérez, McCagh, 2020). There is a hypothesis that disruption of the emotion recognition mechanism may be one of the factors contributing to emotional dysregulation and, consequently, behavioural problems.

Often, when experiencing strong emotions and not understanding them, many patients resort to maladaptive strategies such as self-harm or substance abuse (Gunderson et al., 2018).

The current literature on neuroimaging studies also indicates inconsistent results and a variable pattern (Neumann et al., 2008) and cannot definitively characterise which area of the brain is etiologically associated with each mental disorder or disease. The currently available scientific data are not enough to clarify the question of the relationship between the mechanisms of regulation of one's own emotions and the emotion recognition of other people by facial expression.

**The purpose** of the study was to explore the features of emotion recognition and emotion regulation strategies in substance users as well as in people with borderline personality disorders.

To achieve this goal, the following **tasks** had to be completed:

1. To explore theoretical aspects of emotion recognition and emotion regulation in chemical dependency, substance use, and borderline personality disorder.
2. To study the features of emotion recognition in clinical groups and compare them with data from healthy controls.
3. To determine misrecognition of emotion, a characteristic of clinical groups, and compare it with data from healthy controls.
4. To explore emotion regulation strategies in clinical groups and compare them with data from healthy controls.
5. To study the characteristics of the emotional state, characteristics of impulsivity, and personality traits in clinical groups and compare them with data from healthy controls.
6. To analyse the relationship between emotion recognition features, emotion regulation strategies, impulsivity characteristics, and personality traits in clinical groups.

**The object** of the study is the emotional sphere in patients with the syndrome of dependence, substance users, and patients with BPD.

**The subject of the study** was characteristics of emotion recognition and features of emotion regulation in patients with the syndrome of dependence, substance users, and patients with BPD.

**Research hypotheses:**

1. The accuracy of negative emotion recognition in clinical groups will differ from that of healthy controls.
2. The speed of negative emotion recognition in clinical groups will differ from that of healthy controls.
3. Misrecognition of emotions will be characteristic of clinical groups in contrast to healthy controls.
4. Emotion regulation strategies, impulsivity characteristics, and personality traits in clinical groups will differ from healthy controls.
5. Characteristics of impulsivity, personality traits and levels of anxiety and depression will moderate the misrecognition of emotions and emotion regulation strategies in clinical groups.

**The theoretical and methodological basis of the study was** the biopsychosocial model of human health and disease (Vasserman L.I., Karvasarsky B.D.), the neurocultural model (Ekman P.), the theory of differential emotions (Izard K.), the biosocial theory (Linehan M.M.), and the theory of mentalization (Fonagy P.).

**Scientific novelty:**

1. For the first time in Russian medical psychology, the accuracy and speed of emotion recognition were studied in substance users, patients with the syndrome of dependence, and patients with BPD.
2. For the first time in Russian medical psychology, misrecognition of emotions was studied in substance users, patients with the syndrome of dependence, and patients with BPD.
3. An assumption was made about the relationship between emotion recognition and emotion regulation strategies.

4. An assumption was made about the moderation role of impulsiveness characteristics, anxiety and depression levels, and personality traits in relation to emotion recognition and emotion regulation strategies.

**The theoretical significance of the study:**

The data obtained in this study expand the scientific understanding of the fundamental question of whether impaired emotion recognition is one of the causes of addiction or is a consequence of the disease. In addition, misrecognition of emotions can play a key role both in the formation of addiction and as a cause of relapse. The present study also demonstrated the possibility of expanding our understanding of whether misrecognition of emotions is a key psychopathological marker of borderline personality disorder.

**The practical relevance of the study:**

The data obtained make it possible to optimise an individualised approach in the psychotherapy of addictions and borderline personality disorder. The study can be used to organise a comprehensive system of clinical and psychological interventions at different stages of addiction. The two main targets of such clinical psychological interventions can be individual strategies of emotion regulation and features of interpersonal interaction with a focus on understanding the emotional state of the other person.

**The following statements are defended:**

1. Substance users, patients with the syndrome of dependence, and participants with BPD have impaired sadness recognition compared to healthy participants.
2. Clinical groups differ in a common specific pattern of misrecognition disgust in the direction of sadness in the control group.
3. Recognition and regulation of emotions, as well as individual characteristics, are interconnected in clinical groups. Therefore, our study indirectly proves a possible connection between impaired emotion recognition and human adaptation in society, as well as one of the causes of relapses.

4. Characteristics of impulsivity, levels of anxiety, and depression, as well as personality traits, act as moderators in relation to the recognition and regulation of emotions in clinical groups.

**The degree of reliability and validity of the research results is** ensured by the personal participation of the author of the study in all stages of the collection and analysis of material, a multilateral analysis of literature sources on the chosen topic, the required volume of the experimental sample, a complex of adequate and valid clinical and psychological methods, a wide range of modern methods of mathematical and statistical data processing, and correlating the obtained data with data from other modern scientific studies.

**Personal contribution of the author**

The author of the study has developed an experimental procedure embodied in the computer programme "Emotion Recognition", which is used to study emotion recognition by facial expression (WebStorm software environment, JavaScript programming language) based on an open database of dynamic facial expression images: Emotional Fascial Expression (KDEF-dyn database), Karolinska Institutet, Sweden.

Besides, the author developed a plan for organising the study, set its goals and objectives, and selected the tools. The modern scientific literature on the research topic is analysed in detail.

The author personally interviewed most of the study participants, received voluntary informed consent, issued blank methods and instructions for them, conducted experimental psychological methods, and gave feedback to the participants.

**Testing the results of the study**

The data of this study were presented at the international scientific conference «Ananiev Readings – 2021» (the topic of the report is "Features of emotion recognition by facial expression in persons with addiction to psychoactive substances"), the Russian scientific and practical conference with international participation "Burnout Syndrome. How to keep yourself in the profession? Clinical facets, approaches, solutions at the present stage – 2021" (the topic of the report is "Characteristics of

recognition of emotions depending on professional status") and the international scientific conference of young scientists «Psychology of the 21st century – 2021» (the topic of the report is "The relationship between recognition of emotions and emotional regulation in persons with drug addiction and personality disorder"), in Kazan at the international scientific-practical conference «Psychology of Mental States – 2021» (the topic of the report is "The Relationship between emotion recognition and characteristics of the emotional sphere in personality disorder and health"). Publication of the abstracts "Detection of emotions by facial expression as a predictor of chemical addiction" in the collection of the Russian Congress with international participation «Psychoneurology: century XIX-century XXI» in St. Petersburg and abstracts "A low speed of happiness recognition in facial expression as a predictor of substance use" at the European Psychological Congress 2022 in Ljubljana, Slovenia

**Publications**

1. Fediukovich E.I., Trusova A.V. Raspoznavanie e emocij po mimicheskoj ekspressii pri himicheskoj zavisimosti: pilotazhnoe issledovanie issledovanie [Emotion Recognition by Facial Expression in Chemical Addiction: Pilot Study] // Konsul'tativna psihologiya i psihoterapiya. – 2023. – V. 31(2). – P. 152–170. DOI: 10.17759/cpp.2023310208 [In Russian]
2. Fediukovich E.I., Trusova A.V. Narushenie raspoznavaniya emocij: prediktor ili sledstvie zloupotrebleniya alkogolem? Sravnenie dannyh zdorovyh uchastnikov i pacientov s pogranichnym rasstrojstvom lichnosti. Is impaired emotion recognition a predictor or a consequence of alcohol abuse? Comparison of data from healthy participants and patients with borderline personality disorder [Narkologia]. – 2023. – V. 22(3). – P. 58–70. DOI: 10.25557/1682-8313.2023.03.58-70 [In Russian]
3. Fediukovich E.I., Trusova A.V. Osobennosti raspoznavaniya emocij po licevoj ekspressii pri epilepsii [Features of Emotion Recognition by Facial Expression in Patients with Epilepsy] // Psychology. Psychophysiology. – 2021. – V. 14 (3). – P. 90–98 DOI: 10.14529/jpps210309 [In Russian]

4. Trusova A. V., Fedyukovich E. I. Raspoznavanie emocij kak marker narushenij emocional'noj regulyacii u lic s himicheskoj zavisimost'yu: obzor sovremennyh issledovanij [Emotion recognition as a marker of emotional regulation deficits in substance use disorder: Review of current research] // Vestnik of Saint Petersburg University. Psychology. – 2020. – V. 10 (3). – P. 353–366. DOI: 10.21638/spbu16.2020.310 [In Russian]

**Volume and structure of the dissertation**

The dissertation consists of an introduction, four chapters, conclusions, a list of abbreviations and symbols, a list of references, and applications. The main content of the dissertation is presented on 228 pages (translation is on 204 pages) and includes 49 tables and 22 figures. The list of sources includes 424 publications, 37 of them in Russian and 387 in foreign languages.

# CHAPTER 1. LITERATURE SOURCES REVIEW

## 1.1. Fundamental neurobiological theories of emotion recognition

### 1.1.1. Background to the Study of Emotion Recognition

At the beginning of the 20th century, the emotional sphere was studied more by neurophysiologists. For example, P. Bard was the first to suggested that the hypothalamus may play a key role in emotional experiences. His model was influenced by experiments that showed electrical stimulation of the hypothalamus produces sustained sympathetic arousal. It is worth noting that P. Bard considered emotion as rage, which is characterized by strong sympathetic arousal (Bard, 1928, 1929). In turn, E. Duffy concluded that structures serving mechanisms of arousal also serve as central and peripheral components of emotions (Duffy, 1962).

P. Papez was the first to postulate that emotion recognition is based on an interconnected cortical-subcortical system, which later became known as the "Papez circuit". Later, the limbic system model was formulated, which defines a functional unit responsible for all emotional processes, consisting of the hypothalamus, anterior thalamic nuclei, gyrus cinguli, hippocampus, and their connections. The emotion model proposed by P. Papez (Papez, 1937) suggested that different parts of the brain could mediate varied components of emotions. The idea is that the psychological complexity of emotions should correspond to a complex neurobiological structure.

The distinction between the right and left hemispheres is also related to the understanding of the brain organization of emotions. D. Tucker (1981) suggested that the following cognitive features may give preference to the right hemisphere in processing emotional information: 1) the tendency to represent experience in an analog code; and 2) the ability to integrate information holistically rather than sequentially. Then, E. Ross (1981) proposed that the dominance of the right hemisphere in relation to emotions may primarily concern communicative (rather than other, more elementary) components of emotions. R. Davidson (1984) suggested the idea that valence of emotions (positive and negative) may depend on hemispheres: left - positive, right - negative emotions. G. Gainotti et al. (1972) proposed that the schematic level of emotional processing may primarily be served by the right hemisphere, while

the level of emotional conceptualization and control may be subordinate to the left hemisphere.

After the discovery of f-MRI in neuroscience research, we had a great opportunity to research the human brain and the connection between cognitive and emotional functions. Below are the most common modern conceptions of neuroscience to manifestations of emotional manifestations.

### 1.1.2 Basic emotion theory

This theory of emotions suggests that humans have a limited number of emotions (such as fear, anger, happiness, sadness) that are biologically and psychologically "basic" (Wilson-Mendenhall et al., 2013). Most authors identify six basic emotions - happiness, sadness, anger, fear, disgust, and surprise - with other emotional reactions considered as additional. Understanding basic emotions is essential to consider how these psychological processes can be transformed into cognitive operations in various structures of the emotional sphere. In recent decades, the basic theory of emotions has had a significant impact on the field of affective research (Saarimäki et al., 2016; Williams, 2017; Song, Hakoda, 2018; Wang et al., 2017). Many authors believed that basic emotions are related to our biological needs (Bush, Luu, Posner, 2000; Colmbetti, 2014; An et al, 2017), and each emotion has its own dedicated neural circuitry (Ekman, 1992; Russell, 2006). In addition, C. Izard argued that basic emotions are preserved in phylogeny because their biological and social functions are important for evolution and adaptation. C. Izard proposed that basic emotions have innate neural substrates and universal behavioral phenotypes (Izard, 1979). We suggest taking a closer look at each of the six basic emotions and their approximate localization in the structure of the brain within the framework of the theory of basic emotions.

*Happiness* is a subjective report of one's well-being (Kahneman et al., 1999). In many studies, evidence has been provided for the primary role of the ventromedial prefrontal cortex (PFC), insula, and ventral striatum in evaluating the receipt of pleasure (Frot et al., 2007; Grabenhorst, Rolls, 2011). There is almost no disagreement regarding the involvement of the ventromedial prefrontal cortex in experiencing pleasure (Abler et al., 2005). Moreover, the ventral tegmental area (VTA) is the source

of the mesolimbic dopaminergic pathway, which projects and releases dopamine into the blue spot, prefrontal cortex, and anterior cingulate cortex (ACC) and is responsible for the cognitive processes of positive emotions. It is worth mentioning that the mechanisms of the brain involved in basic pleasures (such as pleasure from food and sex) intersect with the mechanisms of higher-order pleasures (such as pleasure from finance, creativity, music, etc.) (Kringelbach, 2005).

*Sadness* is an emotion that signifies loss and helplessness (Motoki, Sugiura, 2018). It is also associated with the inability to obtain a desired object (such as a reward) or punishment for "wrong" behavior. The neurobiological substrate of sadness is the ACC. The reason why sadness is localized in the ACC may be related to the fact that this part of the brain triggers vocalization for crying, as confirmed by neuroimaging studies (Ramirez-Mahaluf et al., 2018).

*Fear* is an intermediate variable between sets of context-dependent stimuli and sets of behavioral responses (Adolphs, 2013). The amygdala is an important limbic structure associated with important components of fear such as fear conditioning (Davis et al., 1992), initiation of fear-induced behavior in response to stressors (Machado et al., 2009), and creation of memory for stimuli associated with fear (Hamann, 2007). However, many studies have shown that the amygdala is also involved in many other negative emotions, such as anger (Siep et al., 2019). This may be due to the rapid flow of emotions, meaning that the emotion of fear transitions to or elicits other emotions, such as anger as a form of protection after being scared (Zheng et al., 2016). Additionally, amygdala activation has been observed in the recognition of happiness, but it was greater in the recognition of fear (Fusar-Poli et al., 2009).

*Anger*. Anger can function as a response to bodily discomfort, a way of defending against a predator attack (in this sense, anger can be a possible consequence of fear, as mentioned above), and as directed behavior when some external circumstance interferes with achieving a desired goal, causing frustration (Panksepp, 2004). Therefore, the localization of anger represents a complex neurobiological structure and may differ in studies. Due to the association of anger with hunting behavior, the orbitofrontal cortex may be involved; as a reaction to frustration, the

anterior cingulate cortex (a consequence of sadness); and as a secondary emotion after fear as a means of protection, including in response to stress, the amygdala and orbitofrontal cortex may be involved (Reynaud et al., 2015). In addition, a meta-analysis (Bertsch et al., 2019) confirmed increased activation of the left amygdala in response to images of anger.

*Disgust.* Disgust evolved from taste mechanisms that protect the body from eating unsafe foods. C. Darwin believed that disgust is caused by what arouses disgust, primarily in relation to the sense of taste (both perceived and imagined) (Darwin, 1872). The emotion of disgust protects us from infections that can be found in inedible products, as well as from morally offensive phenomena (for example, such as incest, sexual abuse, etc.) (Rozin, 2008). The insula is thought to be the site of disgust, but there is also neuroimaging evidence that the anterior insula is also active during anger (Oaten et al., 2019). Indeed, disgust in moral situations often elicits anger, hence any study of the localization of disgust also includes a neural network associated with anger. Aversive actions include typical facial expressions and, for example, the rapid expulsion of a potentially irritating food. As a result, the subject will not consume potentially toxic food, and other subjects may also be alerted to the potential hazard (Harrison et al., 2010).

*Surprise.* The emotion of surprise warns humans of any deviations from expectations (both positive and negative) (Fouragnan et al., 2018). The surprise system works so that the organism can concentrate its energy on the most important stimuli now (Kahnt et al., 2010). By using this attention for relevant stimuli, a person receives important information and can change their behavior regarding a specific situation in favor of adaptation (Fouragnan et al., 2018). According to a meta-analysis of fMRI studies, surprise is predominantly localized in subcortical areas, including the amygdala and striatum, as well as in certain areas of the cortex, such as the ventromedial prefrontal cortex and cingulate cortex (Bartra et al., 2013). This is consistent with many visual data that suggest that the amygdala plays a key role in processing new stimuli (Blackford et al., 2010). Additionally, it is worth noting that surprise is also associated with hippocampal activity, which plays an important role in

forming and storing memories (Schott et al., 2019). Therefore, surprise can help a person remember and successfully adapt to new situations in the future.

Overall, many neuroimaging studies indicate specific brain regions associated with certain emotions, such as the amygdala for fear (Öhman, 2005), the ventromedial prefrontal cortex for happiness, the anterior cingulate cortex for sadness, and the orbitofrontal cortex for anger (Murphy et al., 2003), and the insula for disgust (Wicker et al., 2003). However, as mentioned earlier, it is likely that people often experience mixed emotions, making it difficult to study the structure of individual emotions. Moreover, the emotional and cognitive spheres are interrelated, and their separation in the brain structure also presents difficulties. Therefore, there is another approach to studying the emotional sphere in neuroscience.

### 1.1.3. Cognitive neuroscience

Cognitive neurobiologists are interested in the emotion recognition by facial expressions, as there is evidence that this ability is supported by discrete neural circuits, thus representing a specialized function of the brain. However, despite the wide and long-standing interest in this topic, it is still unclear how emotion recognition becomes specialized and what drives the development of neural systems that support this ability. The cognitive neurobiology approach is consistent with L. Barrett's psychological theory of emotion construction. According to the theory of constructed emotion, the amygdala is part of a distributed network (in the frontal lobes) that helps to realize the core affect, as it participates in conveying signals about whether the exteroceptive sensory information is motivationally significant (Adolphs, 2008). Core affect is what a person feels at any given moment, it is a neurophysiological state that is consciously accessible as a simple, non-reflexive feeling that represents a mix of hedonic (pleasure-displeasure) and arousal (high activation-low activation) values. Thus, at any given moment, a person can feel calm (low activation and pleasure), tense (high activation and displeasure), or experience happiness (pleasure, high activation) (Russell, 2003).

*The role of the amygdala.* According to proponents of the cognitive biology approach, the amygdala is typically involved in orienting responses to motivationally significant stimuli, rather than as a specific localization for fear according to the basic

theory of emotions (Holland, Gallagher, 1999). The authors of this approach cite studies with new and unusual stimuli that strongly activate the amygdala (Blackford et al, 2013; Herry et al, 2007). Furthermore, the amygdala is activated in response to emotionally significant stimuli for humans (Jenison et al., 2011) and deactivated during the fear of public speaking. Therefore, the role of the amygdala is not limited to the localization of fear and may not be such at all.

*The role of the insula.* As mentioned above in the description of the basic theory of emotions, the insular cortex is considered a localization of disgust, but there are studies that also report its involvement in anger. According to the cognitive neuroscience, the anterior insula plays a key role in creating core feelings in consciousness. It is believed that the anterior insular cortex is responsible for the awareness of bodily sensations and emotions (Craig, 2002; Craig, 2009). The anterior insula shows increased activation during the awareness of body movement (Tsakiris et al.), stomach distension (Wang et al., 2008), and orgasm (Ortigue, 2007). In addition, the role of the insula is important in the allocation of attention (Paulus, Stein, 2006). Overall, constructivists and cognitive biologists believe that insular activity correlates with interoception and the awareness of emotions.

*The role of the frontal lobe.* The frontal lobe is divided into the orbitofrontal, ventrolateral, and dorsolateral cortex. Cognitive scientists believe that the orbitofrontal cortex (OFC) combines exteroceptive and interoceptive sensory information to control behavior. Thanks to the connections between the lateral OFC and sensory modalities (Kringelbach, Rolls, 2004) and the medial OFC with areas involved in visceral control (Carmichael, Price, 1995), the OFC is anatomically well-suited for controlling behavior. In accordance with the idea that the OFC combines internal and external sensory information, the lateral and medial OFC are associated with associative learning (Rolls et al., 1996) and decision-making (Bechara et al., 1996). The ventrolateral and dorsolateral cortex localize the process of interpreting sensory signals. These brain regions may use stored representations of previous experience to interpret core affective data emanating from oneself or from observing others (Lindquist et al., 2002).

*The role of the anterior cingulate cortex.* In the classic theory of the limbic system, the ACC is generally considered to be associated with sadness. However, cognitive neurobiologists believe that this part of the brain is involved in various psychological operations related to the implementation of core affect during motivated action, as well as in making decisions in situations involving conflicting sensory information (Grinband et al., 2011). The anterior cingulate gyrus is also involved in representing abstract social concepts (Zahn et al., 2009) and supports language as a heteromodal associative area, i.e., it is used in constructing emotional perceptions from exteroceptive sensations (Lambon et al., 2009). Additionally, it has been suggested that the ACC may be a center that integrates self-reflective information and is used in evaluating perceptual images of one's own face (Morita et al., 2014).

*The role of the occipital lobe.* A meta-analysis (Fusar-Poli et al., 2009) showed that activation of the visual cortex (lingual gyrus, inferior and middle occipital gyrus, fusiform gyrus) occurs during recognition of all emotions through facial expressions.

Despite the enormous efforts of neuroimaging research, the picture characterizing emotional processes remains incomplete and ambiguous. Let's now turn to the examination of the emotional sphere from the perspective of the psychological approach, starting with its origins.

## 1.2. Fundamental psychological theories of emotion recognition

### 1.2.1. Origins of psychological theories of emotion recognition

Z. Freud considered emotions through the prism of the unconscious. According to his idea, the unconscious is a source of excess energy, which he defines as libido. The structural content of the libido is due to the conflict situation that took place in the past and is encrypted at the instinctive level. That is why the mechanism of displacement of unpleasant impressions from the memory occurs. The famous theories of emotions by W. James, G. Lange, W. Kennon, P. K. Anokhin, L. Postman and B. Schneider and others make a huge contribution to the representation of the emotional sphere. W. Wundt proposed a three-dimensional theory of emotions in terms of a constructive approach and suggested that emotions are caused by a set of basic common elements (Wundt, 1969). Structural theory postulated that human emotions

arise because of the fusion of six basic feelings: pleasure-displeasure, excitation-inhibition, tension-relaxation. These ideas contribute to the dawn of theoretical positions on the emotional sphere by the end of the twentieth century.

P. V. Simonov, inspired by the P. K. Anokhin's theory, put forward his informational theory of emotions. P. V. Simonov (1992) created a classification of emotions according to the nature of the action: overcoming, defense, attack. He also highlights additional shades according to the magnitude of the need that causes the emotion and according to the assessment of the probability of its satisfaction. L. Festinger proposed his cognitive theory. One of its features is the relationship between affect and intelligence (the emotional and cognitive components). The theory states that from the possible ways of interpreting and evaluating the same situation (objects) and their behavior in it, a person chooses those that cause less anxiety and remorse (Festinger, Carlsmith, 1959). B.I. Dodonov (1987) put forward a classification of emotional processes based on the relationship between human needs and emotional processes. The researcher notes that each person has an "emotional melody" - a general emotional orientation, characterized by the closest to a person, desirable and constant emotions. E. D. Khomskaya (1987), in addition to the polarity (sign), intensity, duration and objectivity of emotions, highlights reactivity (speed of occurrence or change), quality (connection with need), the degree of their arbitrary control. Chomskaya also notes there are more unresolved issues in the psychology of emotions than in other areas of psychological knowledge (Khomskaya, Batova, 1992).

### 1.2.2 The differential emotions theory

The well-known definition of emotion by C. Izard is a complex phenomenon includes neurophysiological, motor-expressive components and subjective experience. The interaction of these components in the intra-individual process forms an emotion, which is an evolutionary-biogenetic phenomenon. According to C. Izard, the human expression and experience of emotion is innate, common cultural and universal. C. Izard (1971, 1972) argues that emotions form the primary motivational system of a person, which consists of 10 basic emotions (joy, surprise, interest, sadness, anger, fear, disgust, contempt, shame, guilt). Moreover, emotions also form personal processes that

give meaning and meaning to human existence (Izard, 1999). In addition, C. Izard developed a system for encoding facial muscle movements during emotions (Izard, 1979).

### 1.2.3. The behavioral-psychological approach

A. Friedland and colleagues adhere to the behavioral ecological theory, which originates from the evolutionary approach. According to the author's ideas, emotions do not reflect and express the emotional state of a person (as C. Darwin wrote) but is just a means of social interaction. From this perspective, facial expressions allow both humans and primates to establish social relationships. For example, crying is a request for help, not an expression of grief, and an expression of anger is used to force others to comply, not just to convey emotion. A. Friedland does not deny that emotions exist, but he does not admit that the face is a communicative means, the main purpose of which is their expression (Carlos, Fridlund, 2018; Fridlund, 1994).

### 1.2.4. Cognitive schema of emotion recognition

The authors consider the cognitive schema as the main unit of the organization of knowledge about emotions. Elements of the cognitive schema: the situation that causes emotion; its external manifestations, primarily facial and vocal; accompanying physiological changes; behavioral consequences; desires, thoughts, etc. (Wierzbicka, 1999). Furthermore, the authors provided empirical evidence that the older the child, the more cognitive schemes he operates (Bylkina, Lyusin, 1996).

### 1.2.5. Theory of communication & perception

The communicative theory implies that in the process of social interaction each person is both the subject and the object of everyday cognition, and the process itself proceeds in opposite directions. In other words, people try to understand with the help of perception what kind of person they are and to build an individual communication with him/her, moreover, to choose the right partner, friends and to understand with whom it is not worth communicating. Б. F. Lomov believed that in communication the subjective world of another person is revealed (Lomov, 1984). Adherents of the communicative-perceptual approach distinguish 2 ways of perceiving expressions: "synthetic" (recognition of emotional expression in general) and "analytical"

(recognition and evaluation of facial elements), which affect the identification of emotions in different ways. V.A. Barabanshikov et al. describe different stages of perceptogenesis of expression identification. The early stage is 30 ± 10 ms, here the face is analyzed as a whole, that is, a synthetic method of perception is used. And for 100–200 ms, people use the analytical method – they examine the lower part of the face more and compare the key features of expressions (Barabanshchikov et al., 2012). Within the framework of the theory of communication & perception, the verbalization analysis method was singled out (this analysis considers situations in which research participants need to give a comparative description of perceived events) (Nosulenko, Samoylenko, 2012).

### 1.2.6. Facial expressions as modes of action readiness

Emotion on the side of this approach - a state that includes feelings, physiological changes, expressive behavior, and a tendency to be ready for action, caused by previous events, as evaluated, and demonstrating a certain degree of control priority (Frijda et al., 1986). The state of readiness for action is the actual content of emotional expression and information for other people. The authors of this approach believe that emotions are expressed in facial expressions when additional conditions (that is, the external situation). Also, the emotion of "Anger" is considered by the authors as a designation of a reaction to an event that is assessed as reprehensible, regardless of the nature resulting from the state of readiness for action (Frijda, Tcherkassof, 2002).

### 1.2.7. The dialect theory

The dialect theory suggests the presence of subtle cultural differences in the use of signals to express emotions, to ensure accurate communication across cultural boundaries. As a result, misunderstandings may arise between different cultural groups. Dialects are varieties of language used by different speakers, separated by geographical or social boundaries in linguistics (Francis, 2001). Like with other languages, different cultures may express themselves in different dialects, which is the first premise of the dialect theory. In addition, the existence of dialects may make emotion recognition less accurate in another culture. A meta-analysis by H. Elfenbein

and N. Ambady (2002, b) of cross-cultural studies on emotion recognition using various research procedures and nonverbal channels found that people better recognized emotional expressions of members of their own cultural group. The explanation for cross-cultural differences in emotion recognition is focused on the influence of emotion expression rules in a particular culture and decoding rules (Buck, VanLear, 2002), which are formed in childhood (Ekman, 1971). These rules prescribe what to do with the expression of each emotion in different social situations. Additionally, they vary depending on social role and demographic characteristics and, accordingly, cultures (Elfenbein, Ambady, 2002 (a); Elfenbein, Ambady, 2002 (b); Elfenbein, Ambady, 2003).

### 1.2.8. The theory of constructed emotion

According to L. Barrett, emotions are not reactions to the world and humans are not passive recipients, but active creators of their emotional reactions. Using input signals and past experiences, the human brain constructs meaning and prescribes necessary action. L. Barrett describes the significant contribution of simulation to understanding the emotional sphere: if a person has encountered certain patterns in their life, then in the future, their brain will simulate them when similar stimuli are encountered (for example, a reaction to spoiled food). The classical (basic) emotion theory states that all emotions are innate and universal. The theory of emotion construction suggests that emotions are not innate and are only universal due to common concepts. It is precisely the ability to form concepts that give meaning to a person's physical sensations that is universal. Emotions are a social reality, meaning that words and concepts in each culture help establish connections in the brain and make physical changes during emotion expression. Barrett argues that the constructionist approach has much in common with cognitive neurobiology approaches, which claim that basic psychological operations are common to different areas of the brain rather than located in specific locations (Cole, Schneider, 2007; Smith et al., 2009; Wager et al., 2008). Like the neural context hypothesis, she suggests that the psychological function of individual brain regions is partially determined by the network of brain regions that it excites (McIntosh, 2004).

### 1.2.9. Neurocultural theory of emotions

P. Ekman proposes the neurocultural theory of emotions that includes the following components: 1) stimuli that elicit external manifestations of emotions - external events, expectations, memories, etc.; 2) a program for expressing emotions on the face – muscle activity on the face when expressing basic emotions such as happiness, anger, surprise, fear, disgust, sadness, and contempt; and 3) display rules - cultural prescriptions to intensify or diminish intensity, neutralize or mask emotions. Ekman provides two characteristics of the concept of "basic emotions": (1) emotions are discrete (can be distinguished from each other by facial expression, physiology, and the causes that elicit them); and (2) emotions emerged during phylogenetic and ontogenetic adaptation. Other emotions are a combination of basic emotions (Ekman, 1971). P. Ekman and his colleagues adhere to a compromise theory regarding the true nature of the emotional sphere, between universalism and social constructivism. Some scientists believe that emotions are innate (C. Izard), while others consider them to be social constructs (L. Barrett). From the perspective of linguists, the proponent of universalism is linguist A. Wierzbicka. She asserts that emotions are universal and believes that there is a common metalanguage, which she calls Natural Semantic Metalanguage (NSM), that is used in all languages (Wierzbicka A., 1999). Strong supporters of social constructivism are historians P. Eitler and M. Schir. According to their view, humans currently possess a brain that has evolved over millions of years through the influence of culture, as well as individual biographical changes (Eitler et al., 2014). P. Ekman occupies a middle position and believes that basic emotions are present in all cultures, but facial expressions are mediated by cultural rules of expression. This view is supported by many scientists around the world to this day. For example, in their article, D. Kelly and colleagues provide results from their study on differences in initial visual fixation on facial regions in European and Asian countries. They found that the first visual fixation for Europeans is on the eyes and brows, while for Asians, it is on the nose and mouth, avoiding the eye region, which may be related to communication differences in different cultures (Kelly et al, 2011).

Based on our literature analysis regarding neurobiological and psychological theories, we can identify two main and competing theories. According to the basic emotion theory, each emotion has its own localization in the brain, and basic emotions are universal and innate. Opposite idea by constructivists and cognitive neurobiologists is the basic psychological operations are shared across different brain regions and are not localized to specific areas, and humans are active creators of their emotional reactions.

## 1.3. Structure of emotion recognition

### 1.3.1 Modern concepts of the neurobiological basis of emotion recognition

R. Adolphs (2002) describes the following approximate picture of the dynamic connection between brain substrates during emotion recognition. When an emotionally significant stimulus is presented, the neurobiological pathway of information about emotion recognition looks something like this. Since visual information is in front of a person, the path originates from the visual cortex and passes through the temporal region, then within 100 ms people go through the process of classifying an object based on the structural image, that is, whether a person expresses an emotion at all or not. The amygdala and orbitofrontal cortex may be involved in facial emotion recognition in at least three different ways. First, they can help to understand the subtleties of facial expression and to focus attention on some of its features (Puce et al., 1999). Second, the amygdala and orbitofrontal cortex can help retrieve conceptual knowledge about emotions and relay information to other areas of the brain, such as the anterior cingulate cortex, the insula, and so on, depending on the emotion presented by the stimulus. Thirdly, they can generate an emotional response in the subject through connections with the motor structures, the hypothalamus, and the brainstem nuclei, where components of the emotional response to facial expressions can be activated. It is likely that the simulation of someone else's emotion can occur through the creation of a somatosensory image through the somatosensory cortex of the corresponding body state, even in the absence of real motor mimicry (Adolphs, 2002).

In psychophysiological studies using electroencephalography (EEG), it has been shown that event-related potentials are considered neurocognitive markers of facial expression processing (see review by Schweinberger, 2011).

An event-related potential (ERP) is a brain response that results from an electrophysiological response, i.e., a specific sensory, cognitive, or motor event. Early posterior negativity (EPN) is a component that manifests itself bilaterally in the temporo-occipital regions with a latent period of about 200 ms. EPN is registered regardless of the emotion sign and reflects the switching of attention to an emotional stimulus associated with its intrinsic motivational significance (Lang and Bradley, 2010; Wiens et al., 2011). Another marker of emotion recognition is late positive potential (LPP), which begins approximately 300 ms after the start of the stimulus and manifests itself in differences between neutral and emotional stimuli (words or images) and does not depend on size and other physical characteristics stimulus does not disappear upon repeated presentation of emotional stimuli (Codispoti and Ferrari, 2006; Delplanque, 2004). Also, LPP is a reliable and reproducible indicator of the motivational significance of an image (Lang and Bradley, 2010). A study using dynamic emotional expression stimuli showed that in relation to happiness and neutral facial expressions, negative emotional expressions elicited larger late positive components (LPC), in other words, recognition of negative spectrum emotions is a more complex process (Recio et al., 2014).

The N170 component is an event-related brain potential (ERP) and has a negative waveform with a peak approximately 170 ms after stimulus presentation. It is observed in the occipital-temporal areas and with greater amplitude over the right hemisphere. ERP N170 is observed in response to various facial stimuli, so it may reflect the neural mechanism of human face recognition. The N170 component is often seen as a manifestation of the structural and holistic coding of faces (Eimer, 2011), and may also be enhanced when the emotion of fear is recognized (Batty and Taylor, 2003; Williams et al., 2006). The emotional specificity of N170 may also be related to the demands of tasks and the allocation of attentional resources (Calvo and Beltrán, 2014). A recent study by S. Han et al showed that the N170 stage processed geometric face

configurations rather than the emotional concepts of faces, which are also characteristic of the P2 stage. Moreover, the researchers performed information flow analyzes that showed a significant decrease in the flow from the fusiform gyrus to the dorsal anterior cingulate gyrus/dorsal medial prefrontal cortex and an increase in the flow of information from the fusiform gyrus to the posterior insula (Han et al., 2021).

### 1.3.2 The complexity of the emotional structure

The structure of emotions so far is best shown with the help of an emotional lexicon, in other words, a person's description of his feelings. At the end of the last century, it was believed that the structure of emotions in the human lexicon has a hierarchical organization, in other words, there are main emotional systems and their subsystems (tree structure) (Simon, 1971). However, A. Cowen and D. Keltner showed that the structure of affect is more complex, which includes several emotional categories and numerous relationships between them (Cowen, Keltner, 2017).

According to K. Mulligan and K. Scherer (Mulligan, Scherer, 2012), the minimum conditions that determine an emotion are as follows: (1) emotions are directed towards an object; (2) emotions are associated with bodily changes that are felt; (3) emotions contain subjective experience; (4) emotions are triggered by a particular evaluation of an external event, commonly referred to as evaluation; and (5) emotions have functional implications for individual and/or social life.

R. Berrios (Berrios, 2019) pays attention to the emotional and presents arguments showing that a unified system of emotional complexity is possible, but it requires clarification of the emotional and complex features of emotional complexity. He proposed his systematization of emotions, in which emotional complexity has 3 forms: emotional differentiation, emotional interdependence and aesthetic emotions. Emotional differentiation involves distinguishing between many positive and negative emotions (Grossman et al., 2016). In turn, emotional differentiation includes emotional granularity and a variety of emotions. Emotional granularity is an individual difference associated with the ability to make finer distinctions and well-differentiated reports of emotional experiences, as demonstrated by the weak correlation between emotional states of the same valence (Barrett, 2004). And the variety of emotions is a measure of

the richness of emotional complexity and proportionality of experiences of a wide range of emotions. The extent to which people can experience diverse and rich emotional experiences (Quoidbach et al., 2014). Emotions mutually influence each other throughout the event, changing the intensity of subsequent affects, combining multiple emotional experiences because of similar assessments, or changing the behavior that will be applied at a given moment. Emotional interdependence includes mixed emotions (simultaneous experience of positive and negative emotions), affective dynamics (for example, changing the dynamics from feelings of excitement to melancholy), meta-emotions (when one emotion causes another, for example, sadness causes anger). Aesthetic emotions are a group of experiences experienced during aesthetic perception, including stimuli from nature (such as natural wonders) and human creations (such as painting or music), as well as emotional responses that follow religious experiences or insights. R. Berrios divides aesthetic emotions into 2 complex emotional experiences: awe and being-moved (by something) (Berrios, 2019). Awe is a mixture of surprise, pleasure, exaltation, and amazement (Keltner & Haidt, 1999). Stellar and colleagues (Stellar et al., 2018) found that awe is preceded by appraisals of the perception of infinity and the need for reconciliation (i.e., revising or creating new mental schemas to account for paradoxical or unfamiliar information about the environment). Being-moved (by something) – emotional experiences of sadness and joy. Examples of this experience can be found in critical life events such as death and birth, as well as significant relationship events (reunions) (Menninghaus et al., 2015). Complex emotions can be interpreted as emerging phenomena of self-organization.

Emotion recognition is a very complex mental process, the stages of which are only beginning to be described by recent research. Emotion recognition affects various structures of the brain, the connections of which have not been studied so far. The notion of emotional complexity has only recently been developed and is not classical, but it destroys the usual tree-like representation of the hierarchy of emotions and allows you to look at it in a new way. Emotional complexity expands and complicates the concept of emotion recognition.

## 1.4. Emotion recognition in diseases

### 1.4.1. Neurobiological approach to the impaired emotion recognition

N. Farahat et al. show that damage to the areas of the brain responsible for recognizing emotions by facial expressions, before or immediately after birth, leads to long-term impairments in face recognition (Farahat et al., 1995). Damage to areas of the brain is most studied in strokes, as well as rare but well-known diseases, such as prosopagnosia. Prosopagnosia is a cognitive disorder of facial perception in which the ability to recognize familiar faces, including one's own face, is impaired while other aspects of visual processing (eg, distinguishing objects) and intellectual functioning (eg, decision making) remain intact. The term originally referred to the condition following acute brain injury (acquired prosopagnosia), but there is also a congenital or developmental form of the disorder with a prevalence of 2.5% (Grüter et al., 2008). Prosopagnosia is often accompanied by involvement of the ventral occipitotemporal and temporal lobes. An illustrative example of prosopagnosia can be found in a patient who has difficulty recognizing familiar faces, although his general perception of objects is not impaired (Farahat et al., 1995; Farah, 1996). A. House et al. (1989) focused on the manifestations of emotionality in stroke patients. The authors showed that sudden episodes of uncontrollable bursts of crying are often observed in patients with lesions of the left frontal lobe, indicating that the anterior regions of the left hemisphere may play a critical role in emotional control functions (House et al., 1989).

Regarding the genetic mechanisms in pathology, a study of polymorphic variants of the serotonin transporter genes was carried out to search for the molecular mechanisms of the known deficit in recognition of mimic expression in schizophrenia, which negatively affects the social adaptation of patients (5-HTTLPR SLC6A4) and catechol-O-methyltransferase (Val158Met COMT) (Sirota et al., 2016). Significant associations with the recognition of emotions by patients were shown only for the 5-HTTLPR polymorphism: homozygotes for the long allele identified facial emotions significantly better than carriers of the short allele. Although emotion recognition in the group of patients correlated with negative symptoms, verbal learning, and personal anxiety, these signs did not have a significant modifying effect on the identified

association. At the same time, no effects were found for COMT on the identification of emotions in the norm or in schizophrenia (Alfimova et al., 2014). In addition, the effect of the interaction of polymorphic loci in the GRIN2B and DRD2 genes on the features of emotion recognition based on facial expression in schizophrenia was confirmed (Alfimova et al., 2017).

*1.4.1.1 The role of parts of the brain in violation of the emotional sphere*

The results of a Chinese study show that facial recognition consists of two associations, from the geometric structure of the face to the emotional expression of the face. Analysis of neurobiological level information flow showed a significant increase in fusiform gyrus flow in the dorsal anterior cingulate cortex/dorsal medial prefrontal cortex and an increase in fusiform gyrus flow in the posterior insula (Han et al., 2021). Therefore, we are faced with the problem of brain dysfunction in more detail.

*The role of the amygdala.* In 1994, R. Adolphs and colleagues reported an intriguing discovery that changed our understanding of the brain organization of emotions (Adolphs et al., 1994). They examined a person suffering from Urbach–Wiethe disease. Urbach–Wiethe is a rare hereditary disease that causes bilateral calcifications of the medial temporal lobes, with the amygdala being especially affected. These patients were found to have selective deficits in recognition of facial expressions of fear while maintaining recognition of other basic emotions (happiness, sadness, disgust, anger, and surprise). Besides, the structures of the amygdala are destroyed in Huntington's disease, because of which the recognition of mimic images of fear was weakened. However, disgust recognition was much more impaired in Guttington patients than fear recognition (Sprengelmeyer et al., 1997). Patients with amygdala involvement (LaBar et al., 1995) or atrophy of the amygdala (Bechara et al., 1996) show abnormal skin conduction response during fear learning and have difficulty perceiving voiced fear (Brierley et al., 2004) and have impairments in fear emotion recognition (Adolphs, 2010). A person with bilateral amygdala involvement did not report fearful experiences when placed in close contact with snakes and spiders (Anderson and Phelps, 2002). In addition, the amygdala has been implicated in anxiety-related psychopathology in humans (Damsa et al., 2009; Etkin and Wager, 2007).

According to cognitive biology authors, lesions in the amygdala disrupt the normal mammalian response to novelty and uncertainty (Bliss-Moreau et al., 2010; Nachman and Ashe, 1974). Many scientists believe that the neurological basis for the impaired emotion recognition in personality disorder is dysfunction of the amygdala (Amygdala) (Blair, 2003). A meta-analytic study has shown that a decrease in the bilateral volume of the hippocampus and amygdala is characteristic of patients with a personality disorder (Ruocco et al., 2012). A moderate decrease in the volume of these brain structures was also characteristic of people who had undergone post-traumatic stress disorder (Ahmed-Leitao et al., 2016), and there was also bilateral activation of the amygdala in response to the presentation of an image of the emotion of fear and anger in people with an increased level of anxiety compared to with healthy controls (Steinet et al., 2007). Moreover, the amygdala is involved in emotion recognition processing regardless of psychopathology (Phelps and LeDoux, 2005) and damage to it leads to impaired interpretation of the intensity of the emotion of fear in others (Adolphs, 1999). In opioid dependent individuals, there are studies describing significant amygdala activity in response to images of the emotion of fear. At the same time, the introduction of heroin sharply reduced the reaction of the left amygdala to the presentation of such a stimulus. Also, left amygdala activity correlated significantly with measures of anxiety and ACTH (adrenocorticotropic hormone) and cortisol levels among all participants (Schmidt et al., 2014).

*The role of the insular cortex.* Individuals with damage to the anterior insula and basal ganglia have difficulty perceiving manifestations of disgust in facial expressions and in speech (Adolphs et al., 2003). They also report less disgust in response to human and animal waste, which is usually disgusting in people with an intact insula (Calder et al., 2010). Individuals with neurodegenerative diseases that affect the insula and basal ganglia (such as Huntington's and Parkinson's disease) also show reduced sense of aversion to unpleasant odors (Mitchell et al., 2005) and have difficulty perceiving manifestations of disgust in the faces of others (Kipps et al., 2007). These results have been confirmed by other studies. Interesting data were found by A. Hennenlotter and his colleagues: patients with a preclinical picture of Huntington's disease were worse

at recognizing the emotion of disgust, in contrast to a healthy sample (Hennenlotter et al., 2004), In addition, f-MRI showed a decrease in activity in the insula upon presentation of images of faces with the emotion of disgust. Patients with obsessive-compulsive disorder who have repetitive thoughts about possible pollution show abnormally increased insular activation when viewing disgusting scenes (Shapira et al., 2003). Also, a patient with an ischemic stroke of the left hemisphere involving the insula had a selective deficit in recognition of disgust for scenes and facial expressions, as well as a decrease in subjective statements about disgust. This patient also showed a decrease in subjective statements about disgust, although he could accurately recognize other emotions and easily discuss the logical side of the emotion of disgust (Calder et al., 2000). Another patient with bilateral insular (frontal and temporal) lesions showed a general deficit in recognition of facial expressions in static images, but selectively the impaired recognition of disgust when using dynamic facial cues (Adolphs et al., 2003). One large study showed that vascular damage in the right somatosensory cortex, including the insula, was associated with impaired ability to recognize emotions, although disgust was not specifically studied (Adolphs et al., 2000). Abnormal insular gray matter volumes obtained by neuroimaging have been characteristic of patients with schizophrenia, eating disorders, anxiety, and mood disorders, conduct disorders, autism, addiction, and chronic pain (Gasquoine, 2014). A decrease in the volume and activity of gray matter in the insula was shown in chemical addictions (Droutman et al., 2015). In addition, damage to the insula leads to nicotine addiction (Naqvi and Bechara, 2010).

*The role of the frontal lobe.* There is evidence that one of the consequences of traumatic brain injury in the frontal lobe is the impaired recognition of negative emotions (Callahan et al., 2011). For example, emotion recognition has been shown to be impaired after ventromedial injury (Heberlein et al., 2008). An increased level of aggression has been shown in antisocial personality disorder and changes in the medial orbitofrontal cortex (Raine et al., 2000; Yang, Raine, 2009; Grüter et al., 2008). Studies of the prefrontal cortex have confirmed that its disorders lead to emotional dysregulation (Banks et al., 2007). Patients with a personality disorder show deficits in

functioning in an area of the brain designed to detect planning failure (Masi et al., 2014). Besides, a bilateral decrease in glucose uptake in the medial orbital cortex, including Brodmann areas 9, 10, and 11, has been found in patients with BPD compared with healthy controls (Soloff et al., 2003). Chemical dependence studies have shown a decrease in the volume of the frontal lobes in cocaine addicts (Liu et al., 1998; Franklin et al., 2002), alcohol addicts (Pfefferbaum et al., 1997; Catafau et al., 1999) and heroin addicts (Liu et al., 1998). The latest study noted a negative correlation between prefrontal cortex volumes and years of cocaine or heroin use, suggesting a cumulative effect of substance abuse on the frontal lobe. Moreover, according to a meta-analysis, abnormal or delayed development of key frontal areas of executive control may predispose people to excessive alcohol consumption (Lees et al., 2019).

*The role of the anterior cingulate cortex.* The ACC is the link in the ascending and descending pathways between the frontal lobes and the limbic system in relation to the emotional realm. Besides, this region of the brain is involved in emotion assessment, emotion-related learning, and autonomic regulation (Stevens et al., 2011). ACC lesions (including lesions of the dorsomedial prefrontal cortex) cause hypersensitivity and an increased tendency to cry at sad events (Hornak et al., 2004). Functional ACC abnormalities are present in mood disorders such as depression (Gotlib and Hamilton, 2008) and mania (Fontaine et al, 2007). In addition, a significant correlation was obtained between craving and changes in ACC glucose metabolism (Maas et al., 1998).

A study of Theory of Mind (ToM) impairment using the Eyes Test technique (identification of the emotional state by eye expression in local brain lesions) showed regardless of the location of brain damage, all patients experienced difficulties in recognizing facial expressions (Sharp et al., 2011). In case of damage to the basal ganglia, there was a general decrease in the ability to identify facial expressions, regardless of the complexity of emotions. The authors conclude that a relatively higher degree of preservation of understanding of mixed emotions, as opposed to basic ones, in patients with cortical/subcortical brain lesions may indicate a multilevel and bilateral cerebral organization of social perception (Shipkova, Malyukova., 2017).

### 1.4.2. Psychological approach to impaired emotion recognition

Deficiencies in the ability to recognize basic emotions are associated with various mental health problems (Mikhailova et al., 1996). Initially, the ability to recognize emotions by facial expression was studied in severe mental disorders, most often in schizophrenia. According to some authors, the assessment of this ability makes it possible to predict the social competence of patients with schizophrenia (Mueser et al., 1996). J. Pena-Garijo et al believe that impaired emotion recognition may be important in identifying the risk of psychosis. They add that emotion recognition is impaired in individuals at high risk for schizophrenia and increases over the duration of psychosis (Pena-Garijo et al., 2023).

Impairment facial emotion recognition is also characteristic of patients with epilepsy (Fediukovich, Trusova, 2021; Meletti et al., 2009). Patients with focal epilepsy scan facial areas relevant to successful emotion recognition more absently and less efficiently than healthy subjects (Metternich et al., 2022).

Scientists also note that there are impairments in the recognition of all spectrums of emotions, as well as neutral faces, even with mild cognitive decline and early signs of Alzheimer's disease (Weiss et al., 2008) and Huttington's disease (Robotham., 2011). Moreover, there is a deficit in emotion recognition in Parkinson's disease without cognitive decline (Herrera et al., 2011).

One of the psychological constructs that attributes disorders of emotion recognition is alexithymia. Alexithymia is characterized by a limited ability to identify and describe feelings, difficulty distinguishing between different feelings, an externally oriented cognitive approach to reality, and difficulty modulating feelings (Porcelli et al., 2004). There is evidence that alexithymia is associated with impaired facial emotion recognition (Grynberg et al., 2012). K. Prkachin et al. in their study showed a weakened ability to detect emotional expression in individuals with alexithymia. Greater difficulties were recorded in recognizing emotions such as sadness, anger, and fear (Prkachin et al., 2009). A study by D. Grynberg et al. showed people with high rates of alexithymia need more attentional resources to process emotionally negative facial expressions (fear, pain, anger) (Grynberg et al., 2013). One of the few Russian

studies of facial expression recognition of another person's emotions was conducted in the context of studying the relationship between alexithymia and the ability to emotional and cognitive empathy (Moskacheva et al., 2014). In a sample of 90 healthy subjects, it was shown that persons with a more developed ability to recognize and verbalize their feelings are better than other subjects to recognize such emotions that are difficult to recognize by facial expression, such as contempt and surprise. These subjects also had a higher overall score for emotion recognition accuracy. In this study, the severity of alexithymia was negatively correlated only with the accuracy of recognition of the emotion of fear. The authors conclude that alexithymia is a generalized disorder that affects not only the ability to be aware of one's own feelings, but also the impressive ability of a person (Moskacheva et al., 2014).

The study by V. A. Shabalina demonstrated significant gender differences in the perception of facial expressions in highly subjects with alexithymia: women were more accurate than men in recognizing neutral and negative emotional signals of other people, while men were more successful in recognizing positive and sexualized emotions (Shabalina., 2017). Many authors point to a significant prevalence of features of alexithymia in people with alcohol and drug addiction and its role in the development of addiction (Bychenko., 2020; Craparo et al., 2014; Luminet et al., 2016; Morie et al., 2016). Besides, alexithymia, as a deficit in the ability to recognize one's own emotions, seems to be a stable individual psychological characteristic of patients with alcohol and drug dependence (Tarkhan et al., 2017; Craparo et al., 2016). According to Craparo’s study, long-term heroin exposure is associated with impaired emotion recognition and alexithymia, which negatively affects the interpersonal relationships of addicts (Craparo et al., 2016).

For decades, clinicians and researchers have recognized that borderline personality disorder (BPD) and substance use disorders are often diagnosed in the same person (Gunderson., 2001; Leichsenring et al., 2011; Paris, 1994; Trull et al., 2000). Current theories suggest that emotion dysregulation and impulsivity play an important role in the development of both disorders (Littlefield et al., 2016; Crowell et al., 2009; Gunderson et al., 2018), as well as childhood trauma and heredity (Trull et al., 2018).

Substance use may be an attempt to regulate negative emotions (Cooper et al., 2016), as well as a means of alleviating the emotional stress that alexithymia causes (Bychenko, Kopytov, 2020). In a meta-analysis by L. Hanegraaf et al., four meta-analyses were conducted that revealed significant deficits in the ability to identify emotions by facial expressions and infer the mental state of others in both BPD and chemical addictions (Hanegraaf et al., 2021). It should be considered that one disorder can develop from another and vice versa (Trull et al., 2018). Decreased self-control and experiencing strong emotions, as a diagnostic indicator of BPD, often leads to alcohol and drug abuse, self-harm, interpersonal communication problems, because of which the patient's social adaptation decreases (Gunderson et al., 2018).

In a meta-analysis study by L. Hanegraaf et al., four meta-analyses were conducted that revealed a significant deficit in the ability to identify emotions by facial expression and draw conclusions about the mental state of other people in both BPD and chemical addictions (Hanegraaf et al., 2021). We believe that a detailed study of the misrecognition of emotions will provide the most complete picture of disorders in the emotion recognition by facial expression in the studied groups. We did not find any studies researching patterns of misrecognition of emotions in BPD, apart from one (Unoka et al., 2011), as well as a study by E. Frigerio et al. compared with a group of healthy subjects. The study used animated facial expressions of anger, sadness, happiness, and disgust. The authors showed that alcohol dependent patients made more errors than healthy subjects in recognizing expressions in general and tended to mislabel sad expressions as hostile (“anger/nasty”). The authors believe that inappropriate social responses in alcohol dependent individuals may be caused by erroneous detection of another person's mimic signals as hostile (Frigerio et al., 2002).

The uncorrected emotion recognition by facial expression of others is often linked to mentalization theory. P. Fonagy et al.'s theory of mentalization states that the ability to imagine the mental states of self and others is the central mechanism behind much of social cognition and interpersonal interaction (Allen et al., 2008). According to the theory, there are several types of mentalizations. Optimal mentalization is a balance between several polarities: between automatic and controlled mentalization,

cognitive and affective mentalization, self-mentalization and mentalization of others, internal and external. Automatic mentalization happens quickly, with little use of attention, and is often affective, while controlled mentalization is slow and requires intention (Satpute et al, 2006). Cognitive mentalization involves deliberation, e.g. adopting a point of view. Affective mentalization is based on the emotional domain (empathy). Self-mentalization is the mentalization of one's own thinking, while the mentalization of others is the mentalization of others. Finally, external mentalization is based on observable cues (e.g. facial expressions) and internal mentalization is based on internal experience (e.g. thoughts and feelings). Optimal mentalization requires flexibility and balance between all types of mentalizations and varies according to the demands of the situation. K. Sharp's model of hypertextualization states that people with borderline personality disorder rely exclusively on one or the other polarity. This lack of flexibility and balance is exacerbated in emotionally demanding situations. When people with BPD experience emotional hyperactivation, their capacity for self-control and flexible thinking is reduced. As a result, in difficult or emotionally stimulating situations, people with this disorder exhibit context-inappropriate mentalization. In other words, there is an imbalance between all kinds of mentalization. For example, when a person fails to keep a balance between self-mentalization and the mentalization of others, hypermenzalization occurs. In other words, there is excessive attribution of mental states to others (Ballespí et al., 2019). For example, if a person looks sad, a hypermentalized person may think, "She doesn't want to spend time with me". These attributes of the mental state led to a further increase in hyperactivated emotions, which in turn further increases hypermentalization. Thus, eliminating hypermentalization directly during treatment is important in reducing the symptoms of personality disorder (Sharp C. et al., 2013.). A recent meta-analysis has shown that hypermentalization is not only specific to the diagnosis of IDD, but also to psychopathology in general (McLaren et al., 2022).

*1.4.2.1. Emotion recognition in empirical studies of substance use and abuse. Psychological approach*

There are suggestions that substance addicts have impairments in negative emotion recognition. However, the data have different information about exactly which emotions are violated. For example, M. Foisy et al. provide data on a violation of the accuracy of recognition of sadness (Foisy et al., 2007). Other researchers report on impaired anger recognition in patients with alcohol dependence (Hoffman et al., 2019). The results of a study by M. Donadon and F. Osorio indicate that people with alcohol dependence are the least accurate at recognizing fear and disgust and show an increased reaction time for recognizing of other people emotions compared to healthy controls (Donadon, Osório, 2017). Foreign colleagues cite data about adolescents with high-binge drinking, who found it more difficult to recognize sadness and fear by facial expression (Leganes-Fonteneau et al., 2020) - sadness, (Lannoy et al., 2019) - sadness and fear. One recent meta-analysis examined deficits in social cognitive abilities, including facial emotion recognition, in alcohol use disorders (AUD). The meta-analysis included 25 studies with a pooled sample of 756 people with AUD and 681 healthy controls. It has been shown that emotion recognition from facial expressions was significantly impaired in AUD, especially for the emotions of disgust and anger. An association has also been shown between the duration of AUD and the severity of depressive symptoms, with a more severe deficit in emotion recognition (Bora and Zorlu, 2017).

For individuals with opioid dependence, there are also studies confirming impaired recognition of emotions, in particular fear (Schmidt et al., 2014). In a psychophysiological study, data were obtained on a significant activity of the amygdala response to facial of fear.

Cocaine users also had impaired facial fear recognition (Kemmis et al., 2007). Moreover, cocaine users are slower to recognize the emotion of disgust than healthy subjects. And cocaine users and addicts showed longer delays in correctly identifying anger, fear, happiness, and surprise compared to occasional users and controls. In

addition, selective fear recognition deficits may persist with abstinence for up to 6 months (Rabin et al., 2022).

Impairments in cognitive flexibility have been found to correlate with impairments in facial expressions of emotion in methamphetamine abusers (Kim et al., 2011).

Impairments in expression processing have also been reported in individuals who have engaged in cannabis use. In addition, emotion recognition did not improve over 3 months of abstinence (Bayrakçı et al., 2015).

Co-abuse of drugs has been found to impair recognition of an extended range of negative emotions: sadness, anger, disgust, and fear (Fernández-Serrano et al., 2007). Our pilot study showed only impaired sadness in patients with the syndrome of dependence (Fediukovich, Trusova, 2023(b)).

Other studies find no difference in emotion recognition between addicts and controls (D'Hondt et al., 2015).

Regarding the question of the primacy of emotion recognition disorders, there is both evidence that emotion impairment is a predictor of substance use (and then dependence) and findings that these disorders are a consequence of the disease. Impaired recognition of emotional facial expressions may precede the development of alcohol dependence (Donadon, Osório, 2017). Thus, in adolescents with a high risk of heredity of substance dependence, a lower quality of recognition of the emotions of another person was demonstrated against the background of a decrease in activation of the medial prefrontal, precuneus, and occipital cortex. The authors suggest that such a deficit in cortical activation may serve as a risk marker for the development of addictive disorders (Hulvershorn et al., 2013; Isosaka et al., 2015). On the other hand, there is evidence that emotion recognition characteristics are impaired after alcohol abuse (Eastwood et al., 2020), fear and sadness recognition. According to a meta-analysis by F. Castellano et al., the severity of addiction has an adverse effect on the ability to recognize emotions (Castellano et al., 2015). According to some data, in persons with alcohol dependence, a deficit in the ability to recognize the mimic expression of other people is observed even after long periods of abstinence (Donadon, Osório, 2017) and

is associated with difficulties in interpersonal interaction (Kornreich et al., 2002). In addition, long-term heroin exposure has been shown to exacerbate the severity of alexithymia (Craparo et al., 2016).

C. Kornreich and co-authors present the results impaired recognition of emotional facial expressions can both precede the development of chemical dependence in general and be aggravated by chronic alcohol consumption (Kornreich et al., 2001 (a); Kornreich et al., 2011 (b); Kornreich et al., 2003).

Notably, many psychoactive drugs increase social activity and improve social interaction, which increases their attractiveness to consumers. Although the psychological mechanisms by which psychoactive substances affect social behavior are not fully understood, there is evidence that psychoactive substances change the perception of emotions in other people. They can affect the ability to recognize emotions from facial expressions and respond to them, which, in turn, influences social behavior. Increased reactivity to positive emotional expression or reduced response to negative emotional expression can promote social interaction (Miller et al., 2015). In individuals with AUD a deficit in the ability to recognize the emotions leads to a disturbance in the perception of social signals, prevents adequate and adaptive behavior in a social context, and thus contributes to the relapse of addiction (Rupp et al., 2017).

*1.4.2.2. Features of recognition of emotions of borderline personality disorder*

It is still unknown whether impaired emotion recognition is a marker for the diagnosis of BPD. The results of studying the features of emotion recognition in BPD are ambiguous (Mitchell et al., 2014).

Some results indicate that emotion recognition is impaired in BPD due to some of the brain function abnormalities in BPD (Sharp and Fonagy, 2008). The theory of R. Blair, 1995, 2006 shows that a specific deficit in recognizing the emotions of fear and sadness contributes to the development of a personality disorder (Blair, 1995, Blair, 2006). Interestingly, BPD patients are also less likely to recognize disgust and attribute other emotions to neutral facial expressions compared to healthy controls (Daros et al., 2013), and tend to be negatively biased when there is a deficit in the recognition of neutral and positive emotions (Fenske, 2015). In addition, patients with

BPD are not only worse at recognizing emotions from facial expressions, but from speech and prosody (Niedtfeld, 2017).

Other results show the recognition characteristics of participants with BPD do not differ from healthy controls (Herr et al., 2006; Lynch et al., 2006).

A third side of studies suggests BPD patients are better at detecting emotional subtleties than controls due to traumatic experiences and maladaptive parenting styles. The authors also report sensitivity to anger recognition (Del Gaizo and Falkenbach 2008; Lynch et al. 2008; Krohn 1974; Horstmann 2003).

According to D. Kaiser, patients with BPD and PTSD demonstrate longer eye fixations when recognizing emotions by facial expression (Kaiser et al., 2019).

Recognition of emotions by facial expression in chemical addictions and BPD is still an unexplored process. The opinions of scientists are divided regarding changes in the volume and activity of different brain structures with emotional stimuli. In addition, research within the psychological approach is also controversial in these disorders.

## 1.5. Emotion regulation. Theoretical models and research

### 1.5.1. Prerequisites for the formation of the problem of emotional regulation

In the psychoanalytic approach, there was no concept of emotion regulation, but anxiety regulation was considered (McWilliams, 1999). Z. Freud defined anxiety as (1) a perceived affective state; (2) something that has an obvious sign of being unpleasant (3) that has certain physical sensations. Anxiety occurs when there is a conflict between biological instincts and internal and external deterrents (Freud, 2006). Thus, Z. Freud proposed the definition of the mechanism of psychological defense, as, first, the protection of the I from the threat of the It. Modern ideas about the mechanisms of psychological defense have become almost universal and are divided into several levels of "maturity". The primitive ones include isolation, denial, idealization, control, devaluation, projective and introjective identification, splitting of the ego, dissociation. Mature psychological defense mechanisms: repression, regression, rationalization, substitution, reactive formation (McWilliams, 2011). Undoubtedly, the study and development of the concepts and levels of psychological

defense has made a significant contribution to the formation of the concept of emotion regulation.

According to W. James, there are not only basic, but also more subtle emotional expressions, the reflection of which was less obvious. This gave rise to the development of many theories, including the basic theory of emotion, as well as the neurocultural theory of P. Ekman and others. Moreover, the scientist pointed out that there are no special centers in the brain for emotions. W. James approached the consideration of the emotional sphere in a non-standard way, since his peripheral theory of emotions assumed that it is not the emotional state that causes bodily changes (for example, a person is happy, he laughs), but vice versa (James, 1922).

G. Selye, inspired by the works of W. B. Cannon (the first to speak of the concept of stress) (Cannon, 1915), popularized the definition of stress and describes it as a general non-specific neurohumoral response of the body to any requirement presented to it (Selye, 1936).

Several decades later, R. Lazarus considered the understanding of stress along with coping strategies (Lazarus, 1966). R. Lazarus believed that stress is a special relationship between the individual and the environment. And coping is attempts to overcome the state of damage, threat, or challenge, when ordinary or automatic responses are difficult to achieve, and the requirements of the environment must be met with new behavioral solutions, or old behavioral solutions must be adapted to meet the stressors that have arisen (Lazarus, 2006). Cognitive appraisal is a constant assessment of the environment and events that occur. R. Lazarus in his studies considered 6 evaluative components that form the cognitive profile of each emotion: 3 primary and 3 secondaries. All primary assessment components address motivational variables, all secondary assessment components refer to available coping options. The task of the primary cognitive assessment is to assess the significance of the current event for a given individual. As a result of the primary assessment, three conclusions are possible: (1) the situation is recognized as not significant for the individual, therefore, the emotional reactions and behavior of the person do not change; (2) the situation is recognized as significant and positive, that is, positive emotional reactions

arise; (3) the situation is recognized as significant and stressful, which can be assessed as damage, harm, or challenge. As a result, “stressful” emotions are actualized: fear, sadness, which activate and direct a person’s readiness for action for certain adaptive reactions. Secondary assessment - an assessment of the resources of the individual, as well as the available ways of responding to the current situation. With the help of it, coping behavior is implemented and an arsenal of methods available to the individual to overcome stress is determined. Consequently, with the help of cognitive assessment, a person chooses one or another form of coping with stress for a particular situation (Lazarus, 1991; Wasserman et al., 2009; Isaeva, 2009).

### 1.5.2. Modern ideas about the regulation of emotions. Adaptive and maladaptive strategies

It is worth delimiting the mechanisms of psychological defense, coping strategies, and the concept of emotion regulation. Emotion regulation (ER) is a complex of conscious and unconscious mental processes that enhance, weaken, or maintain the same level of quality and intensity of emotional reactions and emotional states of a person (Davidson, 1998). An important component of emotion regulation is the regulation of positive emotions, which is not directly related to the processes of coping with stress.

The most popular theoretical model of emotion regulation now is the model of J. Gross. J. Gross singled out the key features of emotion regulation: 1) activation of the goal to change the process of generating emotions (regulation of one's emotions and emotions of other people); 2) the involvement of processes responsible for changing the trajectory of emotions (considered on a continuum - from explicit, conscious and controlled, requiring effort to implicit, unconscious, easy and automatic regulation); 3) the effect of emotion regulation on the dynamics of emotions (depending on the goals, emotion regulation can increase or decrease the duration or response time of an emotional reaction) (Gross, John, 2007). In his model, the author considers the regulation of emotions as a process that focuses on 5 points: 1) choice of situation; 2) modification of the situation; 3) switching attention; 4) cognitive change; 5) response transformation. It is worth noting that it is precisely this sequence of

movement in time that is implied: that is, there is a selection, modification, involvement in attention, evaluation, and because of this, a certain set of emotional reactions. However, Gross calls for considering this process more complex (for more details, Gross, 1998). Emotion regulation has 3 main goals: 1) emotion regulation is what people are trying to achieve; 2) strategy of regulation of emotions - represents the specific processes that are involved in achieving this goal; 3) Outcome - refers to the consequences of trying to achieve the goal of emotion regulation using that strategy, more (Gross, John, 2007).

Adaptation of a person is very important for his integration in society and mental health. N. Garnefski and V. Kraaij identified a classification of cognitive emotion regulation strategies, the presented classification is quite detailed and complete and is confirmed by empirical studies. Adaptive (strategies that contribute to successful adaptation): 1) acceptance; 2) positive refocusing; 3) focus on planning; 4) positive revaluation; 5) placement in perspective. Maladaptive (hindering adaptation): 6) self-accusation; 7) ruminations/obsessive thoughts about the event; 8) catastrophization; 9) blaming other people (Garnefski et al., 2001; Garnefski et al., 2002; Padun, 2015).
Emotion regulation can take many forms. D. DeSteno and his colleagues (DeSteno, 2013) describe strategies for regulating emotions, which include: 1) situation choice (placing oneself in situations that cause more pleasant emotions); 2) situation modification (making changes to your environment to improve your mood); 3) distribution of attention (shifting the focus of attention towards less unpleasant or more positive stimuli); 4) cognitive change (changing thoughts to improve mood) and 5) response modulation (directly changing the physical or behavioral aspects of an emotional response). According to this model, a person faced with an unpleasant work environment may change jobs or move to another department (situation selection), renovate the office to make work enjoyable (situation modification), deliberately ignore problem colleagues (attention sharing), rethink criticism boss as feedback, etc. (DeSteno et al., 2013).

### 1.5.3. Emotion regulation in disease

Most neuroscientists distinguish 2 main processes of emotion regulation: "Bottom-up" and "Top-down" processes. The former act in response to unpleasant and threatening environmental stimuli by activating the amygdala. The latter are associated with the cognitive assessment of emotional situations and correlate with conscious strategies for regulating emotions (Ochsner and Gross, 2007). I. Lee et al. indicate that the prefrontal cortex reduces the activation of the amygdala when a person uses Cognitive Reappraisal as an emotion regulation (Lee et al., 2012).

Emotion dysregulation plays a central role in the development and maintenance of psychiatric disorders (Gross, 1998). Emotion regulation deficits have been found in a wide variety of psychological disorders in both children and adults (Jazaieri et al., 2013; Berking and Wupperman, 2013). H. Jazayeri and colleagues identify three important factors in emotion dysregulation, namely: awareness, goals, and strategies. To adapt to the situation, the authors believe that it is useful to have: 1) awareness of the emotion and the corresponding context; 2) knowledge of one's short- and long-term goals and 3) appropriate selection and implementation of emotion regulation strategies to move from the current state to the desired goal state (Jazaieri et al., 2013), however indicate that this classification may not be applicable to all individuals. In our opinion, K. Gratz and L. Roemer reflected the problem of emotion dysregulation in more detail: 1) lack of awareness, understanding and acceptance of emotions; 2) lack of access to adaptive strategies for modulating the intensity and/or duration of an emotional response; 3) unwillingness to experience emotional stress as part of achieving desired goals; 4) difficulty in controlling impulsive behavior under stress; and 5) inability to engage in goal-directed behavior when stressed (Gratz and Roemer, 2004).

The addictive attraction (craving) is a central phenomenon in describing the dependence syndrome, both chemical and non-chemical. Studies show that there is a relationship between the level of craving and various forms of emotion regulation (adaptive and maladaptive) (Klimanova et al., 2019). Emotion regulation is the ability to emotionally respond to life events in a socially acceptable way while remaining

flexible enough to allow for spontaneous reactions and inhibit them if necessary (Gross, 2002).

Emotional dysregulation is seen as a multifaceted construct, including a lack of awareness, understanding, and acceptance of emotions, an inability to control behavior when emotionally distressed, a lack of access to adaptive strategies to change the duration or intensity of negative emotional experiences, and an unwillingness to experience emotional distress (Gratz and Roemer, 2004). Notably, the greatest difficulties in the conscious regulation of emotions are associated with a lack of strategies and skills for voluntary control of them, their suppression, maintenance of purposeful behavior, as well as a tendency to impulsivity (Gratz, Roemer, 2004).

The use of inappropriate emotion regulation strategies or dysregulation of emotions has been implicated in the etiology and course of several psychiatric disorders (Aldao et al., 2010). Emotion dysregulation is hypothesized to be a transdiagnostic mechanism underlying various forms of psychopathology (Berking and Wupperman, 2012). According to the biosocial theory of M. Linehan (Linehan, 1993), people with self-injurious behavior may have problems with the regulation of emotions due to a biological predisposition in combination with a social history of emotional disability in their families. An emotionally disabling environment is an environment in which a person's emotional experiences do not respond appropriately or consistently. Such an environment does not allow people to learn to regulate intense emotions in an adaptive way and to trust their own experiences as valid and real. Thus, these people rely on short-term impulsive strategies to bring emotions back to acceptable levels.

Emotion dysregulation has been described most extensively for alcohol dependence (Petit et al., 2015). According to some data, in persons with alcohol dependence, the difficulties in applying situationally adequate strategies for controlling their own emotional manifestations come to the fore. The role of impulsivity is also noted - the tendency to make impulsive decisions is positively associated with difficulties in paying attention to one's own emotions (Klimanova et al., 2019; Klimanova et al., 2018; Klimanova et al., 2017). These studies show that the parameters of alcohol consumption are closely related to the characteristics of emotion

regulation. There are similar data regarding the use of narcotic substances. Emotion dysregulation and the frequency and severity of substance use have been shown to be related (Garke et al., 2021).

According to current concepts of BPD, problems with emotional dysregulation are central to this disorder (Siever et al., 2002; Linehan, 1993). Emotion dysregulation in BPD has been associated with early vulnerability in childhood, initially manifesting as impulsivity followed by heightened emotional sensitivity. These vulnerabilities are exacerbated during development by environmental risk factors that cause greater emotional, behavioral, and cognitive dysregulation (Crowell et al., 2009).

Environmental risk factors include physical, sexual, or emotional abuse (Goldsmith et al., 2013), other traumatic events (Lilly, 2015) and substance abuse during adolescence (Poon et al., 2016). Several studies on patients with BPD have reported a positive association between immature (maladaptive or maladaptive) defense mechanisms and personality pathology and a negative association between mature (adaptive) defense mechanisms and BPD (Bijttebier and Vertommen, 1999; Birendra and Watson, 2014; Zanarini et al., 2009). Several studies have shown that patients with BPD more often use maladaptive emotion regulation strategies: they use Cognitive Reappraisal less, tend to both Self-blame and Other-blame, tend to think about being fixed on a negative event, turn little to thoughts aimed at creating a positive for others. personal growth values, events and, conversely, are prone to catastrophizing.

Also, patients with BPD are characterized by the following difficulties in regulating emotions: non-acceptance of emotional reactions, limited range of strategies for regulating emotions, difficulties in maintaining goal-directed behavior, lack of clarity in understanding emotional reactions (Akyunus İnce, 2012; Fossati et al., 2013; South, 2005). N. Herr et al. showed that difficulties with emotion regulation completely mediated the association between BPD symptom severity and interpersonal dysfunction. These results empirically support the idea that difficulty regulating emotions is a key mechanism by which people with BPD may experience more interpersonal problems (Herr et al., 2013).

Maladaptive emotion regulation strategies are typical both for individuals with chemical addictions and for patients with BPD. However, the question of the relationship between the features of emotion recognition and emotion regulation strategies remains unexplored.

### 1.6. Relationship between features of emotion recognition, emotion regulation strategies and individual psychological characteristics

Emotion recognition by facial expression is a component of emotion recognition in different modalities (voices, prosody, touch, movements). All these types of emotion recognition are included in the concept of emotional intelligence. Emotional intelligence (EI) is a type of social intelligence that includes the ability to control one's emotions as well as the emotions of others, identify them and use this information to guide thoughts and actions, facilitating the creative thought process, redirecting attention to priority issues, increasing motivation and the possibility of flexible planning (Mayer et al., 2001). It consists of four aspects: the perception and expression of one's own emotions and those of others, the cognitive component of emotion, the understanding of emotions, and the ability to regulate emotions (Mayer et al., 2003).
The study of the ability to recognize emotions by facial expression is the most reliable measure than other components of EI (Nowicki, Duke, 1994). The study of emotion recognition uses non-verbal characteristics that recreate the phenomenon itself, in contrast to questionnaires that use verbal and subjective expression of feelings and emotions. Measurements of emotion recognition features have been shown to be highly reliable and valid, especially when compared to questionnaires (Ciarrochi, Chan, & Caputi, 2000; Davies, Stankov & Roberts, 1981).

The World Health Organization lists emotional intelligence as one of ten life skills that help people act in an adaptive and positive way (Ruíz, 2014).
S. Yoo et al. have shown that emotion recognition affects social adaptation (Yoo et al, 2006). Emotional intelligence theory suggests that before people can regulate emotions, they must recognize them (Matsumoto, 2000; Matsumoto and Ekman, 2000). When people are aware of their own emotions, they react to them faster, express them more easily in relationships, and more openly present their signaled needs

(Johnson et al., 2001; Salovey and Mayer, 1990). Moreover, recognition of one's own and others' emotions is a key prerequisite for understanding and predicting human behavior (Schlegel et al., 2014), but also facilitates the transmission of negative events and helps to find adaptive emotion regulation strategies for emotion regulation. (Cordova et al., 2005). A study by C. Kornreich et al found a significant relationship between impaired emotion recognition and interpersonal problems in AUD.

Research results show a link between interoception and emotion regulation. Interoception reflects how a person perceives stimuli from the body, including temperature, pain, heart rate, and muscle sensations (Craig, 2002). Interoception has been shown to be related to the ability to recognize and understand emotions (Damasio, 1994). In addition, studies show that better interoceptive abilities are associated with better emotion regulation (Kever et al., 2015; Werner et al., 2010). Participants with AUD who are most accurate in their interoception have been found to be better at regulating their emotions. And those patients who are more interoceptively sensitive may have trouble controlling their behavior by experiencing negative emotional states (Jakubczyk et al., 2020). Besides, interoception has recently received increased attention as a factor that can influence both the development and course of addiction (Paulus and Stewart, 2014).

One recent study also shows that impairments in facial emotion recognition in adolescents are significant in emotional dysregulation as an early sign of problematic drinking and addiction. Using an experimental task with an increase in the threshold of perception, it was demonstrated adolescents with problematic alcohol use more easily recognize sad faces and worse – happy ones, compared with adolescents who do not drink alcohol (Leganes-Fonteneau et al., 2020).

Notably, the ability to recognize both one's own and others' emotions is influenced by the experience of early relationships with significant others, including adverse and psychotraumatic childhood experiences. To study the existing emotional schemas in the context of emotion recognition, several tools are used, of which a short version of R. Leahy scale of emotional schemas is available in Russia. The study of the ability to detect emotional expression by facial expression can be supplemented by an

assessment of emotional patterns in connection with the severity of psychopathological symptoms and low-adaptive strategies for cognitive regulation of emotions (Sirota, 2016).

It is important to mention the research on the differentiation of emotions. Emotion differentiation is the ability to discern emotional subtleties by using different words for emotions and reporting one's feelings in response to different emotional situations (Israelashvili et al., 2019). The importance of emotion differentiation for human well-being has been shown in many studies that have demonstrated an association between emotion differentiation and psychopathology (Barrett et al., 2001; Emery, Simons, Clarke, & Gaher, 2014; Erbas et al., 2014; Suvak et al. al., 2011). For example, higher emotion differentiation is associated with better ability to regulate emotions (Barrett et al., 2001). Therefore, more people can discern emotional subtleties using different words in different situations, the more aware they are of their emotional reactions and the more they are able to adapt and regulate their emotions (Erbas et al., 2018; Kashdan et al., 2015). The results of a recent study showed that emotion differentiation is associated with the accuracy of recognition of specific emotions (Israelashvili et al., 2019).

M. Linehan's biopsychosocial theory emphasizes the importance of emotion recognition and regulation in the development and maintenance of BPD (Linehan, 1993). She takes a broad view of emotion regulation, including biological, cognitive, and affective components that work together to effectively regulate a person's emotional states. Furthermore, according to M. Linehan emotion regulation develops in the family environment and poor emotion regulation is partly a consequence of the early disabling environment (Linehan, 1993).

Numerous studies have linked emotional states to impulsivity and addictive behavior. Such studies have shown that smoking and unhealthy diets increase during periods of stress (Shi et al., 2011; Greeno and Wing, 1994). Alcohol is often used to regulate positive and negative mood (Cooper et al., 1995), and increased levels of anxiety and an inability to tolerate emotional discomfort are highly predictive of alcohol or drug problems (Howell et al., 2011; Cheethman et al., 2010; Wu et al., 2011).

Despite a large body of research on emotion recognition features, emotion regulation strategies, and their importance as core areas of emotional competence (Saarni, 2000), there is still no unifying theory of emotional functioning that explains how different areas of emotional competence relate to each other (Milojevich et al., 2021). Theoretical models of addictive disorders consider addictive behavior inextricably linked with the characteristics of emotion regulation and its disorders. However, the available data indicate an ambiguous relationship between the ability to recognize emotions by facial expression and the mechanisms of regulation of one's own emotional state in the context of substance abuse and addiction formation (Trusova, Fediukovich, 2020). Although the abundance of research on emotion recognition and emotion regulation, there is a surprising lack of empirical research examining the relationship between these two components of emotional intelligence. Few studies have shown that emotion regulation is a moderator of emotion recognition and depression levels (Aldinger et al., 2013; England-Mason et al., 2018). For example, women with more severe depression tended to be worse at recognizing anger facial expressions, but not other underlying emotions, however Expression suppression as an ER strategy mediated this relationship: women with more severe depression and less prone to this ER strategy were less accurate at recognizing angry facial expressions. In contrast, in participants with high levels of expressive suppression, the severity of depression did not affect the accuracy of anger recognition (Aldinger et al., 2013). Conversely, there is a suggestion that impaired emotion recognition may affect ER strategies, i.e., lead to misunderstanding and a different interpretation of the emotional signals of another person, and this, in turn, may lead to the use of maladaptive emotion regulation strategies, which may contribute to reduced social adaptation (In-Albon at al., 2013). Often when experiencing strong emotions and not understanding them, many patients turn to maladaptive strategies such as self-harm or substance abuse (Gunderson et al., 2018). The ability to perceive and understand emotions can influence social interaction by helping people interpret internal and social cues, thereby enabling emotional self-regulation and social behavior (Suveg and Zeman, 2004). In other

words, emotion recognition is an important prerequisite for emotion regulation (Gross, 2007).

Anxiety levels can also be a link in the chain of emotion recognition and emotion regulation. For example, in a study of eating disorders, levels of depression were found to predict difficulties in emotion regulation (Harrison et al., 2010).

An analysis of theoretical assumptions and studies' results regarding the features of emotion recognition in people who use it allowed us to draw several conclusions:

1. Emotion recognition is a very complex mental process. The stages of this process are only beginning to be described by recent studies. For example, the concept of emotional complexity has only recently been developed and is not classical, but it destroys the usual tree-like representation of the hierarchy of emotions and allows you to look at it in a new way.
2. Emotion regulation and recognition of emotions are one of the components of emotional intelligence. Both emotion recognition and emotion regulation involve different brain structures, the connections of which are still unexplored.
3. According to many studies, the recognition of negative emotions in people with chemical dependence, as well as in people who abuse substances, is impaired. Moreover, impaired emotion recognition may be primary to cognitive impairment.
4. The question of whether impaired emotion recognition is a marker of borderline personality disorder remains unexplored.
5. The question of primacy regarding nosology remains unexplored: a deficiency in emotion recognition leads to addiction, or whether the characteristics of emotion recognition are impaired under the influence of the disease.
6. The theoretical assumptions emphasize the importance of emotion recognition and regulation in the development and maintenance of BPD, as well as in the development of addiction.

7. The relationship between impaired emotion recognition and a propensity for maladaptive emotion regulation strategies is still unexplored. One view might be the following. Impaired emotion recognition can lead to misunderstanding and a different interpretation of another person's emotional cues. And this can lead to the use of maladaptive emotion regulation strategies, which can contribute to a decrease in social adaptation.

# CHAPTER 2. ORGANIZATION OF THE RESEARCH. MATERIALS AND METHODS

## 2.1. Study Design

### 2.1.1. Participants

A total of 264 people took part in the study, 261 confirmed and signed informed consent to participate in the study. Of these, 237 completed the questionnaires and completed the experimental part. After conducting a clinical-psychological interview, 129 people passed the inclusion and non-inclusion criteria for this work.

Thereby, the study included a total of 129 participants. Of these: 76 women (58.9%) and 53 men (41.1%). The average age of study participants was 26.4 (5.2) years. The minimum age is 18 years, the maximum is 40 years. All participants gave written informed consent. The study was approved by the ethics committee of St. Petersburg State University.

2 studies were carried out:

In Study 1, patients with chemical dependence were compared with a control group, where:

Eighteen outpatients, diagnosed with substance dependence, as well as the combined use of other psychoactive substances, according to the ICD-10 criteria "Dependence syndrome" F1x.2 by a narcologist. 6 women (33.3%), 12 men (66.7%), mean age 31.1 (4.5) years.

The control group included 18 healthy participants. 11 women (61.1%), 7 men (38.9%), mean age 26.1 (6.3) years.

The groups were tested for age homogeneity using the non-parametric Mann-Whitney test healthy control (HC) group and patients with the syndrome of dependence (PSD), p=.059, by gender using the non-parametric Pearson Chi-square test with continuity correction p = .182.

Study 2 is the main study and is characterized by a study of substance users (SU), patients with borderline personality disorder compared to a control group.

Clinical group 1 consisted of 31 participants with a diagnosis established by a narcologist according to the ICD-10 criteria "Harmful use ..." (F10.1, F12.1, F15.1 etc.

depending on the psychoactive substance and / or had from 8 to 20 points according to the AUDIT test – 16 women (51.6%), 15 men (48.2%), mean age – 26.9 (6.3) years.

Clinical group 2 consisted of 32 patients with a diagnosis established by a psychiatrist according to the ICD-10 criteria "Emotionally unstable personality disorder. Borderline type" (F60.31x) – 25 women (78.2%), 7 men (21.8%), mean age – 26.5 (5.1) years.

The control group included 45 participants. 29 women (64.4%), 16 men (35.6%), mean age 26.2 (5.4) years. 15 people from healthy controls of study 1 are part of this control group.

The groups were tested for homogeneity: 1) by age using the non-parametric Manh-Whitney test (HC and substance users: $p = .799$; HC and BPD: $p = .796$; BPD and SU: $p = .978$; 2) by education using nonparametric Pearson's chi-square test (HC and SU: $p = .371$; HC and BPD: $p = .236$; BPD and SU: $p = .995$); 3) by gender using a non-parametric Pearson chi-square test with continuity correction (HC and SU: $p = .378$; HC and BPD: $p = .298$; BPD and SU: $p = .052$), differences are not significant.

We included a sample of patients with the syndrome of dependence to compare their results with those of participants who use substances. The question remains whether emotion recognition is impaired premorbidly or due to chemical dependence. In addition, we included a group of participants with BPD, as impaired facial emotion recognition is being studied as one of the characteristics of the transdiagnostic phenotype in both addiction and BPD. BPD patients often use psychoactive substances to regulate emotions. In other words, study 2 is the main study.

The recruitment of participants was carried out in 2020-2022 in St. Petersburg based on the City Psychiatric Hospital No. 6 (a hospital with a dispensary) and based on the St. Petersburg City Narcological Hospital (Rehabilitation Department No. 1) on an outpatient basis. The control group was recruited based on non-state companies: Quadcode, Avito, Karuna. In addition, the control group included senior students of

the Pavlov First Saint Petersburg State Medical University, graduate students of the Saint Petersburg University and voluntary participants.[1]

### 2.1.2. Inclusion and non-inclusion criteria

Inclusion Criteria:

1) Age from 18 to 40 years.

2) Diagnosis "Syndrome of dependence" (F1x.2) according to ICD-10 for a group with chemical dependence.

3) For the group of substance users – Diagnosis "Harmful use" (F1x.1), from 8 to 15 points on the AUDIT test.

4) Diagnosis "Emotionally unstable personality disorder, borderline type" (F60.31) according to ICD-10 for the second experimental group for the second study.

5) Fluency in Russian.

6) Ability to sign informed consent.

7) Voluntary participation.

Exclusion Criteria:

1) Being in an acute psychotic state.

2) Severe somatic disorders that impede daily functioning (for example, severe liver dysfunction, pain, etc.).

3) Active suicidal tendencies.

4) Current major depressive episode.

5) Use of psychoactive substances less than 14 days before the study for dependent individuals, less than 10 days for users and patients with BPD, in addition to pharmacotherapy.

6) Intensive pharmacological therapy, which has a pronounced negative effect on the state of attentive-amnestic and cognitive functions.

7) Impaired or uncorrected vision.

8) The presence of other mental illnesses.

Participants in the control group did not have any current or past mental illnesses.

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[1] The author of the study thanks Ipatova K. A., Vavilina P. S. and Rodionova E. B. for their valuable assistance in data collection.

### 2.1.3. Methods

1) An experimental procedure for studying the recognition of emotions by facial expressions.

2) AUDIT screening test.

3) Emotion Regulation Questionnaire (ERQ).

4) Cognitive Emotion Regulation Questionnaire (CERQ).

5) Hospital Anxiety and Depression Scale (HADS).

6) Impulsivity scale (BIS-11).

7) Questionnaire of the Dark Triad (SD3).

8) Research questionnaire.

## 2.2. Description of methods

### 2.2.1. Experimental procedure of Facial emotion recognition task

The facial emotion recognition task assesses participants' ability to correctly identify facially expressed emotions. «The Emotion recognition» program was developed specifically for this study, which measured the accuracy and speed of emotion recognition. The software environment is WebStorm, the programming language is JavaScript. The foundation of the program – the KDEF-dyn data base - Emotional Facial Expression from the Karolinska Institutet. (Calvo et al., 2018 (a); Calvo et al., 2018 (b)). The KDEF-dyn data base consists of color photographs of 40 actors (20 women; 20 men) from the KDEF27 set, all the actors portrayed six basic emotions (happiness, sadness, anger, fear, disgust, and surprise). Based on the photos from the KDEF27 set, 240 video clips (1033 ms long) were created using the FantaMorph © computer program (v. 5.4.2, Abrosoft, Beijing, China) to turn the photos into video clips. Each emotional expression in a video clip takes 33.33 ms. The first frame starts with a neutral facial expression (frame 0; original KDEF), continues at 30 frames per second, and ends with the peak of emotional expression (happy, sad, etc.) in the last frame (frame 30; original KDEF).

All participants were presented with all 240 video-clips using the «Emotion Recognition» computer program, which began with instructions for the participant. By pressing the respective key on the keyboard, participants had to label the emotions giving one of six possible answers: happiness, sadness, anger, fear, disgust and surprise. Each emotion is matched by the numeric button (for example, 4 - happiness, 5 - sadness, etc.). All participants were trained using 12 videos (2 emotions from 6 basic emotions) from the main set. The practice trials were the same for all participants. The experimental part consisted of 240 video clips, between each clip there was 1500-ms central fixation cross on a screen. The duration of the emotion is 1033 ms (fig.1). Near each emotional face, a reminder was presented in the form of numbers and emotions that associated them. The time for thinking and deciding (pressing the associated key) was 3 seconds. The duration of one test is 5.5 seconds. This number of seconds was not taken by chance. Participants could not cope with fewer seconds in pilot research, and more seconds will not be the first impression and recognition of emotions. Fisher-Yates Shuffle was used so that the order of presentation of video clips was random for each participant. The following indicators were measured with the help of the computer program "Emotion Recognition": emotion recognition accuracy (percentage of number of correct answers, speed (time required for correct emotion recognition) and misrecognition of emotions (percentage of answers each emotion on right emotion, for example, person answered 20% anger for happiness). All errors and all correct responses to each emotion add up to 100%, for example, a person responded 20% anger to disgust, 5% sadness to disgust, and 75% disgust to disgust (see validation Calvo et al., 2018 (a); Calvo et al., 2018 (b)). Below are examples for the experimental procedure (fig. 1 и fig. 2).

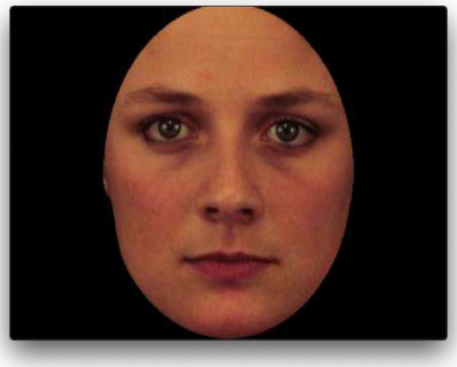

*Figure 1. Neutral Facial Expression Stimulus in the Emotional Facial Expression (KDEF-dyn data base)*

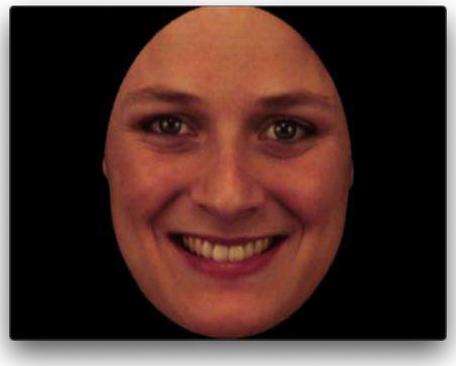

*Figure 2. Stimulus of emotion in the expression of happiness in the Emotional Facial Expression (KDEF-dyn data base)*

Dynamic facial expression stimuli are of greater experimental significance than static images because the change in facial expression in real social interaction occurs constantly and rather quickly, especially when people are emotional, while emotions depicted in static images correspond only to identifiable peaks or intermediate stages of socially significant movements (Atkinson et al., 2004). Many researchers suggest that the mechanisms that process information about movement may be important components of the neural network, formed by evolution, for the recognition and interpretation of emotional manifestations (Allison et al., 2000). In addition, dynamic facial expression stimuli have been shown to lead to stronger activity in the amygdala, a brain region involved in emotional information processing (Sato et al., 2004; Sato et al., 2008). Thus, the author of the study decided to use the dynamic stimuli of mimic images in this work.

### 2.2.2. AUDIT

Alcohol consumption was assessed using the AUDIT screening questionnaire developed under the auspices of the World Health Organization (Saunders et al., 1993). The screening consists of 10 statements, where 8 of them contain 5 answers and 2 statements with 3 answers. All responses are rated from 0 to 4. In 2020, we used an early version of the AUDIT, according to which, 1-7 is considered insignificant risk or sobriety, 8-15 is moderate risk of adverse effects of drinking, 16-19 is high risk of harm to health associated with alcohol consumption, more than 20 points – a high probability of alcohol dependence, regardless of gender. The study used an early version of the test, but a more recent version of this screening is available (for more details, Neufeld et al., 2021; Bunova et al., 2022).

### 2.2.3. Emotion Regulation Questionnaire (ERQ)

Emotion Regulation Questionnaire (ERQ; Gross, J.J., & John, O.P., 2003), A 10-item scale designed to measure respondents' tendency to regulate their emotions in two ways: (1) Cognitive Reappraisal and (2) Expressive Suppression. Respondents answer each item on a 7-point Likert-type scale ranging from 1 (strongly disagree) to (strongly agree). Adaptation by Kornienko D.S., Pankratova A.A., 2017. This questionnaire was developed within the framework of the process model of emotion regulation by J. Gross (which we described in the literature review). Cognitive Reappraisal is a change in attitude to a situation that allows you to change the emotional response. Suppression of expression – containment of external manifestations of an already arisen emotional response.

### 2.2.4. Cognitive Emotion Regulation Questionnaire (CERQ)

The Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski et al., 2001) was administered to assess participants' use of adaptive cognitive strategies for coping with emotion-arousing events. Participants respond to 36 items using a 5-point Likert scale from 1 ('almost never') to 5 ('almost always') to indicate the extent to which they engage in different cognitive strategies when experiencing stressful or threatening events. The questionnaire has 9 subscales, which are divided into (1)

contributing to successful adaptation: Acceptance (accepting the experienced situation), Refocusing on planning (thinking about what next steps are best to take), Positive refocusing (distracting thoughts about favorable events), Positive Reappraisal (search for a positive meaning in what happened), Putting into perspective (reducing the exceptional significance of the situation due to comparison with past experience); (2) impeding successful adaptation: Self-blame (thoughts in which a person blames himself for what happened), Other-blame (shifting the blame on others for the experienced event), Rumination (constant thoughts about thoughts of feelings associated with the experienced situation), Catastrophizing (thoughts about the global size of the event). The subject is asked to refer to his experience of experiencing difficult situations and assess how often he uses certain methods of coping with difficulties. Adaptation by O. L. Pisareva, and A. Gricenko, 2010 (Garnefski, Kraaij, 2007; Pisareva, Gricenko, 2011).

### 2.2.5. Hospital Anxiety and Depression Scale (HADS)

The Hospital Anxiety and Depression Scale (HADS) is designed to identify clinically significant anxiety and depression in outpatients, and to differentiate between anxiety and depression. The questionnaire consists of 14 statements, 7 of which are aimed at diagnosing anxiety and 7 – at diagnosing depression. For each statement, 4 answers are given, which are scored from 0 to 3 points, depending on the severity of anxiety or depression. There are no back questions. Scoring is done by summing up the scores for the responses of each scale. 0-7 – normal, 8-10 – subclinical levels of anxiety and depression, 11 and above – clinical levels of anxiety and depression (Zigmond, Snaith, 1983; Andryushchenko et al., 2003)

### 2.2.6. Barratt impulsiveness scale (BIS-11)

The Barratt impulsiveness scale adapted by S. N. Enikolopov and T. I. Medvedeva consists of 30 questions that helps determine the extent to which a person suffers from impulsivity control disorder or pathological impulsivity. For each question, you can give one of 4 answers from ‘Rarely/Never’ (1) to ‘Almost always/always’ (4). Questions relate to the train of thought and behavior without being

tied to a specific point in time. The questionnaire consists of three subscales: motor impulsivity, non-planning impulsivity, and attentional impulsivity. The general level of impulsivity is also calculated. According to E. S. Barratt, an general level of impulsivity of 75 or higher indicates an impulse control disorder (Barratt, 1993; Barratt et al., 1997; Fossati et al., 2015; Enikolopov, 2015).

### 2.2.7. Short Dark Triad (SD3)

Questionnaire of the Dark Triad in the adaptation of M. S. Egorova et al. Contains 27 statements, 9 for each trait of the Dark Triad: Machiavellianism, Narcissism and Psychopathy, which have long been studied in psychology both in clinical practice and in the study of variability within the norm. For each question in the questionnaire, 5 responses are given from ‘Strongly agree’ to ‘Strongly disagree’, which are evaluated on a 5-point Likert scale. There are reverses. When creating this questionnaire, the authors D. Jones and D. Polhus considered the idea that these features have both differences and similarities. The main differences between Machiavellianism and Psychopathy have to do with impulsivity. Machiavellians tend to calculate the consequences of their behavior and focus on long-term goals and delayed rewards. And those with high Psychopathy tend to act impulsivity. Narcissism, according to this questionnaire, is characterized by an exaggerated sense of self-importance, a desire to constantly confirm one's superiority. Those with high levels of Machiavellianism and/or high levels of Psychopathy seek real achievement, not the constant affirmation of high self-esteem, unlike people with pronounced narcissistic traits. All three traits are united by callousness and indifference to people. A decrease in empathy allows you not to waste time and energy on other people's problems and not feel guilty about manipulating other people to achieve your own goals. According to the authors, the use of manipulation and lack of emotional response are the core of the Short Dark Triad (Jones and Paulhus, 2014; Egorova et al., 2015).

## 2.3. Procedure

The selection of participants for the study was carried out in two stages, at the first of which the attending physician verified the diagnoses of "Dependence Syndrome" (F10.2, F12.2, F15.2, F19.2) from various types of PAS, "Harmful use ..."

(F10.1, F12.1, F15.1, etc.) depending on the psychoactive substance, "Emotionally unstable personality disorder, borderline type" (F60.31x) according to the ICD-10 criteria, as well as determining the stability of the patient's mental state , allowing the experiment and filling out questionnaires. The second stage was informing the patient about the goals, stages, and procedures of this study, as well as signing an informed consent to participate. After filling in the voluntary informed consent, a conversation was conducted with the subjects, the results of which were entered by the researcher into the author's questionnaire. After the interview, the subjects proceeded to fill out the questionnaires. If the subjects had questions, the researcher clarified and gave explanations regarding some items in the questionnaires.

Then the participants moved on to the experimental part. Participants were asked to indicate which of the six main emotions were shown in each video by pressing a key. Each key meant a certain emotion (for example, 4 – happiness, 5 – sadness, etc.). Stimuli were displayed on a computer screen (14-inch 1920x1080 FHD, Lenovo) using the "Emotion Recognition" software. Participants were located at 70 cm from the computer screen and looked at the image binocularly. Light conditions in the room were normal. All participants were trained, where 12 videos were used (2 emotions of each of the 6 basic ones) from the main set. The video clips in the training were the same. The experimental part itself consisted of 240 video clips, and the gap between each clip was a gray background with a white cross, so that the participant could relax and switch their attention. The time of demonstration of each video clip (dynamic image of emotion) was 1033 ms, then the final emotional image was saved for another 3 seconds. Near each emotional face, a reminder was presented in the form of numbers and emotions denoting them. The time for thinking and pressing the key was 3 seconds. After passing the experimental part, the program returned to the instruction, which was the confirmation of the end of the experiment. Estimated time to complete the experimental procedure is 20 to 30 minutes, depending on the speed of the participants.

All willing participants who successfully passed all stages of the research procedure were provided with feedback on the results of the study. The final stage of

the study was the processing of the obtained material, maintaining a database and further statistical analysis.

## 2.4. Data Analysis

Statistical data analysis[2] was carried out in several stages. Preliminary analysis of comparisons between groups for emotion recognition accuracy (percentage of emotions correctly identified), misrecognition of emotions (percentage of emotions misidentified for each of six) and speed (time taken to correctly recognize emotions), as well as for individually psychological characteristics were analyzed using the non-parametric U-Mann-Whitney test. The non-parametric Kruskal-Wallis test was used to compare these characteristics between substance users, BPD patients, and health controls (i.e., three groups). The percentage and questionnaire data did not follow a normal distribution, so the author chose nonparametric tests for intergroup comparison.

We used the non-parametric U-Mann-Whitney test to test for differences in age between groups, the non-parametric Pearson's Chi-square test to test for differences in gender and educational attainment (adjusted for continuity for gender).

In the main step, we used the arcsine transform to convert percentages of correct and incorrect answers to radians to get the best approximation to a normal distribution (Lo, Andrews, 2015; Lin, 2020; Jeong, 2018), as this is an important criterion for linear regression. The hierarchical multiple linear regression analysis was used to the main comparison analysis for emotion recognition accuracy (radians of emotions correctly identified), misrecognition (radians of emotions misidentified for each of six) and speed (time taken to correctly recognize emotions) with controlling variables. Control variables: gender, age, level of education, level of impulsivity, anxiety, and depression as potentially influencing factors on emotion recognition in relation to accuracy and speed. High rates of these variables may be characteristic of individuals with addictive disorders and BPD. When conducting a moderation regression analysis, the dependent variable was each scale of questionnaires of emotion regulation strategies – CERQ, ERQ, independent - misrecognition of emotions, which were transformed from

[2] The author of the study thanks P. A. Fediukovich, K. G. Miroshnik and A. N. Gvozdetskii for them careful review and valuable comments on the procedures of statistical analysis.

percentages to radians. Each of the scales of the questionnaires acted as a moderator: the Barratt impulsiveness questionnaire (BIS-11), the Short Dark Triad (SD3), Hospital Anxiety and Depression Scale (HADS). Gender, age, level of education served as control variables. Moderator and independent variable data were centered. The accuracy (%) and speed (mc) of emotion recognition between groups were described by the mean, standard deviation.

Questionnaire data between groups were described by the median, 1-3 quartiles Me [Q1; Q3]. Null hypotheses were rejected at $p < 0.05$.

In most cases, for the data on the accuracy and speed of emotion recognition, erroneous emotion recognition, the analysis and questionnaire data did not reveal the presence of outliers and established that the assumption of homoscedasticity and normal distribution of the residual components of the variance was observed. The non-multicollinearity requirement was also met, as the inflation factor of variance (VIF) scores were below 5. The studentized remote residuals did not reveal any observations beyond 3 SD in absolute value, just as no outliers were detected by Cook's distance. The identified assumptions in the analysis are described in Chapter 3 for each case. For the moderation analysis models, there were no outliers that were out of bounds at 1 in the Cook's distance. An exception is described in specific examples. Preliminary data analysis and hierarchical linear regression analysis were carried out using the Statistical Package for the Social Sciences ver. 28.0 (IBM SPSS). Moderation analysis was carried out in the PyCharm 2022.3.3 (Community Edition) software environment, the Python programming language using the pyprocessmacro library. Model validation, moderation analysis with control factors, and plotting were carried out in the RStudio v.1.2.1335 software environment (RStudio Team, Boston, Massachusetts, USA). The sjPlot library was used to visualize the data.

Thus, the research methods we have chosen provided an opportunity to obtain the data necessary to test the assumptions about the features of emotion recognition by mimic expression in people who use PAS, as well as their effect on emotion regulation strategies depending on individual psychological characteristics.

# CHAPTER 3. RESULTS

## 3.1. Study 1

### 3.1.1 General social characteristics and clinical and anamnestic data on participants

Study 1 included 36 people. Of these, 18 patients with chemical dependence, 18 - the control group.

General characteristics of the sample and description of socio-demographic and clinical-anamnestic data for patients with the syndrome of dependence and for healthy controls are given below (Table 1).

*Table 1. Description of demographic and clinical-anamnestic data in the study groupsч*

| Indicator | PSD ($N$ = 18) | HC ($N$ = 18) |
|---|---|---|
| Age | | |
| M | 31.1 | 26.1 |
| SD | 4.5 | 6.3 |
| Gender | | |
| Female | 6 (33.3%) | 11 (61.1%) |
| Male | 12 (66.7%) | 7 (38.9%) |
| Education | | |
| Incomplete secondary | 0 | 1 (5.6%) |
| Secondary/ vocational | 12 (66.7%) | 3 (16.7%) |
| Incomplete higher education/ student | 2 (11.1%) | 8 (44.4%) |
| Higher education | 4 (22.2%) | 6 (33.3%) |
| Marital status | | |
| Single | 11 (61.1%) | 17 (94.4%) |
| Married | 5 (27.8%) | 1 (5.6%) |
| Divorced | 2 (11.1%) | 0 |
| Children | | |

| | | |
|---|---|---|
| Yes | 8 (44.4%) | 2 (11.1%) |
| No | 10 (65.6%) | 16 (88.9%) |
| Employment status | | |
| Student | 0 | 4 (22.2%) |
| Working with lower qualification | 5 (27.8%) | 1 (5.6%) |
| Manager | 1 (5.6%) | 0 |
| Specialist | 3 (16.6%) | 8 (44.4%) |
| State employee | 1 (5.6%) | 0 |
| Other | 1 (5.6%) | 0 |
| Unemployed | 6 (38.8%) | 5 (27.8%) |
| Heredity | | |
| Yes | 9 (50%) | 8 (44.4%) |
| No | 9 (50%) | 10 (55.6%) |
| Duration of the disease (years) | | |
| M | 9.4 | - |
| SD | 5.4 | - |
| Average duration of remission (months) | | |
| M | 7.5 | - |
| SD | 9.0 | - |
| Criminal record | | |
| No | 4 (22.2%) | 18 (100%) |
| Russian Criminal Code 228 | 10 (55.6%) | 0 |
| Russian Criminal Code228 and other | 3 (16.6%) | 0 |
| Other Russian Criminal Code | 1 (5.6%) | 0 |

*Key: N – absolute values, M – arithmetic mean, SD – standard deviation.*

Based on the data in the table, the study involved 18 patients with a diagnosis of "Dependence Syndrome" (F1x.2) according to ICD-10. The gender distribution of patients is as follows: 6 women (33.3%), 12 men (66.7%) of the sample size, respectively. The average age of the patients who participated in the study was 31.1±4.5 years (M±SD), the age range was from 18 to 40 years. The mean duration of illness in the study patients was 9.4±5.4 (M±SD) with a wide range from 1 to 17 years.

12 patients (66.7%) have an average level of education, 2 people have incomplete higher education or are senior students (11.1%), 4 patients (22.2%) have higher education. 9 (50%) participants with chemical dependence on the number of the clinical group have burdened heredity (substance abuse of close relatives).

The control group included 18 participants. 11 women (61.1%), 7 men (38.9%), mean age 26.1 (6.3) years.

The groups were tested for age homogeneity among themselves using a non-parametric Mann-Whitney test (control group and patients with the syndrome of dependence, p = .059, for gender – non-parametric Pearson Chi-square test adjusted for continuity, p = .182. However, the groups differ in educational level, non-parametric Pearson's Chi-square test, p = .015. Educational level is a control variable in our analysis, so we decided to test the effect of this variable on the results in regression models.

### 3.1.2 Preliminary intergroup comparison analysis

Hypotheses 1 and 2 of the present study assumed that the accuracy and speed of recognition of negative spectrum emotions would be different in patients with chemical dependence compared to the control group. Hypothesis 3 assumed that the clinical groups would be characterized by patterns of erroneous recognition of emotions. To test them, we performed a comparative analysis using the nonparametric Mann-Whitney test, since the data on the percentages of correct and erroneous responses to emotion recognition deviate significantly from the normal distribution. In a preliminary analysis to assess emotion recognition, three parameters of emotion recognition were compared: the number of correct responses in emotion recognition (accuracy) in percent (%), misrecognition of emotions (%), and the average response delay (speed) in ms. Differences were found between the clinical and control groups in terms of the results of recognizing emotions of the negative spectrum: the number of correct answers and the average response delay significantly differed when recognizing the emotions of sadness (p = .006, p = .003), anger (p = .021, p = .002), fear (p = .010, p = .001) and disgust (p = .013, p = .007) (Table 2). The following intergroup differences in erroneous recognition of emotions were found. The patients with the syndrome of

dependence differed from the healthy controls in misidentification of disgust instead of sadness (p = 0.020) and misidentification of sadness instead of fear (p = 0.031).

*Table 2. Intergroup comparison of the accuracy and speed of emotion recognition*

| Emotion | Indicator | PSD (*N*=18) M (SD) | HC (*N*=18) M (SD) | U-test (p-value) |
|---|---|---|---|---|
| Happiness | % of correct answers | 96.1 (5.0) | 95.3 (8.4) | 146.0 (p= .582) |
| | recognition speed, ms | 736.8 (224.8) | 699.4 (268.8) | 134.0 (p=.376) |
| **Sadness** | **% of correct answers** | **64.4 (14.8)** | **78.2 (10.4)** | **75.5 (p=.006)** |
| | **recognition speed, ms** | **1507.3 (365.8)** | **1115.3 (319.2)** | **68.0 (p=.003)** |
| **Anger** | **% of correct answers** | **67.6 (20.3)** | **81.8 (12.6)** | **89.0 (p=.021)** |
| | **recognition speed, ms** | **1491.1 (386.8)** | **1060.7 (364.9)** | **66.0 (p=.002)** |
| **Fear** | **% of correct answers** | **39.4 (20.3)** | **57.6 (16.0)** | **80.5 (p=.010)** |
| | **recognition speed, ms** | **1668.9 (320.5)** | **1340.2 (227.0)** | **61.0 (p=.001)** |
| **Disgust** | **% of correct answers** | **60.1 (18.9)** | **75.3 (11.8)** | **83.5 (p=.013)** |
| | **recognition speed, ms** | **1316.3 (358.2)** | **999.6 (266.5)** | **77.0 (p=.007)** |
| Surprise | % of correct answers | 85.8 (15.8) | 86.3 (9.1) | 149.0 (p=.679) |
| | **recognition speed**, ms | 1070.1 (440.3) | 866.5 (287.3) | 149.0 (p=.681) |

*Key: N – absolute values, M – arithmetic mean, SD – standard deviation, U-test – two-tailed Mann-Whitney test, p-value – significance level, significant results are marked in bold.*

*Table 3. Intergroup comparison of misrecognition of emotions*

| Indicator | PSD (N = 18) M (SD) | HC (N = 18) M (SD) | U-test (p-value) |
|---|---|---|---|
| Responses to happiness stimulus | | | |
| Sadness for happiness, number of error answers, % | 0.42 (1.29) | 0.42 (0.96) | 154.0 (p=.815) |
| Anger for happiness, number of error answers, % | 0.14 (0.59) | 0.42 (0.96) | 144.0 (p=.584) |
| Fear for happiness, number of error answers, % | 0.28 (0.81) | 0.42 (1.78) | 154.0 (p=.815) |
| Disgust for happiness, number of error answers, % | 0.14 (0.58) | 0.69 (2.40) | 152.2 (p=.767) |
| Surprise for happiness, number of error answers, % | 1.11 (2.60) | 0.83 (2.58) | 122.0 (p=.214) |
| Responses to sadness stimulus | | | |
| Happiness for sadness, number of error answers, % | 1.11 (1.60) | 0.42 (0.96) | 133.5 (p=.372) |
| Anger for sadness, number of error answers, % | 1.53 (1.94) | 1.25 (1.55) | 154.0 (p=.815) |
| Fear for sadness, number of error answers, % | 7.22 (6.41) | 6.25 (7.38) | 141.5 (p=.521) |
| Disgust for sadness, number of error answers, % | **15.28 (12.33)** | **7.78 (6.47)** | **89.0 (p=.020)** |
| Surprise for sadness, number of error answers, % | 3.75 (5.89) | 1.53 (1.94) | 134.5 (p=.389) |
| Responses to anger stimulus | | | |
| Happiness for anger, number of error answers, % | 0.56 (1.37) | 0.14 (0.59) | 143.5 (p=.563) |
| Sadness for anger, number of error answers, % | 5.28 (6.35) | 3.33 (5.07) | 118.5 (p=.171) |
| Fear for anger, number of error answers, % | 3.75 (4.48) | 1.53 (2.73) | 111.5 (p=.111) |

| | | | |
|---|---|---|---|
| Disgust for anger, number of error answers, % | 9.86 (6.39) | 8.19 (7.06) | 127.5 (p=.279) |
| Surprise for anger, number of error answers, % | 4.17 (7.57) | 1.39 (3.12) | 136.5 (p=.424) |
| Responses to fear stimulus | | | |
| Happiness for fear, number of error answers, % | 0.83 (1.21) | 0.14 (0.59) | 117.0 (p=.161) |
| Sadness for fear, number of error answers, % | **7.22 (6.00)** | **3.19 (2,95)** | **94.0 (p=.031)** |
| Anger for fear, number of error answers, % | 1.53 (2.45) | 0.97 (1.52) | 144.5 (p=.584) |
| Disgust for fear, number of error answers, % | 12.36 (6.78) | 8.75 (6.37) | 106.0 (p=.079) |
| Surprise for fear, number of error answers, % | 30.28 (12.30) | 24.58 (13.59) | 122.0 (p=.214) |
| Responses to disgust stimulus | | | |
| Happiness for disgust, number of error answers, % | 0.42 (0.96) | 0.00 | 135.0 (p=.406) |
| Sadness for disgust, number of error answers, % | 5.83 (5.42) | 4.58 (3.56) | 150.5 (p=.719) |
| Anger for disgust, number of error answers, % | 23.06 (13.13) | 13.61 (5.37) | 102.5 (p=.059) |
| Fear for disgust, number of error answers, % | 3.75 (4.30) | 1.81 (2.40) | 120.5 (p=.192) |
| Surprise for disgust, number of error answers, % | 1.11 (1.76) | 0.69 (1.44) | 143.0 (p=.563) |
| Responses to surprise stimulus | | | |
| Happiness for surprise, number of error answers, % | 3.89 (4.22) | 3.06 (3.50) | 145.5 (p=.606) |
| Sadness for surprise, number of error answers, % | 0.69 (1.43) | 0.14 (0.59) | 134.5 (p=.389) |
| Anger for surprise, number of error answers, % | 0.55 (1.37) | 0.28 (1.18) | 145.0 (p=.606) |
| Fear for surprise, number of error answers, % | 5.28 (7.42) | 7.92 (7.69) | 121.0 (p=.203) |

| | | | |
|---|---|---|---|
| Disgust for surprise, number of error answers, % | 0.83 (1.49) | 0.83 (2.43) | 145.5 (p=.606) |

*Key: N – absolute values, M – arithmetic mean, SD – standard deviation, U-test – two-tailed Mann-Whitney test, p-value – significance level, significant results are marked in bold.*

Hypothesis 4 of the present study suggested that emotion regulation strategies and individual psychological characteristics would be different in patients with chemical dependence compared with the control group. For comparison, the nonparametric Mann-Whitney test was chosen since the questionnaire data deviated significantly from the normal distribution. Table 4 presents comparative data obtained using self-report scales. Significant differences were obtained for the following parameters: the level of motor impulsivity (BIS, p = .019), Blaming others (CERQ, p = .021), as well as the scale of Psychopathy (SD3, p = .042).

*Table 4. Intergroup comparison of self-report scales*

| Indicator | PSD (N = 18) Me [Q1; Q3] | HC (N = 18) Me [Q1; Q3] | U-test (p-value) |
|---|---|---|---|
| Hospital Anxiety and Depression Scale (HADS) | | | |
| Depression | 3.5 [1.8;6.3] | 4.5 [1.8; 7.3] | 141.0 (p=.504) |
| Anxiety | 5.5 [3.8; 9.5] | 5.0 [2.8; 7.3] | 138.0 (p=.445) |
| Barratt Impulsiveness Scale (BIS-11) | | | |
| General impulsivity | 67.0 [60.5; 75.5] | 64.0 [56.8; 68.3] | 114.5 (p=.132) |
| Attentional impulsivity | 17.0 [15.0; 21.3] | 16.5 [13.8; 19.0] | 116.0 (p=.143) |
| **Motor impulsivity** | **23.5 [21.8; 27.8]** | **21.0 [19.5; 24.0]** | **88.0 (p=.019)** |
| Non-planning impulsivity | 27.0 [23.0; 30.3] | 25.0 [23.8; 29.3] | 144.5 (p=.578) |
| Emotion Regulation Questionnaire (ERQ) | | | |
| Cognitive Reappraisal | 4.8 [4.0; 5.7] | 4.8 [4.0; 5.2] | 136.0 (p=.410) |
| Expressive Suppression | 3.5 [2.8; 5.0] | 3.8 [3.3; 4.5] | 150.5 (p=.715) |
| Cognitive Emotion Regulation Questionnaire (CERQ) | | | |

| | | | |
|---|---|---|---|
| Self-blame | 13.0 [10.8; 15.0] | 14.0 [9.8; 16.3] | 151.0 (p=.727) |
| **Blaming other** | **7.0 [5.8; 8.3]** | **9.0 [7.0; 10.0]** | **90.0 (p=.021)** |
| Acceptance | 13.5 [11.8; 16.0] | 13.0 [10.0; 15.3] | 141.0 (p=.503) |
| Refocusing on planning | 15.0 [14.0; 16.0] | 16.5 [14.8; 18.3] | 107.0 (p=.079) |
| Positive refocusing | 13.5 [10.3; 16.0] | 9.5 [7.0; 14.5] | 114.0 (p=.127) |
| Rumination | 11.0 [8.5; 12.3] | 13.0 [9.5; 16.3] | 111.0 (p=.105) |
| Positive reappraisal | 15.0 [12.0; 17.0] | 14.5 [12.0; 17.3] | 158.5 (p=.911) |
| Putting into perspective | 12.5 [8.0; 16.0] | 10.0 [7.8; 14.3] | 128.5 (p=.287) |
| Catastrophizing | 8.0 [7.0; 10.0] | 6.5 [5.0; 9.3] | 113.5 (p=.121) |
| Short Dark Triad (SD3) | | | |
| Machiavellianism | 25.0 [17.0; 28.0] | 24.5 [17.8; 27.3] | 159.5 (p=.937) |
| Narcissism | 28.0 [20.3; 29.3] | 28.5 [22.5; 31.3] | 132.5 (p=.349) |
| **Psychopathy** | **21.0 [17.3; 28.3]** | **17.0 [14.0; 21.0]** | **98.0 (p=.042)** |

*Key: N – absolute values, Me – mediana, Q1, Q3 – 1st and 3rd quartiles, U-test – two-tailed Mann-Whitney test, p-value – significance level, significant results are marked in bold.*

According to a preliminary analysis, hypothesis 1 was confirmed: patients with the syndrome of dependence differ from healthy controls in the impairment of the accuracy of recognizing sadness, anger, fear, and disgust. Hypothesis 2 was also confirmed: the clinical group differed from the control group in the speed of recognition of negative emotions (sadness, anger, fear, disgust). The third hypothesis was confirmed – patients with the syndrome of dependence have misrecognition of emotions. Hypothesis 4 also found its partial confirmation: patients with substance dependence differ in the level of motor impulsivity, and they also differ in personality traits characteristic of Psychopathy, in contrast to healthy controls. The control group differs from patients with the syndrome of dependence in terms of the ER Blaming other strategy.

### 3.1.3 Main analysis of intergroup differences in emotion recognition characteristics

*3.1.3.1 Results of accuracy facial negative emotion recognition*

Hierarchical multiple linear regression was used to study the issue of impaired accuracy in recognizing negative spectrum emotions in patients with the syndrome of dependence, considering factors of gender, age, education level, level of anxiety and depression, and general level of impulsivity. The independent variable was the group (substance-dependent, control group), the control factors, and the characteristics of emotion recognition (radians) were the dependent variable.

**Sadness recognition accuracy**

The results showed the group membership significantly predicted the accuracy of sadness recognition (Model 1: F(1, 34) = 11.20, p = .002, adj. R2 = .226). Specifically, PSD was characterized by a violation of the accuracy sadness recognition (b = 10.03 [95% CI: 3.937, 16.112], p = .002), (Table 5).

Also, adding control factors such as gender, age, educational level, levels of anxiety and depression, and general level of impulsivity led to the fact that the differences between clinical groups and healthy controls remained statistically significant (Model 2: F(7, 28) = 2.52, p = .039, adj.R2 = .233, b = 11.53 [95% CI: 2.339, 20.722], p = .030), (Table 5). One observation was found in the removed studentized residues, modulo exceeding 3 SD. However, after the removal of this outlier, the model did not change significantly, and the model is shown with an outlier (Table 5).

*Table 5. Hierarchical regression results for sadness recognition accuracy*

| Sadness recognition accuracy, radians | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | 10.03 (3.00)** | 11.53 (4.49)* |
| Age | - | 0.72 (0.37) |
| Gender | - | -3.46 (3.86) |
| Education | - | -0.26 (2.59) |
| Anxiety | - | -0.37 (0.53) |
| Depression | - | 0.70 (0.57) |

| | | |
|---|---|---|
| General impulsivity | - | -0.05 (0.20) |
| Adj. R2 | .226 | .233 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Anger recognition accuracy**

The results showed the group membership significantly predicted *accuracy of anger recognition* (Model 1: F(1, 34) = 4.90, p = .034, adj. R2 = .100). Specifically, the clinical group was characterized by the impaired anger recognition accuracy (b = 8.21 [95% CI: 0.673, 15.744], p = .034) (Table 6).

However, adding control factors such as gender, age, educational level, levels of anxiety and depression, and general level of impulsivity led to the fact that the differences between clinical groups and healthy controls did not remain statistically significant (Model 2: F(7, 28) = 2.40, p = .047, adj. R2 = .218, b = 0.36 [95% CI: -10.297, 11.010], p = .946), (Table 6).

*Table 6. Hierarchical regression results for anger recognition accuracy*

| **Anger recognition accuracy, radians** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | 8.21 (3.71)* | 0.36 (5.20) |
| Age | - | -0.60 (0.43) |
| Gender | - | -8.87 (4.48) |
| Education | - | 5.60 (3.00) |
| Anxiety | - | -0.42 (0.61) |
| Depression | - | 0.66 (0.66) |
| General impulsivity | - | 0.30 (0.23) |
| Adj. R2 | .100 | .218 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Fear recognition accuracy**

Table 7 shows the results of hierarchical regression for *recognition accuracy of the emotion of fear*. The clinical group was characterized by *the impaired fear recognition accuracy* (Model 1: F(1, 34) = 11.14, p = .005, adj. R2 = .225, b = 12.39 [95% CI: 4.848, 19.934], p = . 002).

However, after adjusting for control factors, intergroup difference was no statistically significant (Model 2: F(7, 28) = 2.88, p = .021, adj. R2 = .273, b = 8.00 [95% CI: -3.077, 19.079], p = .150), (Table 7).

*Table 7. Hierarchical regression results for fear recognition accuracy*

| **Fear recognition accuracy, radians** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | 12.39 (3.71)** | 8.00 (5.41) |
| Age | - | -0.61 (0.45) |
| Gender | - | 2.68 (4.65) |
| Education | - | 1.51 (3.12) |
| Anxiety | - | -1.11 (0.63) |
| Depression | - | 0.99 (0.68) |
| General impulsivity | - | 0.21 (0.24) |
| Adj. R2 | .225 | .273 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Disgust recognition accuracy**

The group membership also predicted *recognition accuracy of disgust* significantly (Model 1: F(1, 34) = 8.29, p = .007, adj. R2 = .172). The group of patients with the syndrome of dependence was characterized by *the impaired disgust recognition accuracy* (b = 10.30 [95% CI: 3.028, 17.566], p = .007), (Table 8).

However, adding control factors such as gender, age, educational level, levels of anxiety and depression, and general level of impulsivity led to the fact that the differences between clinical groups and healthy controls did not remain statistically significant (Model 2: F(7, 28 ) = 2.05, p = .083, adj.R2 = .174, b = 11.35 [95% CI: 0.330, 22.359], p = .044), (Table 8).

Two observations were identified in the removed studentized residuals and Cook's observations, modulo beyond 3 SD, however, after the removal of this outlier, the model did not change significantly, and the model is shown with an outlier.

*Table 8. Hierarchical regression results for disgust Recognition Accuracy*

| **Disgust recognition accuracy, radians** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | 10.30 (3.58)** | 11.35 (5.38)* |
| Age | - | 0.28 (0.45) |
| Gender | - | -3.17 (4.63) |
| Education | - | -2.15 (3.10) |
| Anxiety | - | -0.36 (0.63) |
| Depression | - | 1.22 (0.68) |
| General impulsivity | - | 0.16 (0.23) |
| Adj. R2 | .172 | .174 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Hypothesis 1 of the present study was partially confirmed. Patients with the syndrome of dependence were worse at recognizing the emotion of sadness than the control group after adjusting for control factors such as gender, age, education, levels of anxiety and depression, and general level of impulsivity.

Importantly, the control factor – the level of education did not show a significant effect on the results.

*3.1.3.2 Results of speed facial negative emotion recognition*

Hierarchical multiple linear regression was also used to study the issue of the impaired speed negative emotion recognition in patients with substance-dependent, considering factors of gender, age, level of education, as well as characteristics of impulsivity and personality traits. Speed negative emotion recognition data follow a normal distribution. The independent variable was the group (PSD, HC), the dependent variable was the characteristics of emotion recognition (ms). Control factors: age, gender, level of education, levels of anxiety and depression, and general level of impulsivity. In this study, it was found that the speed of recognition of sadness, anger, fear, and disgust was significantly predicted by the group in Models 1. However, after adjusting for control factors, differences between the groups were no longer statistically significant (see Appendices 3, 4, 5, 6).

Thus, hypothesis 2 of the present study did not find confirmation. After adjusting for control factors such as gender, age, education, levels of anxiety and depression, and general level of impulsivity, differences between groups in the speed negative emotion recognition lost their statistical significance.

*3.1.3.3 Misrecognition of emotions*

Hierarchical multiple regression was also used to explore the issue of misrecognition of emotions in patients with chemical dependence, considering control factors. The independent variable was the group (PSD, HC), the dependent variable was emotion recognition errors (radians). Control factors: age, gender, level of education, levels of anxiety and depression, and general level of impulsivity.

**Misrecognition disgust instead of sadness**

In the present study *misrecognition disgust instead of sadness* was significantly predicted by the group membership (Model 1: F(1, 34) = 6.60, p = .015, adj. R2 = .138). The clinical group was characterized *misrecognition disgust instead of sadness* (b = -7.32 [95% CI: -13.105, -1.529], p = .015), (Table 9).

After inclusion of control factors (gender, age, educational level, level of anxiety, depression, and general level of impulsivity) in the model, the statistical significance of group differences remained (Model 2: F(7, 28) = 5.90, p < .001, adj. R2 = .495, b = -7.27 [95% CI: -13.994, -0.552], p = .035), (Table 9).

*Table 9. Results of hierarchical regression for misrecognition disgust instead of sadness*

| **Misrecognition disgust instead of sadness, radians** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | -7.32 (2.49)* | -7.27 (3.28)* |
| Age | - | -0.87 (0.27)** |
| Gender | - | 2.81 (2.82) |
| Education | - | -0.60 (1.90) |
| Anxiety | - | 0.86 (0.38)* |
| Depression | - | -1.26 (0.42)** |
| General impulsivity | - | 0.22 (0.14) |
| Adj. R2 | .138 | .495 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Misrecognition sadness instead of fear**

The results showed *misrecognition sadness instead of fear* was also significantly predicted by the factor of the group (Model 1: F(1, 34) = 4.72, p = .037, adj. R2 = .096). That is, PSD was characterized by *misrecognition sadness instead of fear* (b = -5.16 [95% CI: -9.990, -0.332], p = .037), (Table 10).

However, adding control factors such as gender, age, educational level, levels of anxiety and depression, and general level of impulsivity did not lead to statistically significant differences between the group of substance-dependent participants and healthy controls (Model 2: F(7, 28) = 1.93, p = .102, adj.R2 = .157, b = -0.26 [95% CI: -7.327, 6.817], p = .942), (Table 10).

*Table 10. Results of hierarchical regression for misrecognition sadness instead of fear*

| **Misrecognition sadness instead of fear, radians** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | -5.16 (2.38) | -0.26 (3.45) |
| Age | - | 0.79 (0.29) |
| Gender | - | -1.42 (2.97) |
| Education | - | -2.65 (1.99) |
| Anxiety | - | 0.33 (0.40) |
| Depression | - | 0.22 (0.44) |
| General impulsivity | - | -0.01 (0.15) |
| Adj. R2 | .096 | .157 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Hypothesis 3 of this study was confirmed. When adjusted for control factors, patients with the syndrome of dependence have the following specific pattern of facial emotion misrecognition – misrecognition disgust instead of sadness.

### 3.1.4 Results of emotion regulation and individual psychological measurement

Hypothesis 4 of the present study assumed patients with chemical dependence would differ in emotion regulation strategies, impulsivity characteristics, and personality traits from the control group. A preliminary comparative analysis using the

non-parametric Mann-Whitney test showed that there were differences in the following characteristics: motor impulsivity (BIS-11), Blaming other (CERQ), Psychopathy (SD3). Hierarchical multiple regression was used to examine these differences with the influence of control factors. The independent variable was the group (substance-dependent, control group), the dependent variable was the scale of questionnaires, control factors: age, gender, education level, levels of anxiety and depression, and general level of impulsivity. However, the general level of impulsivity was not used as a control factor for the level of motor impulsivity since these characteristics are scales of one questionnaire (BIS-11).

Adding control factors did not lead to differences between PSD and HC. At the same time, there were no intergroup differences for the Psychopathy in Model 1 either (see Appendixes 7, 8, 9).

Thus, hypothesis 4 of the present study was not confirmed. After considering control factors, the difference between groups in individual psychological characteristics ceases to be significant.

### 3.1.5 Moderation analysis

To test the influence of impulsivity characteristics, personality traits, and levels of anxiety and depression on the relationship between emotion recognition features and emotion regulation strategies (Hypothesis 5), we used a moderation analysis. The dependent variable was the ERQ and CERQ questionnaires for emotion regulation strategies, the independent variable was the radians of misrecognition of emotions, and the moderator was the BIS-11, SD3, and HADS scales. Moderator and independent variable data were centered.

11 significant results were obtained for the group of substance-dependent participants.

**Moderator – characteristics of impulsivity (BIS-11)**

**General level of impulsivity**

The moderation effect as general level of impulsivity, effect of misrecognition sadness instead of happiness on emotion regulation strategy Self-blame and the effect of interaction between the moderator and the independent variable were statistically

significant *F*(3, 14 = 3.62, p = .040, adj. R2 = .316, (b= -2.12 (0.98), p = .048; b= -8.10 (2.78), p = .011; b = -5.93 (1.86), p = .007, accordingly). According to Figure 3, as the general level of impulsivity increased, the relationship between the propensity to self-blame and the misrecognition sadness instead of happiness became more negative. In other words, the higher the severity of general impulsivity and the greater the misrecognition of sadness instead of happiness, the lower the tendency for Self-blame.

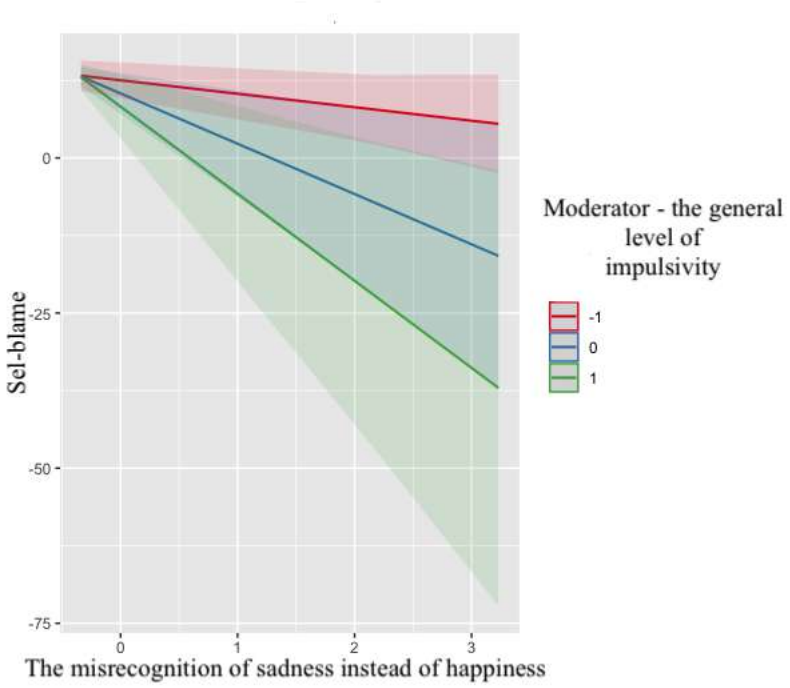


*Figure 3 – Graph of the moderation effect as the general level of impulsivity on the relationship between the misrecognition of sadness instead of happiness and the tendency to Self-blame*

The statistically significant effect of the independent variable and the moderation effect, and the interaction between them remained after adding control variables in the model F(6, 11 = 3.40, p = .037, adj. R2 = .458, ( b = -10.26 (2.73), p = .009, b = -2.44 (1.02), p = .008, b = -7.64 (1.80), p = .001, respectively), (Table 11).

*Table 11 Moderation analysis results as the general level of impulsivity with control variables*

| **Indicators** | **B (SE)** |
|---|---|
| Misrecognition of sadness instead of happiness | -10.26 (2.73)** |
| General level of impulsivity | -2.44 (0.92)* |

| | |
|---|---|
| Age | 0.02 (0.17) |
| Gender | -3.00 (1.53) |
| Education | -0.74 (1.03) |
| Interaction between moderator and independent variable | -7.64 (1.80)** |
| Adj. R2 | .458 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Level of motor impulsivity**

There were statistically significant the moderator effect on the level of motor impulsivity, the effect of the misrecognition of sadness instead of happiness on emotion regulation strategy Self-blame and the effect of interaction between the moderator and the independent variable $F(3, 14 = 4.35$, p = .023, adj. R2 = .372, (b = 3.81 (1.10), p = .004; b = 10.28 (3.08), p = .005; b = 8.91 (2.87), p = .008, accordingly). According to Figure 4, as the degree of motor impulsivity increases, the relationship between the tendency to Self-blame and the misrecognition of sadness instead of happiness became more positive. In other words, the higher the severity of motor impulsivity and the greater the misrecognition of sadness instead of happiness, the greater the propensity for Self-blaming.

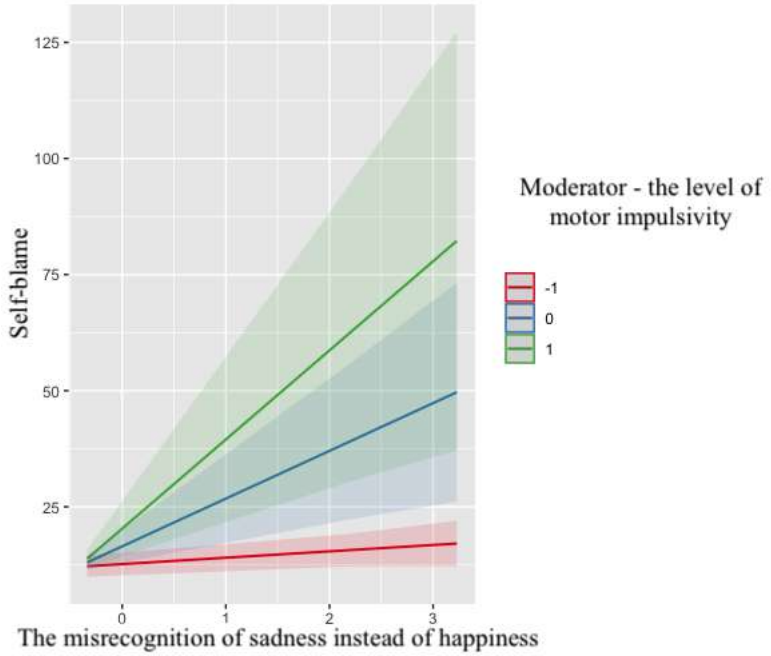


*Figure 4 – Graph of the moderation effect as the level of motor impulsivity on the relationship between the misrecognition of sadness instead of happiness and the tendency to Self-blame*

Adding control factors such as gender, age, and education, led to the fact that statistically significant result remained. The independent variable effect, the moderation effect, effect of interaction between them were deemed to be present $F(6, 11 = 4.02$, p = .022, adj. R2 = .517, (b = 13.16 (2.93), p < .001; b = 4.62 (1.02), p < .001; b =11.44 (2.76), p = .002, accordingly), (Table 12).

*Table 12. Results of moderation analysis as the level of motor impulsivity with control variables (a)*

| Indicators | B (SE) |
|---|---|
| Misrecognition of sadness instead of happiness | 13.16 (2.93)*** |
| Level of motor impulsivity | 4.62 (1.02)*** |
| Age | 0.06 (0.16) |
| Gender | -2.74 (1.46) |
| Education | -0.83 (0.94) |
| Interaction between moderator and independent variable | 11.44 (2.76)** |
| Adj. R2 | .517 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Also, the effect of the level of motor impulsivity, the effect of the misrecognition of sadness instead of disgust on the emotion regulation strategy Rumination, as well as their interaction were statistically significant *F*(3, 14 = 6.89, p = .004, adj. R2 = .510, (b = -1.46 (0.62), p = .034; b = -2.35 (0.63), p = .002; b = 1.86 (0.70), p = .018, accordingly). As the degree of motor impulsivity increased, the relationship between Rumination and the misrecognition of sadness instead of disgust became less negative. In other words, the greater the level of motor impulsivity and the greater the misrecognition of sadness instead of disgust, the lower the propensity for the emotion regulation strategy Rumination. In this case, the relationship was weakly expressed (Fig. 5).

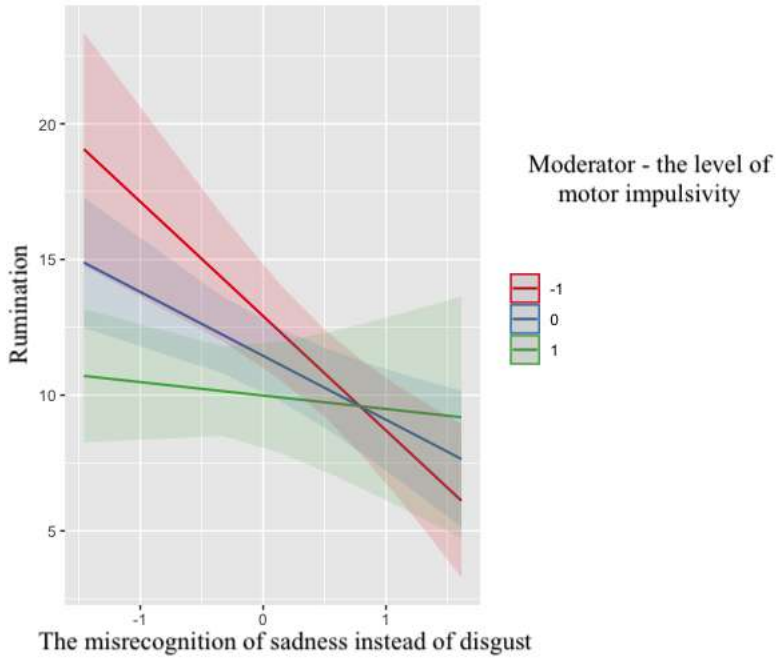


*Figure 5 – Graph of the moderation effect as the level of motor impulsivity on the relationship between the misrecognition of sadness instead of disgust and the tendency to Rumination*

According to Table 13, after adding control variables to the model, the effect of the independent variable and the moderation effect, as well as the interaction between them, were statistically significant F(6, 11 = 7.00, p = .003, adj. R2 = .670, (b = -2.80 (0.55), p < .001, b = -1.71 (0.54), p = .008, b = 2.27 (0.59), p = .003, respectively).

In the model with control variables, there were 2 outliers in the Cook's distance that went beyond the limit of 1, after removing them the model did not change significantly. Table 13 shows values before removing outliers.

*Table 13. Results of moderation analysis as the level of motor impulsivity with control variables (b)*

| Indicators | B (SE) |
|---|---|
| Misrecognition of sadness instead of disgust | -2.80 (0.55)*** |
| Level of motor impulsivity | -1.71 (0.54)** |
| Age | -0.07 (0.12) |
| Gender | -3.09 (1.02)* |
| Education | -0.11 (0.65) |
| Interaction between moderator and independent variable | 2.27 (0.59)** |
| Adj. R2 | .679 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Level of non-planning impulsivity**

There were statistically significant the effect of the level of non-planning impulsivity in the role of moderator, the effect of the misrecognition fear instead of happiness on the tendency to Cognitive Reappraisal, and the interaction of the moderator effect and the effect of the independent variable $F(3, 14 = 3.77$, p = .008, adj. R2 = .462, (b = -0.90 (0.23), p = .001; b = -0.82 (0.34), p = .030; b = -0.90 (0.35), p = .022, accordingly). As the degree of non-planning impulsivity increased, the relationship between Cognitive Reappraisal and the misrecognition fear instead of happiness became more negative. In other words, the higher the level of non-planning impulsivity, the greater the misrecognition fear instead of happiness, the lower the propensity for Cognitive Reappraisal (Fig. 6).


*Figure 6 – Graph of the moderation effect as the level of non-planning impulsivity on the relationship between the misrecognition fear instead of happiness and the tendency to Cognitive Reappraisal*

Adding control variables to the model as gender, age, and education, the statistically significant effect of the independent variable, the moderation effect and effect of the interaction between them, are preserved $F(6, 11 = 6.31$, p = .004, adj. R2 = .651, (b = -0.75 (0.29), p = .026; b = -0.78 (0.19), p = .002; b = -0.74 (0.29), p = .026, accordingly), (Table 14).

*Table 14. Results of moderation analysis as the level of non-planning impulsivity with control variables*

| **Indicators** | **B (SE)** |
|---|---|
| Misrecognition fear instead of happiness | -0.75 (0.29)* |
| Level of non-planning impulsivity | -0.78 (0.19) ** |
| Age | -0.10 (0.05) * |
| Gender | -0.30 (0.46) |
| Education | 0.75 (0.25) * |
| Interaction between moderator and independent variable | -0.74 (0.29) * |
| Adj. R2 | .652 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Moderator – personality traits (SD3)**

**Level of Narcissism**

The moderation effect as the level of Narcissism, the effect of the misrecognition fear instead of anger at the tendency to Catastrophizing, and the interaction of the moderator effect and the effect of the independent variable were statistically significant $F(3, 14 = 8.01$, p = .002, adj. R2 = .553, (b = -2.49 (0.70), p = .003; b = 1.51 (0.57), p = .019; b = -3.11 (0.69), p <.001, accordingly). According to Figure 7, the relationship between Catastrophizing and the misrecognition fear instead of anger changed from positive to negative as the degree of Narcissism increased. The higher the Narcissism trait, the greater the misrecognition fear instead of anger, the lower the tendency towards Catastrophizing.

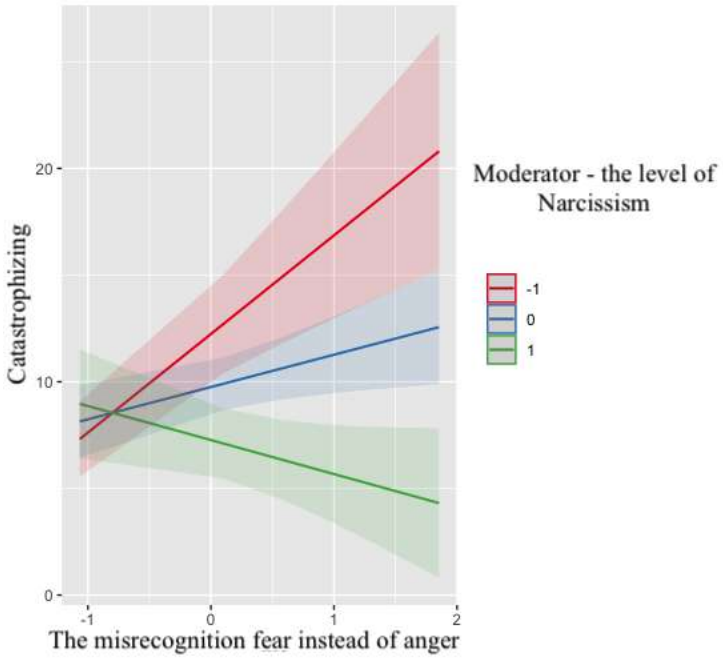


*Figure 7 – Graph of the moderation effect as the level of Narcissism on the relationship between the misrecognition fear instead of anger and the tendency to Catastrophizing*

The statistically significant effect persists after adding control variables to the model for the moderation effect and for the interaction between the moderator of the independent variable $F(6, 11 = 3.93$, p = .024, adj. R2 = .508, (b = -2.13 (0.80), p =.021;

b = -2.86 (0.78), p = .004, accordingly). However, the effect of the independent variable ceased to be statistically significant (b = 1.49 (0.72), p = .063), (Table 15).

*Table 15. Moderation analysis results as the level of Narcissism with control variables (a)*

| Indicators | B (SE) |
|---|---|
| Misrecognition fear instead of anger | 1.49 (0.72) |
| Level of Narcissism | -2.13 (0.80)* |
| Age | -0.04 (0.15) |
| Gender | -1.40 (1.37) |
| Education | 0.77 (0.88) |
| Interaction between moderator and independent variable | -2.86 (0.78)** |
| Adj. R2 | .508 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

There were statistically significant the moderator effect as the level of Narcissism, the effect of the misrecognition happiness instead of sadness on the ER strategy Refocusing on planning, and the interaction between these effects $F(3, 14 = 5.89$, p = .008, adj. R2 = .463, (b = -2.08 (0.65), p = .006; b = 1.31 (0.53), p = .027; b = 0.90 (0.37), p = .028, accordingly). According to Figure 8, as the degree of Narcissism increased, the relationship between the Refocusing on planning and the misrecognition happiness instead of sadness became more positive. In other words, the higher the level of the Narcissism and the greater the misrecognition happiness instead of sadness, the greater the propensity for such an emotion regulation strategy as the Refocusing on planning.

In this model, there was 1 outlier in the Cook's distance, which went beyond the boundary by 1, after its removal the model did not change significantly. Figure 8 shows the model without outlier removal.

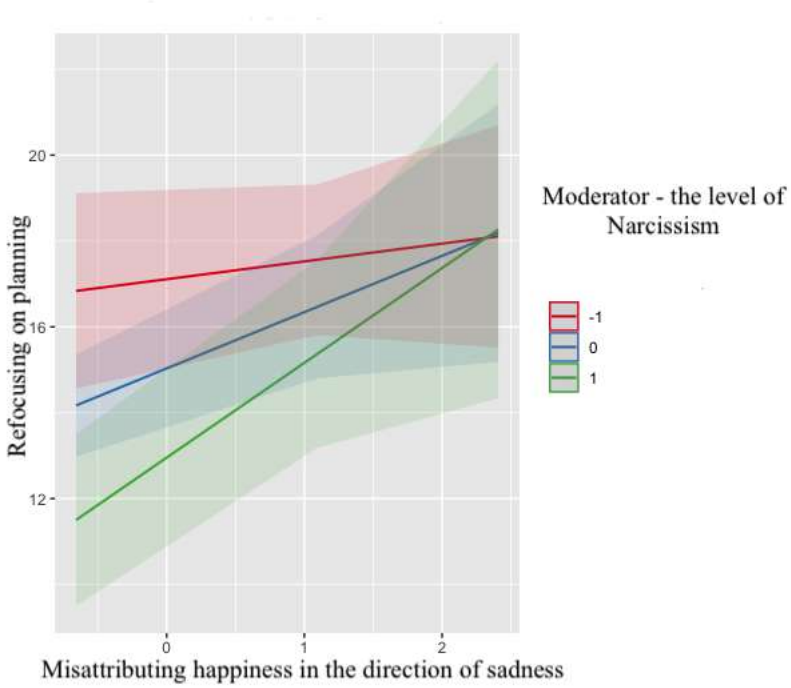


*Figure 8 – Graph of the moderation effect as the level of Narcissism on the relationship between the misrecognition happiness instead of sadness and the tendency to Refocus on planning*

This models showed statistically significant effect for all variables (effect of the independent variable, the moderation effect and effect of the interaction between them) *F*(6, 11 = 2.79, p = .070, adj. R2 = .381, (b = 1.35 (0.60), p = .046; b = -2.08 (0.72), p = .015; b = 1.07 (0.44), p = .034, accordingly), (Table 16).

In the model with control variables, there was also 1 outlier in the Cook's distance, which went beyond the border by 1, after its removal the model did not change significantly. Table 16 shows the values before removing outliers.

*Table 16. Moderation analysis results as the level of Narcissism with control variables (b)*

| **Indicators** | **B (SE)** |
|---|---|
| Misrecognition happiness instead of sadness | 1.35 (0.60)* |
| Level of Narcissism | -2.08 (0.72) ** |
| Age | -0.06 (0.14) |
| Gender | -0.07 (1.17) |
| Education | 0.82 (0.79) |
| Interaction between moderator and independent variable | 1.07 (0.44) * |

| | |
|---|---|
| Adj. R2 | .381 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Also, the effect of the features described by the concept of Narcissism in the moderator role, the effect of the misrecognition surprise instead of fear on the tendency to Cognitive Reappraisal, and the interaction of the moderator effect and the effect of the independent variable were statistically significant $F(3, 14 = 3.77$, p = .035, adj. R2 = .328, (b = -0.55 (0.23), p = .033; b = -0.55 (0.25), p = .041; b = 1.04 (0.45), p = .036, accordingly). As the degree of Narcissism increased, the relationship between Cognitive Reappraisal and the misrecognition surprise instead of fear shifted from negative to positive and became more positive. In other words, the greater the severity of Narcissism traits, the greater the misrecognition surprise instead of fear and strategy, the greater the propensity for Cognitive Reappraisal (Figure 9).

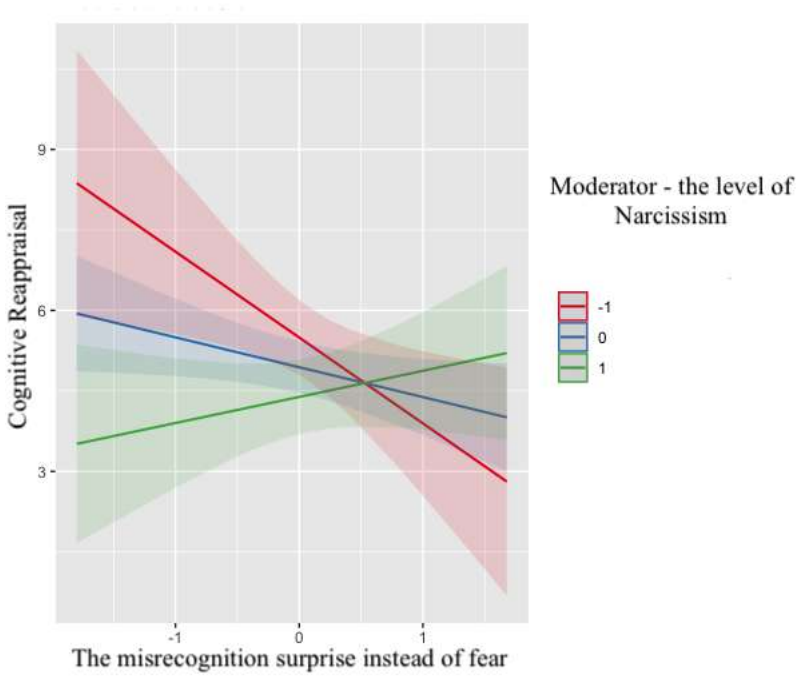


*Figure 9 - Graph of the moderation effect as the level of Narcissism on the relationship between the misrecognition surprise instead of fear and the tendency to Cognitive Reappraisal*

However, adding control variables led to the fact that no significant effect of the independent variable and the moderator. The interaction between them remained

statistically significant *F*(6, 11 = 4.80, p = .012, adj. R2 = .573, (b = -0.29 (0.23), p = .225; b = -0.32 (0.20), p = .138; b = 1.30 (0.38), p = .005, accordingly), (Table 17).

In the model with control variables, there was 1 outlier in the Cook's distance that went beyond the boundary by 1, after removing it the model did not change significantly. Table 17 shows the values before removing outliers.

*Table 17. Moderation analysis results as the level of Narcissism with control variables (c)*

| Indicators | B (SE) |
|---|---|
| Misrecognition surprise instead of fear | -0.29 (0.23) |
| Level of Narcissism | -0.32 (0.20) |
| Age | -0.15 (0.06)* |
| Gender | -0.68 (0.43) |
| Education | 0.98 (0.31)** |
| Interaction between moderator and independent variable | 1.30 (0.38) ** |
| Adj. R2 | .573 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Level of Psychopathy**

There were statistically significant moderation effect as a level of Psychopathy, effect of the misrecognition happiness instead of sadness as an independent variable on the strategy of ER Refocusing on planning, and the interaction of the moderator effect and the independent variable effect *F*(3, 14 = 7.45, p = .003, adj. R2 = .532, (b = -1.99 (0.56), p = .003; b =1.36 (0.49), p = .015; b = 1.12 (0.38), p = .010, accordingly). The higher the severity of the Psychopathy trait, the more positive the relationship between the misrecognition of happiness instead of sadness and the emotion regulation strategy Refocusing on planning. In other words, the greater the severity of Psychopathy and the misrecognition happiness instead of sadness, the more pronounced is the tendency to Refocusing on planning (Figure 10).

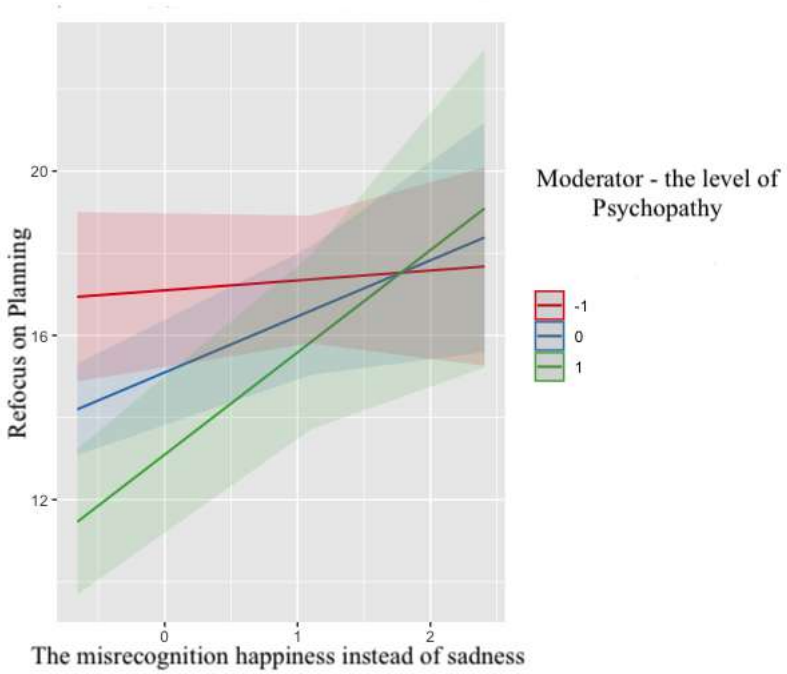


*Figure 10 – Graph of the moderation effect as the level of Psychopathy on the relationship between the misrecognition happiness instead of sadness and the tendency to Refocus on Planning*

After adding control variables as gender, age, and education to the model, the statistically significant moderation effect and the interaction between the moderation effect and the independent variable are preserved, but the statistical effect of the independent variable is not preserved $F(6, 11 = 3.85$, p = .025, adj. R2 = .502, (b = -2.11 (0.59), p = .004; b = 1.14 (0.44), p = .026; b = 1.14 (0.59), p = .077, accordingly), (Table 18).

In the model with control variables, there was 1 outlier in the Cook's distance that went beyond the boundary by 1, after removing it the model did not change significantly. Table 18 shows the values before removing outliers.

*Table 18. Moderation analysis results as a psychopathy level with control variables*

| **Indicators** | **B (SE)** |
|---|---|
| Misrecognition happiness instead of sadness | 1.14 (0.59) |
| Level of Psychopathy | -2.11 (0.59)** |
| Age | -0.13 (0.14) |
| Gender | -0.55 (1.12) |
| Education | 0.94 (0.65) |

| | |
|---|---|
| Interaction between moderator and independent variable | 1.14 (0.44)* |
| Adj. R2 | .502 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Moderator – anxiety and depression levels (HADS)**

In the group with chemical dependence, only 3 significant results were obtained, where levels of anxiety and depression (HADS) act as a moderator.

**Level of anxiety**

There were statistically significant Moderator effect as the level of anxiety, independent variable effect as the misrecognition happiness instead of anger at emotion regulation strategy $F(3, 14 = 16.57, p < .001$, adj. R2 = .733, (b = 3.26 (0.54), p < .001; b = 3.45 (0.78), p < .001; b = 2.19 (1.01), p = .049, accordingly). As anxiety levels increased, the association between Catastrophizing and the misrecognition happiness instead of anger became more positive. In other words, the higher the level of anxiety and the greater the misrecognition happiness instead of anger, the greater the propensity for Catastrophizing (Figure 11).

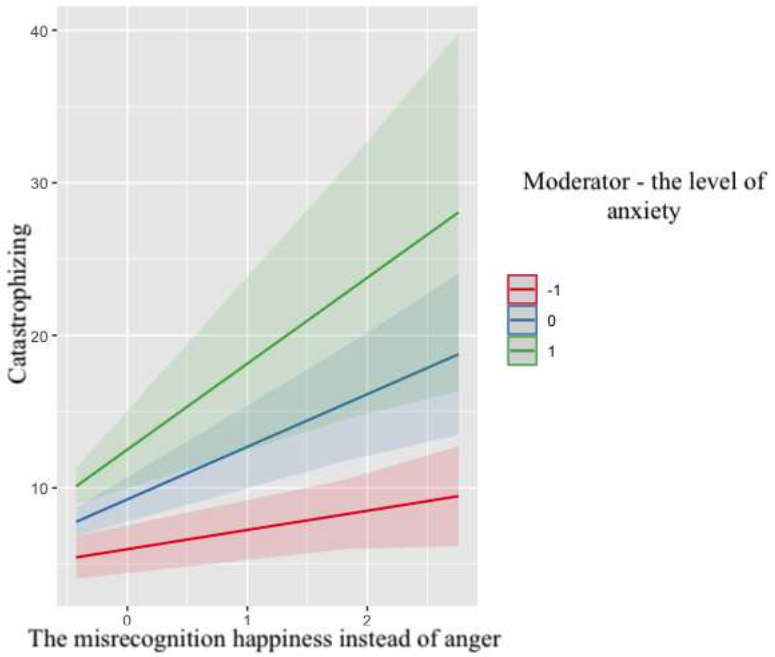


*Figure 11 – Graph of the moderation effect as the level of anxiety on the relationship between the misrecognition happiness instead of anger and the tendency to Catastrophizing*

However, when the control factors were taken into account, was no statistically significant effect of interaction between the moderator and the independent variable *F*(6, 11 = 9.12, p = .001, adj. R2 = .741, (b = 2.17 (1.03), p = .060). This preserves the statistically significant effect of the moderator and the independent variable separately (b = 3.30 (0.65), p < .001; b = 3.56 (0.83), p = .001, accordingly) (Table 19).

In the model with control variables, there was 1 outlier in the Cook's distance that went beyond the boundary by 1, after removing it the model did not change significantly. Table 19 shows the values before removing outliers.

*Table 19. Moderation analysis results as anxiety level with control variables (a)*

| Indicators | B (SE) |
|---|---|
| Misrecognition happiness instead of anger | 3.57 (0.83)** |
| Level of anxiety | 3.30 (0.65)*** |
| Age | -0.11 (0.11) |
| Gender | -0.43 (1.08) |
| Education | -0.38 (0.58) |
| Interaction between moderator and independent variable | 2.16 (1.03) |
| Adj. R2 | .741 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

The moderation effect as an anxiety level, the effect of the misrecognition surprise instead of happiness on ER strategy as Catastrophizing, and the interaction of the moderator effect and the effect of the independent variable were statistically significant *F*(3, 14 = 14.85, p < .001, adj. R2 = .733, (b = 4.67 (0.73), p < .001; b = 6.08 (1.33), p < .001; b = 4.12 (1.15), p = .003, accordingly). The higher the anxiety level, the more positive the relationship between the misrecognition surprise instead of happiness and the emotion regulation strategy of Catastrophizing. In other words, the greater the level of anxiety and the greater the misrecognition surprise instead of happiness, the greater the propensity for Catastrophizing (Figure 12).

There were 3 outliers in the Cook's distance in the model, which went beyond the boundary by 1, after their removal the model did not change significantly. Figure 12 shows the values before removing outliers.

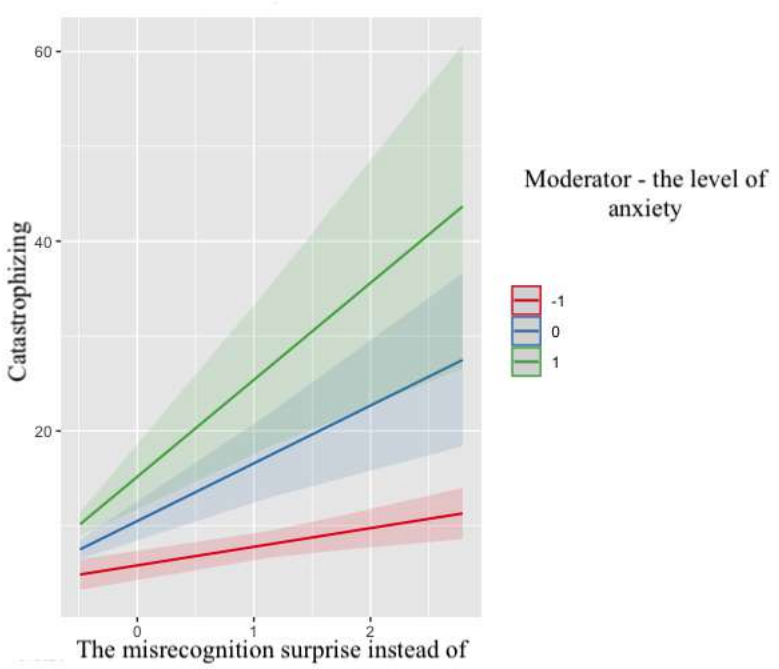


*Figure 12 – Graph of the moderation effect as the level of anxiety on the relationship between the misrecognition surprise instead of happiness and the tendency to Catastrophizing*

The statistically significant effect of the independent variable, the moderator, and their interaction after adjusting for control variables remained $F(6, 11 = 7.98$, p = .002, adj. R2 = .711, (b = 6.24 (1.42), p = .001; b = 4.66 (0.87), p < .001; b = 4.26 (1.23), p = .005, accordingly), (Table 20).

In the model with control variables, there were also 3 outliers in the Cook's distance that went beyond the limit of 1, after removing them the model did not change significantly. Table 20 shows the values before removing outliers.

*Table 20. Moderation analysis results as anxiety level with control variables (b)*

| **Indicators** | **B (SE)** |
|---|---|
| Misrecognition surprise instead of happiness | 6.24 (1.42)** |
| Level of anxiety | 4.66 (0.87)*** |
| Age | -0.09 (0.11) |
| Gender | -0.82 (1.13) |
| Education | -0.39 (0.63) |
| Interaction between moderator and independent variable | 4.26 (1.23)** |
| Adj. R2 | .711 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

The effect of the level of depression as a moderator, the effect of the misrecognition sadness instead of happiness as an independent variable on the ER strategy Self-blame, and the interaction of the moderator effect and the effect of the independent variable were statistically significant *F*(3, 14 = 4.53, p = .020, adj. R2 = .384, (b = -3.31 (1.40), p = .033; b = -10.19 (3.32), p = .008; b = -12.30 (3.64), p = .005, accordingly). As the degree of depression increased, the relationship between the propensity to Self-blame and the misrecognition sadness instead of happiness became more negative. In other words, the higher the severity of depression, the greater the misrecognition sadness instead of happiness, the lower the propensity for Self-blame (Figure 13).

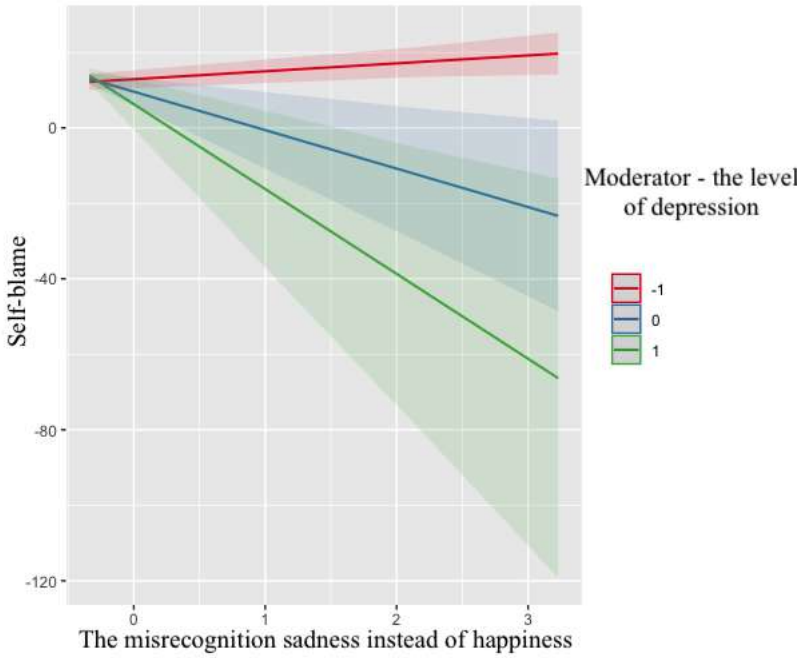


*Figure 13 – Graph of the moderation effect as the level of depression on the relationship between the misrecognition sadness instead of happiness and the tendency to Self-blame*

Adding control factors led to fact that the statistically significant effect of the independent variable, the moderator remained *F*(6, 11 = 4.08, p = .021, adj. R2 = .521, (b = -12.86 (3.23), p = .002; b = -4.50 (1.36), p = .007; b = -15.53 (3.49), p < .001, accordingly), (Table 21).

*Table 21. Moderation analysis results as depression level with control variables*

| Indicators | B (SE) |
|---|---|
| Misrecognition sadness instead of happiness | -12.86 (3.23)** |
| Level of depression | -4.50 (1.36)** |
| Age | 0.02 (0.16) |
| Gender | -2.68 (1.46) |
| Education | -0.89 (0.94) |
| Interaction between moderator and independent variable | 15.53 (3.49)*** |
| Adj. R2 | .521 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Thus, Hypothesis 5 was confirmed. Impulsivity characteristics, personality traits, and levels of anxiety and depression as a moderator influence the relationship between misrecognition of emotions and emotion regulation strategies in patients with the syndrome of dependence.

## 3.2. Study 2

### 3.2.1 General social characteristics and clinical and anamnestic data on participants

Study 2 included 108 people. Of these, 31 participants with the use of psychoactive substances, 32 patients with a diagnosis of "Emotionally unstable personality disorder, borderline type", 45 - the control group.

The general characteristics of the sample and a description of socio-demographic and clinical-anamnestic information for patients with chemical dependence and for the control group are given below (Table 22).

*Table 22. Description of demographic and clinical-anamnestic data in the study groups*

| Indicator | BPD (*N* = 32) | SU (*N* = 31) | HC (*N* = 45) |
|---|---|---|---|
| Age | | | |
| M | 26.5 | 26.9 | 26.2 |
| SD | 5.1 | 6.3 | 5.4 |

| | | | |
|---|---|---|---|
| Gender | | | |
| Female | 25 (78.1%) | 16 (51.6%) | 29 (64.4%) |
| Male | 7 (21.9%) | 15 (48.4%) | 16 (35.6%) |
| Education | | | |
| Incomplete secondary | 1 (3.1%) | 1 (3.2%) | 1 (2.2%) |
| Secondary/ vocational | 6 (18.8%) | 5 (16.1%) | 2 (4.5%) |
| Incomplete higher education/ student | 11 (34.4%) | 11 (35.5%) | 18 (40%) |
| Higher education | 14 (43.7%) | 14 (45.2%) | 24 (53.3%) |
| Marital status | | | |
| Single | 29 (90.6%) | 23 (74.2%) | 36 (80%) |
| Married | 1 (3.1%) | 6 (19.4%) | 6 (13.3%) |
| Divorced | 2 (6.3%) | 2 (6.4%) | 3 (66.7%) |
| Children | | | |
| Yes | 0 (0%) | 4 (12.9%) | 4 (8.9%) |
| No | 32 (100%) | 27 (87.1%) | 41 (91.1%) |
| Employment status | | | |
| Student | 4 (12.5%) | 1 (3.2%) | 14 (31.1%) |
| Working with lower qualification | 3 (9.4%) | 1 (3.2%) | 1 (2.2%) |
| Manager | 1 (3.1%) | 3 (9.7%) | 2 (4.5%) |
| Specialist | 12 (37.5%) | 15 (48.4%) | 23 (51.1%) |
| State employee | 0 (0%) | 0 (0%) | 0 |
| Other | 2 (6.3%) | 6 (19.4%) | 1 (2.2%) |
| Unemployed | 10 (31.3%) | 5 (16.1%) | 4 (8.9%) |
| Heredity | | | |
| Yes | 9 (28.1%) | 16 (29.1%) | 19 (42.3%) |
| No | 23 (71.9%) | 15 (70.9%) | 26 (57.7%) |

*Key: N – absolute value, M – arithmetic mean, SD – standard deviation.*

Clinical group 1 consisted of 31 participants with a diagnosis established by a narcologist according to the ICD-10 criteria "Harmful use ..." (F10.1, F12.1, F15.1 etc. depending on the psychoactive substance and / or had from 8 to 20 points on the AUDIT test – 16 women (51.6%), 15 men (48.2%), mean age – 26.9 (6.3) years 1 participant (3.2%) had an incomplete secondary education, 5 participants had a complete secondary education (16.1%), 11 (35.5%) – with incomplete higher education, 14 (45.2%) people had higher education.

Clinical group 2 consisted of 32 patients with a diagnosis established by a psychiatrist according to the ICD-10 criteria "Emotionally unstable personality disorder, borderline type" (F60.31x) – 25 women (78.2%), 7 men (21.8%), mean age - 26.5 (5.1) years. 1 participant (3.1%) had an incomplete secondary education, 6 (18.8%) had a complete secondary education, 11 (34.4%) had an incomplete higher education, 14 participants (43.7%) had a higher education.

The control group included 45 participants. 29 women (64.4%), 16 men (35.6%), mean age 26.2 (5.4) years. 1 (2.2%) participant had an incomplete secondary education, complete secondary education – 2 (4.5%), incomplete higher education – 18 (40%), and 24 (53.3%) – higher education.

The groups were tested for homogeneity: 1) by age using the nonparametric Mann-Whitney test (HC and substance users: p= .799; HC and BPD: p = .796; BPD and SU: p = .978; 2) by education using the nonparametric Pearson chi-square test (HC and SU: p = .371; HC and BPD: p = .236; BPD and SU: p = .995); 3) by gender using a non-parametric Pearson chi-square test adjusted for continuity (HC and substance users: p = .378; HC and BPD: p = .298; BPD and SU: p = .052), differences are not significant.

### 3.2.2 Preliminary intergroup comparison analysis

Hypothesis 1 and 2 of the present study assumed that the accuracy and speed of recognition of negative spectrum emotions would differ in clinical groups compared to the control group. Hypothesis 3 assumed that the clinical groups would be characterized by misrecognition of emotions. We performed a comparative analysis using the nonparametric Kruskal-Wallis test, since the data on the percentages of

correct and incorrect responses to emotion recognition deviate significantly from the normal distribution. In a preliminary analysis to evaluate emotion recognition, three parameters of emotion recognition were compared: the number of correct responses in emotion recognition (accuracy) in percent (%), misrecognition of emotions (%), and the average response delay (speed) in ms. Differences were found between the groups in the accuracy of sadness recognition and in the speed of happiness recognition (Table 23). Notably, there were differences in the speed of happiness between BPD patients and controls, and between substance users and BPD patients ($p = .022$, $p = .007$, accordingly). Clinical groups differ from healthy controls in the accuracy of recognition of sadness (SU and HC – $p = .002$, BPD and HC – $p = .001$) (Table 24). There were no statistically significant differences in the accuracy of recognition of happiness, anger, fear, disgust, and surprise, as well as in the speed of recognition of sadness, anger, fear, disgust, and surprise.

Regarding intergroup differences in emotion misrecognition, the substance user group and BPD patients were found to differ from the control group in the misrecognition disgust instead of sadness ($p = .033$, $p = .003$, accordingly) (Table 26). For other emotions, no intergroup differences in erroneous recognition were found (Table 25).

*Table 23. Intergroup comparison of the accuracy and speed of emotion recognition*

| Emotion | Indicator | BPD (N=32) M (SD) | SU (N=31) M (SD) | HC (N=45) M (SD) | K-W test (p-value) |
|---|---|---|---|---|---|
| **Happiness** | % of correct answers | 95.94 (5.53) | 97.10 (3.54) | 97.06 (5.67) | 2.746 (p=.253) |
| | **recognition speed, ms** | **770.33 (289.25)** | **585.45 (157.89)** | **623.93 (93)** | **8.277 (p=.016)** |
| **Sadness** | **% of correct answers** | **71.95 (12.55)** | **72.82 (9.33)** | **80.56 (8.92)** | **13.997 (p<.001)** |
| | recognition speed, ms | 1170.08 (313.59) | 1120.75 (296.20) | 1010.87 (272.34) | 5.406 (p=.067) |
| Anger | % of correct answers | 83.67 (11.01) | 79.92 (13.36) | 83.89 (10.53) | 1.838 (p=.399) |
| | recognition speed, ms | 1131.40 (288.27) | 1113.72 (347.98) | 1012.11 (318.15) | 3.316 (p=.191) |

| | | | | | |
|---|---|---|---|---|---|
| Fear | % of correct answers | 58.13 (20.07) | 52.42 (18.59) | 58.17 (15.90) | 2.182 (p=.336) |
| | recognition speed, ms | 1353.15 (314.85) | 1478.71 (358.93) | 1267.96 (277.97) | 5.909 (p=.052) |
| Disgust | % of correct answers | 75.31 (11.51) | 77.18 (10.12) | 73.00 (13.97) | 1.710 (p=.425) |
| | recognition speed, ms | 1117.73 (341.61) | 1055.91 (301.50) | 978.35 (265.30) | 3.601 (p=.165) |
| Surprise | % of correct answers | 83.44 (11.50) | 83.55 (11.36) | 85.61 (8.40) | 0.232 (p=.891) |
| | recognition speed, ms | 1057.10 (348.54) | 934.90 (327.82) | 882.18 (253.55) | 5.756 (p=.056) |

*Key: M – mean value, SD – standard deviation, K-W test – Kruskal Wallis test, p-value – significance level, significant results are marked in bold type.*

*Table 24. Intergroup comparison of the accuracy and speed of emotion recognition (pairwise comparisons of significant results)*

| Comparison pairs | M (SD) | K-W test | MSE | p-value |
|---|---|---|---|---|
| **Happiness recognition speed, ms** | | | | |
| SU (N=31)<br>HC (N=45) | 585.45 (157.89)<br>623.93 (93) | -4.653 | 7.31 | .524 |
| BPD (N=32)<br>HC (N=45) | 770.33 (289.25)<br>623.93 (93) | 16.062 | 7.24 | .022 |
| SU (N=31)<br>BPD (N=32) | 585.45 (157.89)<br>770.33 (289.25) | 21.273 | 7.89 | .007 |
| **Sadness, % of correct answers** | | | | |
| SU (N=31)<br>HC (N=45) | 72.82 (9.33)<br>80.56 (8.92) | -22.531 | 7.28 | .002 |
| BPD (N=32)<br>HC (N=45) | 71.95 (12.55)<br>80.56 (8.92) | -23.023 | 7.22 | .001 |
| SU (N=31)<br>BPD (N=32) | 72.82 (9.33)<br>71.95 (12.55) | -.492 | 7.86 | .950 |

*Key: M – mean value, SD – standard deviation, MSE – mean square error, K-W test – Kruskal Wallis test, p-value – significance level.*

*Table 25. Intergroup comparison of misrecognition of emotions*

| Indicator | BPD (N=32) M (SD) | SU (N=31) M (SD) | HC (N=45) M (SD) | K-W test (p-value) |
|---|---|---|---|---|
| Responses to happiness stimulus | | | | |
| Sadness for happiness, number of error answers, % | 0.86 (3.15) | 0.32 (0.85) | 0.44 (1.10) | 0.593 (p=.743) |
| Anger for happiness, number of error answers, % | 1.02 (2.83) | 0.48 (2.27) | 0.17 (0.63) | 5.357 (p=.069) |
| Fear for happiness, number of error answers, % | 0.16 (0.61) | 0.32 (0.85) | 0.28 (1.21) | 1.125 (p=.570) |
| Disgust for happiness, number of error answers, % | 0.16 (0.61) | 0.08 (0.45) | 0.28 (0.53) | 0.320 (p=.852) |
| Surprise for happiness, number of error answers, % | 0.55 (1.05) | 1.29 (2.34) | 0.89 (1.93) | 1.423 (p=.491) |
| Responses to sadness stimulus | | | | |
| Happiness for sadness, number of error answers, % | 1.02 (1.78) | 0.57 (1.24) | 1.06 (2.41) | 1.292 (p=.524) |
| Anger for sadness, number of error answers, % | 1.64 (2.51) | 0.97 (1.54) | 1.11 (1.65) | 0.868 (p=.648) |
| Fear for sadness, number of error answers, % | 6.33 (4.84) | 8.15 (6.22) | 5.44 (4.50) | 4.115 (p=.128) |
| Disgust for sadness, number of error answers, % | **11.33 (7.46)** | **9.68 (6.41)** | **6.78 (5.32)** | **9.849 (p=.007)** |
| Surprise for sadness, number of error answers, % | 1.72 (2.50) | 2.34 (2.73) | 2.06 (2.52) | 0.986 (p=.611) |
| Responses to anger stimulus | | | | |
| Happiness for anger, number of error answers, % | 0.31 (0.84) | 0.81 (0.45) | 0.22 (0.72) | 1.787 (p=.409) |
| Sadness for anger, number of error answers, % | 3.13 (3.97) | 3.07 (3.80) | 2.61 (2.61) | 0.082 (p=.960) |

| | | | | |
|---|---|---|---|---|
| Fear for anger, number of error answers, % | 1.41 (2.00) | 2.74 (4.20) | 1.50 (2.16) | 2.605 (p=.272) |
| Disgust for anger, number of error answers, % | 6.17 (5.78) | 7.10 (5.09) | 6.94 (6.17) | 0.865 (p=.649) |
| Surprise for anger, number of error answers, % | 1.64 (3.63) | 1.45 (2.80) | 1.22 (2.64) | 0.411 (p=.814) |
| Responses to fear stimulus | | | | |
| Happiness for fear, number of error answers, % | 0.16 (0.61) | 0.65 (1.29) | 0.44 (1.23) | 3.470 (p=.176) |
| Sadness for fear, number of error answers, % | 2.89 (3.12) | 3.87 (4.69) | 3.61 (3.35) | 0.994 (p=.608) |
| Anger for fear, number of error answers, % | 0.86 (1.36) | 1.45 (2.40) | 0.94 (1.94) | 1.249 (p=.524) |
| Disgust for fear, number of error answers, % | 9.92 (7.28) | 10.89 (7.23) | 9.06 (8.09) | 2.027 (p=.363) |
| Surprise for fear, number of error answers, % | 24.06 (14.68) | 26.05 (11.58) | 24.22 (12.11) | 0.990 (p=.610) |
| Responses to disgust stimulus | | | | |
| Happiness for disgust, number of error answers, % | 0.00 | 0.00 | 0.11 (0.75) | 1.400 (p=.497) |
| Sadness for disgust, number of error answers, % | 3.36 (3.89) | 4.03 (4.50) | 4.72 (3.89) | 3.559 (p=.169) |
| Anger for disgust, number of error answers, % | 16.64 (9.26) | 12.10 (7.33) | 16.67 (9.78) | 5.737 (p=.057) |
| Fear for disgust, number of error answers, % | 1.95 (2.44) | 2.58 (2.78) | 2.39 (2.97) | 0.804 (p=.669) |
| Surprise for disgust, number of error answers, % | 0.63 (1.27) | 0.89 (1.77) | 0.72 (0.47) | 0.205 (p=.902) |
| Responses to surprise stimulus | | | | |
| Happiness for surprise, number of error answers, % | 2.89 (3.37) | 4.35 (4.91) | 2.94 (3.03) | 1.666 (p=.435) |
| Sadness for surprise, number of error answers, % | 0.00 | 0.00 | 0.28 (1.22) | 4.279 (p=.118) |

| | | | | |
|---|---|---|---|---|
| Anger for surprise, number of error answers, % | 0.39 (1.12) | 0.32 (0.85) | 0.22 (0.90) | 0.973 (p=.615) |
| Fear for surprise, number of error answers, % | 11.41 (13.23) | 9.27 (10.07) | 9.33 (8.14) | 0.542 (p=.763) |
| Disgust for surprise, number of error answers, % | 0.63 (1.27) | 0.97 (2.11) | 0.61 (1.70) | 0.428 (p=.807) |

*Key: M – mean value, SD – standard deviation, K-W test – Kruskal Wallis test, p-value – significance level, significant results are marked in bold type.*

*Table 26. Intergroup comparison of misrecognition of emotions (pairwise comparisons of significant results)*

| Comparison pairs | M (SD) | K-W test | MSE | p-value |
|---|---|---|---|---|
| Disgust for sadness, number of error answers, % | | | | |
| SU (N=31)<br>HC (N=45) | 9.68 (6.41)<br>6.78 (5.32) | 15.406 | 7.234 | .033 |
| BPD (N=32)<br>HC (N=45) | 11.33 (7.46)<br>6.78 (5.32) | 21.338 | 7.167 | .003 |
| SU (N=31)<br>BPD (N=32) | 9.68 (6.41)<br>11.33 (7.46) | 5.932 | 7.810 | .448 |

*Key: M – mean value, SD – standard deviation, MSE – mean square error, K-W test – Kruskal Wallis test, p-value – significance level.*

Hypothesis 4 of the present study suggested that emotion regulation strategies and individual psychological characteristics would differ between clinical groups compared with healthy controls. For comparison, the non-parametric Kruskal-Walliss test was chosen since the questionnaire data deviated significantly from the normal distribution. Table 27 presents comparative data obtained using self-report scales. Significant intergroup differences were obtained for the following parameters: levels of depression ($p = .006$) and anxiety ($p = .006$) (HADS), all characteristics of impulsivity (BIS-11, $p < .001$, $p = .001$, $p < .001$, $p < .001$), Cognitive Reappraisal (ERQ, $p = .001$), Refocusing on planning ($p = .017$), Positive Reappraisal ($p = .015$), Catastrophizing ($p < .001$), CERQ, and on the Psychopathy scale (SD3, $p < .001$). Pairwise comparisons are presented in Table 28. The clinical groups differed from the control group in the emotion regulation strategy Catastrophizing ($p = .034$, $p < .001$).

Patients with BPD differ both from the control group and from the substance users in all other parameters listed above (Table 28).

*Table 27. Intergroup comparison of self-report scales*

| Indicator | BPD (N=32) Me [Q1; Q3] | SU (N=31) Me [Q1; Q3] | HC (N=45) Me [Q1; Q3] | K-W test (p-value) |
|---|---|---|---|---|
| Hospital Anxiety and Depression Scale (HADS) | | | | |
| **Depression** | **6.00 [4.25; 11.00]** | **4.00 [1.00; 6.00]** | **4.00 [2.00; 7.00]** | **10.101 (p=.006)** |
| **Anxiety** | **11.00 [6.00; 12.75]** | **7.00 [4.00; 12.00]** | **6.00 [4.00; 8.00]** | **11.304 (p=.004)** |
| Barratt Impulsiveness Scale (BIS-11) | | | | |
| **General impulsivity** | **75.50 [69.00; 86.00]** | **66.00 [58.00; 75.00]** | **63.00 [55.00; 68.00]** | **26.415 (p<.001)** |
| **Attentional impulsivity** | **20.00 [17.25; 22.75]** | **17.00 [15.00; 21.00]** | **16.00 [14.00; 19.00]** | **13.393 (p=.001)** |
| **Motor impulsivity** | **25.00 [22.00; 29.00]** | **22.00 [18.00; 26.00]** | **21.00 [18.50; 24.00]** | **17.790 (p<.001)** |
| **Non-planning impulsivity** | **31.00 [27.25; 33.00]** | **25.00 [22.00; 30.00]** | **25.00 [22.00; 29.00]** | **14.789 (p<.001)** |
| Emotion Regulation Questionnaire (ERQ) | | | | |
| **Cognitive Reappraisal** | **3.67 [3.00; 4.45]** | **4.33 [3.83; 5.00]** | **4.33 [3.92; 4.83]** | **13.584 (p=.001)** |
| Expressive Suppression | 3.5 [3.00; 4.25] | 4.25 [3.75; 4.75] | 3.75 [3.00; 4.50] | 4.620 (p=.099) |
| Cognitive Emotion Regulation Questionnaire (CERQ) | | | | |
| Self-blame | 14.50 [11.25; 16.00] | 12.00 [10.00; 17.00] | 13.00 [9.50; 16.50] | 1.719 (p=.423) |
| Blaming other | 8.00 [7.00; 10.75] | 8.00 [7.00; 10.00] | 8.00 [5.50; 10.00] | 1.660 (p=.436) |
| Acceptance | 13.00 [11.25; 15.75] | 14.00 [11.00; 16.00] | 13.00 [12.00; 15.50] | 0.269 (p=.874) |
| **Refocusing on planning** | **12.00 [10.00; 17.00]** | **17.00 [12.00; 19.00]** | **16.00 [14.00; 18.00]** | **8.183 (p=.017)** |
| Positive refocusing | 8.00 [7.00; 10.00] | 9.00 [7.00; 13.00] | 11.00 [8.00; 13.50] | 5.264 (p=.072) |
| Rumination | 14.00 [11.25; 16.00] | 15.00 [11.00; 18.00] | 14.00 [10.50; 16.00] | 0.252 (p=.882) |
| **Positive reappraisal** | **10.50 [8.00;14.00]** | **16.00 [12.00; 18.00]** | **14.00 [12.00; 17.50]** | **8.402 (p=.015)** |

| | | | | |
|---|---|---|---|---|
| Putting into perspective | 10.50 [8.00;14.00] | 13.00 [10.00; 15.00] | 11.00 [9.00; 14.00] | 5.010 (p=.082) |
| **Catastrophizing** | **10.50 [7.00;12.75]** | **9.00 [6.00; 12.00]** | **7.00 [5.00; 8.50]** | **14.125 (p<.001)** |
| Short Dark Triad (SD3) | | | | |
| Machiavellianism | 25.00 [19.25; 27.00] | 26.00 [25.00; 29.00] | 24.00 [19.00; 27.50] | 5.299 (p=.071) |
| Narcissism | 25.00 [18.25; 30.00] | 27.00 [23.00; 32.00] | 27.00 [21.00; 29.00] | 1.388 (p=.500) |
| **Psychopathy** | **20.00 [18.00; 25.00]** | **19.00 [17.00; 21.00]** | **17.00 [14.00; 19.50]** | **15.029 (<.001)** |

*Key: Me – Median, Q1, Q3 – 1st and 3rd quartiles, K-W test – Kruskal Wallis test, p-value – significance level, significant results are marked in bold type.*

*Table 28. Intergroup comparison of self-report scales (pairwise comparisons of significant results)*

| Comparison pairs | Me (Q1; Q3) | K-W test | MSE | p-value |
|---|---|---|---|---|
| **Depression level (HADS)** | | | | |
| SU (N=31)<br>HC (N=45) | 4.00 [1.00; 6.00]<br>4.00 [2.00; 7.00] | -0.441 | 7.28 | .952 |
| BPD (N=32)<br>HC (N=45) | 6.00 [4.25; 11.00]<br>4.00 [2.00; 7.00] | 21.155 | 7.86 | .007 |
| SU (N=31)<br>BPD (N=32) | 4.00 [1.00; 6.00]<br>6.00 [4.25; 11.00] | 20.714 | 7.22 | .004 |
| **Anxiety level (HADS)** | | | | |
| SU (N=31)<br>HC (N=45) | 7.00 [4.00; 12.00]<br>6.00 [4.00; 8.00] | 8.428 | 7.28 | .247 |
| BPD (N=32)<br>HC (N=45) | 11.00 [6.00; 12.75]<br>6.00 [4.00; 8.00] | 24.198 | 7.22 | <.001 |
| SU (N=31)<br>BPD (N=32) | 7.00 [4.00; 12.00]<br>11.00 [6.00; 12.75] | 15.771 | 2.87 | .045 |
| **General level of impulsivity (BIS-11)** | | | | |
| SU (N=31)<br>HC (N=45) | 66.00 [58.00; 75.00]<br>63.00 [55.00; 68.00] | 11.541 | 7.31 | .114 |
| BPD (N=32)<br>HC (N=45) | 75.50 [69.00; 86.00]<br>63.00 [55.00; 68.00] | 36.970 | 7.24 | <.001 |
| SU (N=31)<br>BPD (N=32) | 66.00 [58.00; 75.00]<br>75.50 [69.00; 86.00] | 25.429 | 7.89 | .001 |

| | | | | |
|---|---|---|---|---|
| **Attentional impulsivity (BIS-11)** | | | | |
| SU (N=31)<br>HC (N=45) | 17.00 [15.00; 21.00]<br>16.00 [14.00; 19.00] | 8.339 | 7.29 | .252 |
| BPD (N=32)<br>HC (N=45) | 20.00 [17.25; 22.75]<br>16.00 [14.00; 19.00] | 26.272 | 7.22 | <.001 |
| SU (N=31)<br>BPD (N=32) | 17.00 [15.00; 21.00]<br>20.00 [17.25; 22.75] | 17.932 | 7.87 | 0.23 |
| **Motor impulsivity (BIS-11)** | | | | |
| SU (N=31)<br>HC (N=45) | 22.00 [18.00; 26.00]<br>21.00 [18.50; 24.00] | 12.770 | 2.29 | .080 |
| BPD (N=32)<br>HC (N=45) | 25.00 [22.00; 29.00]<br>21.00 [18.50; 24.00] | 30.455 | 7.22 | <.001 |
| SU (N=31)<br>BPD (N=32) | 22.00 [18.00; 26.00]<br>25.00 [22.00; 29.00] | 17.69 | 7.87 | .025 |
| **Non-planning impulsivity (BIS-11)** | | | | |
| SU (N=31)<br>HC (N=45) | 25.00 [22.00; 30.00]<br>25.00 [22.00; 29.00] | 2.832 | 7.30 | .698 |
| BPD (N=32)<br>HC (N=45) | 31.00 [27.25; 33.00]<br>25.00 [22.00; 29.00] | 26.357 | 7.23 | <.001 |
| SU (N=31)<br>BPD (N=32) | 25.00 [22.00; 30.00]<br>31.00 [27.25; 33.00] | 23.525 | 7.88 | .003 |
| **Cognitive Reappraisal (ERQ)** | | | | |
| SU (N=31)<br>HC (N=45) | 4.33 [3.83; 5.00]<br>4.33 [3.92; 4.83] | -2.332 | 7.30 | .749 |
| BPD (N=32)<br>HC (N=45) | 3.67 [3.00; 4.45]<br>4.33 [3.92; 4.83] | -25.153 | 7.23 | <.001 |
| SU (N=31)<br>BPD (N=32) | 4.33 [3.83; 5.00]<br>3.67 [3.00; 4.45] | -22.822 | 7.88 | .004 |
| **Refocusing on planning (CERQ)** | | | | |
| SU (N=31)<br>HC (N=45) | 17.00 [12.00; 19.00]<br>16.00 [14.00; 18.00] | -0.041 | 7.28 | .996 |
| BPD (N=32)<br>HC (N=45) | 12.00 [10.00; 17.00]<br>16.00 [14.00; 18.00] | -18.823 | 7.21 | .009 |
| SU (N=31)<br>BPD (N=32) | 17.00 [12.00; 19.00]<br>12.00 [10.00; 17.00] | -18.783 | 7.86 | .017 |
| **Positive Reappraisal (CERQ)** | | | | |
| SU (N=31)<br>HC (N=45) | 16.00 [12.00; 18.00]<br>14.00 [12.00; 17.50] | 6.028 | 7.29 | .408 |

| | | | | |
|---|---|---|---|---|
| BPD (N=32)<br>HC (N=45) | 10.50 [8.00;14.00]<br>14.00 [12.00; 17.50] | -21.843 | 7.87 | .005 |
| SU (N=31)<br>BPD (N=32) | 16.00 [12.00; 18.00]<br>10.50 [8.00;14.00] | -15.815 | 7.22 | .028 |
| **Catastophizing (CERQ)** | | | | |
| SU (N=31)<br>HC (N=45) | 9.00 [6.00; 12.00]<br>7.00 [5.00; 8.50] | 15.42 | 7.27 | .034 |
| SU (N=32)<br>HC (N=45) | 10.50 [7.00;12.75]<br>7.00 [5.00; 8.50] | 26.650 | 7.20 | <.001 |
| SU (N=31)<br>BPD (N=32) | 9.00 [6.00; 12.00]<br>10.50 [7.00;12.75] | 11.231 | 7.85 | .152 |
| **Psychopathy (SD3)** | | | | |
| SU (N=31)<br>HC (N=45) | 19.00 [17.00; 21.00]<br>17.00 [14.00; 19.50] | 14.123 | 7.28 | .052 |
| BPD (N=32)<br>HC (N=45) | 20.00 [18.00; 25.00]<br>17.00 [14.00; 19.50] | 27.831 | 7.22 | <.001 |
| SU (N=31)<br>BPD (N=32) | 19.00 [17.00; 21.00]<br>20.00 [18.00; 25.00] | 13.709 | 7.86 | .081 |

*Key: Me – Median, Q1, Q3 – 1st and 3rd quartiles, K-W test – Kruskal Wallis test, p-value – significance level.*

According to a preliminary analysis, hypothesis 1 was confirmed: clinical groups differ from healthy controls in the impairment of the accuracy of sadness recognition. Hypothesis 2 was not confirmed because the clinical groups did not differ from the control group in the recognition speed of negative emotions. However, in a preliminary analysis, a difference was found in the recognition speed of happiness in patients with BPD compared to substance users and healthy controls The third hypothesis was confirmed – patients with BPD and substance users have the misrecognition disgust instead of sadness compared to healthy controls. Hypothesis 4 also found partial support: BPD patients and the substance user group are more prone to Catastrophizing than the control group. Also, patients with BPD differ in all the characteristics of impulsivity, levels of anxiety and depression, and personality traits that characterize Psychopathy. Control and substance use groups differ from BPD patients in the following emotion regulation strategies: Cognitive Reappraisal, Refocusing on planning, Positive Reappraisal.

### 3.2.3 The Main analysis of intergroup differences in emotion recognition characteristics

*3.2.3.1 Results of accuracy facial negative emotion recognition*

Hierarchical multiple linear regression was also used to investigate differences in the accuracy of recognizing negative emotions between substance users and BPD patients when factors such as gender, age, education, and general level of impulsivity were considered. The independent variable was the group (BPD, SU, HC), the control factors listed above, the dependent variable was the accuracy of emotion recognition (radians). According to a preliminary analysis, there were differences between clinical and control groups only in the accuracy of recognition of sadness. In addition, according to the results of regression analysis, the models for the accuracy of recognition of anger, fear and disgust did not confirm their statistical significance and did not pass the criteria for normal distribution of residuals.

The results showed the group membership significantly predicted *the accuracy of sadness recognition* (Model 1: $F(1, 106) = 13.76$, $p < .001$, adj. $R2 = .107$). Specifically, there was a characteristic impairment in *the accuracy of recognition of sadness* for groups of substance users and patients with BPD (b = 3.26 [95% CI: 1.525, 5.025], $p < .001$), (Table 29).

Also, adding control factors such as gender, age, educational level, levels of anxiety and depression, and general level of impulsivity led to the fact that the differences between clinical groups and healthy controls remained statistically significant (Model 2: $F(7, 100) = 3.87$, $p < .001$, adj. $R2 = .158$, b = 3.79 [95% CI: 1.797, 5.790] $p < .001$), (Table 29).

*Table 29. Hierarchical regression results for sadness recognition accuracy*

| **Sadness recognition accuracy, radians** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | 3.26 (0.88)*** | 3.79 (1.00)*** |
| Age | - | 0.35 (0.15) |
| Gender | - | -1.48 (1.54) |
| Education | - | 1.76 (1.07) |
| Anxiety | - | 0.17 (0.21) |

| | | |
|---|---|---|
| Depression | - | -0.13 (0.22) |
| General impulsivity | - | 0.08 (0.09) |
| Adj. R2 | .107 | .158 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Thus, hypothesis 1 of this study was confirmed. Substance users and BPD patients were less likely to recognize the emotion of sadness compared to healthy controls. Adding control factors such as gender, age, education, levels of anxiety and depression, and general level of impulsivity led to the fact that statistically significant differences between groups remained for the accuracy of sadness recognition.

*3.2.3.2 Results of speed facial negative emotion recognition*

According to a preliminary analysis, we did not receive confirmation of Hypothesis 2. However, intergroup differences were found in the speed of recognition of happiness. Hierarchical multiple linear regression was used to examine the issue of impairment in the speed of happiness recognition in patients with BPD, considering factors of gender, age, level of education, levels of anxiety and depression, and general level of impulsivity. The independent variable was the group membership, the control factors listed above, the dependent variable was the recognition speed of happiness (ms). It was found that a group of patients with BPD was characterized by a violation of the speed of recognition of happiness. However, after control factors were considered, intergroup differences ceased to be statistically significant (Appendix 10).

Thus, intergroup differences in the recognition speed of happiness, obtained in the preliminary analysis, after considering control factors such as gender, age, education, level of anxiety and depression, and the general level of impulsivity, lost their significance.

*3.2.3.3 Misrecognition of emotions*

Hierarchical multiple regression was also used to analyze patterns of misrecognition of negative emotions in participants with substance use and patients with BPD, control factors of gender, age, level of education, and general level of impulsivity. The group (BPD, SU, HC), the control factors listed above, as a dependent

variable – the characteristics of erroneous recognition of emotions (radians). According to a preliminary analysis, there were differences between clinical and control groups only for the misrecognition disgust instead of sadness. According to the results of regression analysis, models for other misrecognition of emotions did not confirm their statistical significance and did not pass the criteria for the normal distribution of residuals.

As a result, it was found that the group membership significantly predicted *the misrecognition of disgust in response to the sadness emotion stimulus* (Model 1: $F(1, 106) = 10.09$, p = .002, adj. R2 = .078). The groups of substance users and patients with BPD was characterized by *the misrecognition disgust instead of sadness* (b = -2.31 [95% CI: -3.745, -0.867], p = .011), (Table 30).

After controlling for factors including gender, age, educational level, levels of anxiety and depression, and general level of impulsivity, between-group differences remained statistically significant (Model 2: $F(7, 100) = 2.33$, p = .030, adj. R2 = .080, b = -2.44 [95% CI: -4.128, -0.749], p = .005), (Table 30).

In this model, there were 2 outliers for studentized and removed studentized residues. After their removal, the model did not change significantly. Table 30 shows model data with outliers.

*Table 30. Hierarchical regression results for the misrecognition disgust instead of sadness*

| **Misrecognition disgust instead of sadness, radians** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | -2.31 (0.73)** | -2.44 (0.85)** |
| Age | - | -0.16 (0.13) |
| Gender | - | 0.98 (1.31) |
| Education | - | -1.12 (0.90) |
| Anxiety | - | -0.03 (0.18) |
| Depression | - | -0.06 (0.18) |
| General impulsivity | - | -0.01 (0.07) |
| Adj. R2 | .078 | .080 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Hypothesis 3 was also confirmed in the main intergroup analysis. Differences between the clinical groups and control group in the misrecognition disgust instead of sadness remained statistically significant after adding control factors.

### 3.2.4 Results of emotion regulation and individual psychological measurement

Hypothesis 4 of this study suggested that clinical groups would differ in emotion regulation strategies, impulsivity characteristics, and personality traits from the control group. Preliminary comparative analysis using Kruskal-Walliss showed that differences between clinical groups and the control group are present only on the Catastrophizing (CERQ). The BPD patient group differs from the group of substance users and healthy controls in the following parameters: Level of anxiety, level of depression (HADS), general level of impulsivity, level of attentional impulsivity, motor impulsivity and non-planning impulsivity (BIS-11), Cognitive Reappraisal (ERQ), Refocusing on planning, Positive Reappraisal (CERQ), Psychopathy (SD3), however pre-comparative analysis was without control factors. Hierarchical multiple linear regression was used to explore these questions with the influence of control factors. The independent variable was the group membership (SU, BPD, HC), the dependent variable was questionnaire scales, control factors: age, gender, level of education, levels of anxiety and depression, and general level of impulsivity. However, the general level of impulsivity was not used as a control factor for impulsivity scales, as these are scales of one questionnaire (BIS-11). In addition, control factors such as levels of anxiety and depression were not used in models with the dependent variable – levels of anxiety and depression (HADS)

**Depression level (HADS)**

The group membership significantly predicted *the level of depression* (Model 1: $F(1, 106) = 8.94$, $p = .003$, adj. $R2 = .069$). In other words, the BPD group differed from the substance use group and the control group in *the level of depression* (b = -1.39 [95% CI: -2.306, -0.567], p = .003), (Table 31).

However, adding controlling factors including gender, age, level of education, and general level of impulsivity led to the fact that intergroup differences were no

statistically significant (Model 2: $F(7, 100) = 6.33$, p<.001, adj. R2 = .199, b = -0.27 [95% CI: -1.264, 0.723], p = .036), (Table 31).

*Table 31. Hierarchical regression results for depression level*

| Depression level | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -1.39 (0.46)*** | -0.27 (0.50) |
| Age | - | -0.01 (0.08) |
| Gender | - | -0.19 (0.77) |
| Education | - | -0.47 (0.53) |
| General impulsivity | - | 0.16 (0.04)*** |
| Adj. R2 | .069 | .199 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Anxiety level (HADS)**

Intergroup differences were also found in *anxiety level* (Model 1: $F(1, 106) = 13.27$, p < .001, adj. R2 =.103). The BPD group had different *the level of anxiety* from the participants in the substance use and the control group (b = -1.75 [95% CI: -2.695, -0.795], p < .001), (Table 32).

However, intergroup differences ceased to be statistically significant after adding for control variables (Model 2: $F(5, 102) = 6.61$, p < .001, adj. R2 = .208, b = -0.68 [95% CI: -1.719, 0.361], p = .198), (Table 32).

*Table 32. Hierarchical regression results for anxiety level*

| Anxiety level | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -1.75 (0.49)*** | -0.68 (0.52) |
| Age | - | 0.002 (0.08) |
| Gender | - | -0.93 (0.81) |
| Education | - | 0.37 (0.55) |
| General impulsivity | - | 0.16 (0.04)*** |
| Adj. R2 | .103 | .208 |

*«*» p<0.05, «**» p<0.01, «***» p<0.001*
*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error.*

**General level of impulsivity (BIS-11)**

According to Table 33, the BPD group had an increased *general level of impulsivity* (Model 1: *F*(1, 106) = 34.88, p<.001, adj. R2 =.240, b = -6.55 [95% CI: -8.745, -4.349], p < .001).

Adding control variables let to the fact that intergroup differences remained statistically significant (Model 2: *F*(6, 101) = 11.75, p < .001, adj. R2 = .376, b = -4.55 [95% CI: -6.714, -2.392], p < .001), (Table 33).

*Table 33. Results of hierarchical regression for the general level of impulsivity*

| General level of impulsivity | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -6.55 (1.11)*** | -4.55 (1.09)*** |
| Age | - | -0.07 (0.18) |
| Gender | - | 0.11 (1.81) |
| Education | - | -1.36 (1.24) |
| Anxiety | - | 0.55 (0.24)* |
| Depression | - | 0.63 (0.25)* |
| Adj. R2 | .240 | .376 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Level of attentional impulsivity (BIS-11)**

The group membership was found to significantly predict *attentional impulsivity* (Model 1: *F*(1, 106) = 13.30, p < .001, adj. R2 = .103). Specifically, patients with BPD had an increased *the level of attentional impulsivity* (b = -1.70 [95% CI: -2.617, -0.774], p < .001), (Table 34).

According to Table 34, after inclusion of control factors (gender, age, educational level, level of anxiety, depression, and general level of impulsivity) in the model, the statistical significance of group differences remained (Model 2: *F*(6, 101) = 5.27, p < .001, adj. R2 = .193, b = -1.03 [95% CI: -1.979, -0.082], p = .033).

In this model, there was one outlier for studentized and studentized removed residues. After its removal, the Model did not change significantly. Table 34 shows the values of the regression model without removing residuals.

*Table 34. Results of hierarchical regression for the level of attentional impulsivity*

| Level of attentional impulsivity | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -1.70 (0.47)*** | -1.03 (0.48)* |
| Age | - | -0.02 (0.07) |
| Gender | - | -0.14 (0.79) |
| Education | - | 0.07 (0.55) |
| Anxiety | - | 0.21 (0.11) |
| Depression | - | 0.22 (0.10)* |
| Adj. R2 | .103 | .193 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Level of motor impulsivity (BIS-11)**

As a result of regression analysis regarding *the level of motor impulsivity*, the results showed the group membership significantly predicted it (Model 1: $F(1, 106) = 22.98$, $p < .001$, adj. R2 = .170). Specifically, patients with BPD had an increased *the level of motor impulsivity* и (b = -2.79 [95% CI: -3.939, -0.634], $p < .001$), (Table 35).

Also the model with control variables had intergroup statistically significant differences (Model 2: $F(6, 101) = 5.75$, $p < .001$, adj. R2 = .210, b = -2.11 [95% CI: -3.330, -0.089], $p < .001$), (Table 35).

*Table 35. Results of hierarchical regression for the level of motor impulsivity*

| Level of motor impulsivity | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -2.79 (0.58)*** | -2.11 (0.62)*** |
| Age | - | 0.04 (0.10) |
| Gender | - | 0.91 (1.02) |
| Education | - | -0.42 (0.70) |
| Anxiety | - | 0.26 (0.13) |
| Depression | - | 0.16 (0.14) |
| Adj. R2 | .170 | .210 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Level of non-planning impulsivity (BIS-11)**

The results showed the BPD group was different from the group with substance users and healthy controls in *the level of non-planning impulsivity* (Model 1: $F(1, 106) = 11.07$, p = .001, adj. R2 = .086, b = -2.06 [95% CI: -3.294, -0.834], p = .001), (Table 36).

After adding control factors in this model, between-group differences remained statistically significant (Model 2: $F(6, 101) = 4.20$, p<.001, adj. R2 = .152, b = -1.41 [95% CI: -2.694, -0.123], p = .032), (Table 36).

In this model, there was one outlier for the studentized removed residues. After its removal, the Model did not change significantly. Table 36 shows the values of the regression model without removing residuals.

*Table 35. Results of hierarchical regression for the level of non-planning impulsivity*

| **Level of non-planning impulsivity** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | -2.06 (0.62)** | -1.41 (0.65)* |
| Age | - | -0.08 (0.10) |
| Gender | - | -0.65 (1.08) |
| Education | - | -1.01 (0.74) |
| Anxiety | - | 0.08 (0.14) |
| Depression | - | 0.26 (0.15) |
| Adj. R2 | .086 | .152 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Cognitive Reappraisal (ERQ)**

The results showed the group membership significantly predicted the emotion regulation strategy *Cognitive Reappraisal* (Model 1: $F(1, 106) = 13.62$, p < .001, adj. R2 = .106). Participants with substance use and healthy controls were prone to *Cognitive Reappraisal* (b = 0.36 [95% CI: 0.166, 0.551], p < .001), (Table 37).

According to Table 37, after inclusion of control factors (gender, age, educational level, level of anxiety, depression, and general level of impulsivity) in the model, the statistical significance of group differences remained (Model 2: $F(7, 100) = 4.19$, p < .001, adj. R2 =.173, b = 0.23 [95% CI: 0.015, 0.450], p = .036).

*Table 37. Hierarchical regression results for ER strategy – Cognitive Reappraisal*

| Cognitive Reappraisal | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | 0.36 (0.10)*** | 0.23 (0.11)* |
| Age | - | 0.03 (0.02) |
| Gender | - | 0.11 (0.17) |
| Education | - | -0.26 (0.12) |
| Anxiety | - | 0.00 (0.23) |
| Depression | - | -0.02 (0.02) |
| General impulsivity | - | -0.002 (0.01) |
| Adj. R2 | .106 | .173 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Refocusing on planning (CERQ)**

The group membership also significantly predicted a Refocusing on planning (Model 1: $F(1, 106) = 9.16$, p = .003, adj. R2 = .071). Specifically, participants with substance use and healthy controls are more prone to Positive Refocusing than BPD patients (b = 1.28 [95% CI: 0.443, 2.125], p = .003), (Table 38).

However, intergroup differences ceased to be statistically significant after adding control factors (Model 2: $F(7, 100) = 5.10$, p < .001, adj. R2 = .211, b = 0.40 [95% CI: -0.508, 1.312], p = .383) (Table 38).

*Table 38. Hierarchical Regression Results for ER Strategy – Refocusing on Planning*

| Refocusing on planning | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | 1.28 (0.42)** | 0.40 (0.46) |
| Age | - | 0.02 (0.07) |
| Gender | - | -0.82 (0.70) |
| Education | - | -0.08 (0.49) |
| Anxiety | - | -0.01 (0.09) |
| Depression | - | -0.27 (0.10)** |
| General impulsivity | - | -0.08 (0.04)* |
| Adj. R2 | .071 | .211 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Positive Reappraisal (CERQ)**

Substance users and healthy controls were found to be more prone to Positive Review than BPD patients (Model 1: $F(1, 106) = 5.09$, p = .025, adj. R2 = .037, b = 1.04 [95% CI: 0.126, 1.947], p = .026) (Table 39).

However, according to Table 39, adding control variables led to the fact that intergroup differences were no statistically significant (Model 2: $F(7, 100) = 5.21$, p<.001, adj. R2 = .216, b = 0.01 [95% CI: -0.954, 0.977], p = .981).

*Table 39. Hierarchical Regression Results for ER Strategy – Positive Reappraisal*

| **Positive reappraisal** | **Model 1 B (SE)** | **Model 2 B (SE)** |
|---|---|---|
| Group | 1.04 (0.50)* | 0.01 (0.49) |
| Age | - | -0.15 (0.07)* |
| Gender | - | -0.25 (0.75) |
| Education | - | -0.32 (0.52) |
| Anxiety | - | -0.01 (0.10) |
| Depression | - | -0.31 (0.11)** |
| General impulsivity | - | -0.09 (0.04)* |
| Adj. R2 | .037 | .216 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Catastrophizing (CERQ)**

The group membership significantly predicted such an ER strategy as *Catastrophizing* (Model 1: $F(1, 106) = 15.30$, p < .001, adj. R2 =.118). Specifically, participants with substance use and patients with BPD were prone to *Catastrophizing* (b = -1.61 [95% CI: -2.424, -0.793], p < .001) (Table 40).

According to Table 40, intergroup differences were no statistically significant after adding control factors (Model 2: $F(7, 100) = 9.07$, p < .001, adj. R2 = .346, b = -0.23 [95% CI: -1.057, 0.594], p = .579).

*Table 40. Results of hierarchical regression for the RE strategy – Catastrophizing*

| Catastrophizing | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -1.61 (0.41)*** | -0.23 (0.42) |
| Age | - | 0.13 (0.06)* |
| Gender | - | -1.08 (0.64) |
| Education | - | -0.33 (0.44) |
| Anxiety | - | 0.13 (0.09) |
| Depression | - | 0.09 (0.09) |
| General impulsivity | - | 0.14 (0.04)*** |
| Adj. R2 | .118 | .346 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Psychopathy (SD3)**

BPD patients have been found to be prone to personality traits that include Psychopathy (Model 1: $F(1, 106) = 17.09$, $p < .001$, adj. R2 =.131, b = -2.17 [95% CI: -3.215, -1.131], $p < .001$) (Table 41).

After adding controlling factors including gender, age, education level, levels of anxiety and depression, and general level of impulsivity, between-group differences remained statistically significant (Model 2: $F(7, 100) = 4.63$, $p < .001$, adj. R2 = .346, b = -1.61 [95% CI: -2.791, -0.429], $p = .008$), (Table 41).

In this model, there was 1 outlier for studentized residuals and 2 outliers for studentized remote residuals. After each removal one at a time, Model did not change significantly. Table 41 shows the values of the regression model without removing residuals.

*Table 41. Results of hierarchical regression of the level of Psychopathy*

| Psychopathy level | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -2.17 (0.53)*** | -1.61 (0.60)** |
| Age | - | -0.11 (0.09) |
| Gender | - | 1.16 (0.91) |
| Education | - | 0.51 (0.63) |
| Anxiety | - | -0.13 (0.12) |

| | | |
|---|---|---|
| Depression | - | 0.28 (0.13)* |
| General impulsivity | - | 0.09 (0.05) |
| Adj. R2 | .131 | .192 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Thus, hypothesis 4 of the present study was partially confirmed. Patients with BPD differed by all the characteristics of impulsivity, personality traits, characterized by Psychopathy. The group of substance users and the control group differ in the strategy of regulation of emotions Cognitive Reappraisal.

### 3.2.5 Moderation analysis

We used a moderation analysis to test the influence of impulsiveness characteristics, personality characteristics, and levels of anxiety and depression on the relationship between emotion recognition features and emotion regulation strategies (Hypothesis 5). The dependent variable was the ERQ and CERQ questionnaire scales for emotion regulation strategies, the independent variable was the radians of misrecognition of emotions. As a moderator – scales BIS-11, SD3, HADS. Moderator and independent variable data were centered.

#### *3.2.5.1 Moderation analysis in substance users*

Only 4 significant results were obtained for the group of participants using psychoactive substances. No significant results were found for moderator as anxiety level and depression level (HADS).

**Moderator – characteristics of impulsivity (BIS-11)**

**General level of impulsivity**

There were statistically significant the moderation effect as *the general level of impulsivity*, the effect of the misrecognition sadness instead of disgust on emotion regulation strategy and interaction between the moderation and independent variable effects $F(3, 27 = 5.68$, p = .004, adj. R2 = .319, (b = 1.59 (.061), p = .014; b= 1.39 (0.61), p = .030; b = 1.67 (0.78), p = .042, accordingly). According to Figure 14, as the general level of impulsivity increased, the relationship between the propensity to Catastrophizing and the misrecognition sadness instead of disgust became more

positive. In other words, the higher the general level of impulsivity and the greater the misrecognition sadness instead of disgust, the higher the propensity to Catastrophizing.

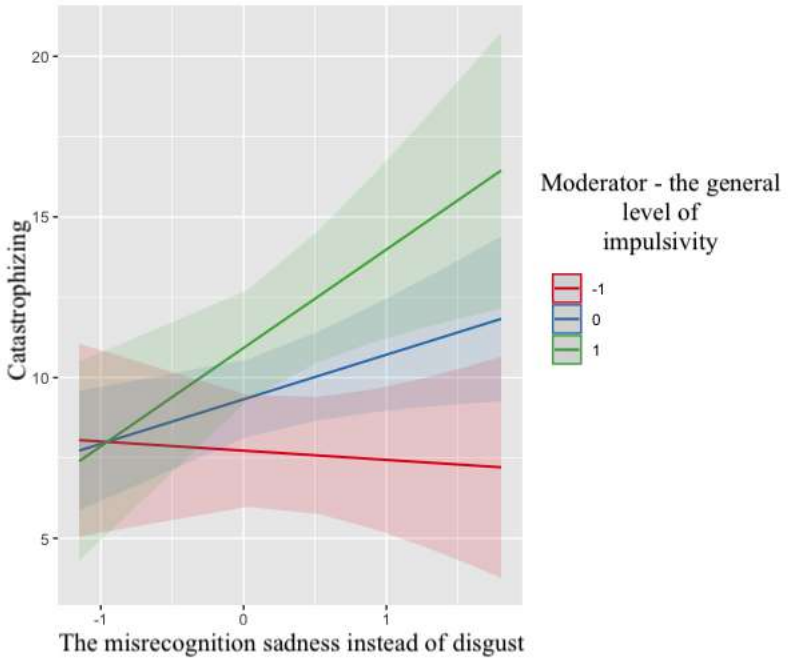


*Figure 14 – Graph of the moderation effect as the general level of impulsivity on the relationship between the misrecognition sadness instead of disgust and the tendency to Catastrophizing*

However, after adding control variables to the Model as gender, age, and level of education, the statistically significant moderation effect and effect of interaction between it and the independent variable were not preserved $F(6, 24 = 5.21$, p = .001, adj. R2 = .457, (b = 1.12 (0.58), p = .064; b = 0.92 (0.77), p = .240, accordingly). There was the statistically significant effect of the independent variable – misrecognition of sadness instead of disgust (b =1.16 (0.55), p = .044) (Table 42).

*Table 42. Moderation Analysis results as general level of impulsivity with control variables*

| **Indicators** | **B (SE)** |
|---|---|
| Misrecognition sadness instead of disgust | 1.16 (0.55)* |
| General level of impulsivity | 1.12 (0.58) |
| Age | 0.14 (0.09) |
| Gender | -1.92 (1.23) |
| Education | -1.50 (0.71) |

| | |
|---|---|
| Interaction between moderator and independent variable | 0.92 (0.77) |
| Adj. R2 | .457 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Level of non-planning impulsivity**

The moderation effect as *the level of non-planning impulsivity*, effect of the misrecognition fear instead of sadness on emotion regulation strategy Expressive Suppression and the effect of interaction between the moderator and the independent variable were statistically significant $F(3, 27 = 4.04$, p = .016, adj. R2 = .233, (b = -0.36 (0.16), p =.035; b = -0.42 (0.18), p =.024; b =0.40 (0.18), p =.037, accordingly). The greater the non-planning impulsivity of substance users, the less negative was the association between the misrecognition fear instead of sadness and Expressive Suppression. In other words, the higher the level of non-planning impulsivity in substance users and the greater the misrecognition fear instead of sadness, the less pronounced was the tendency to Expressive Suppression. It is worth noting that the relationship is weak (Figure 15).

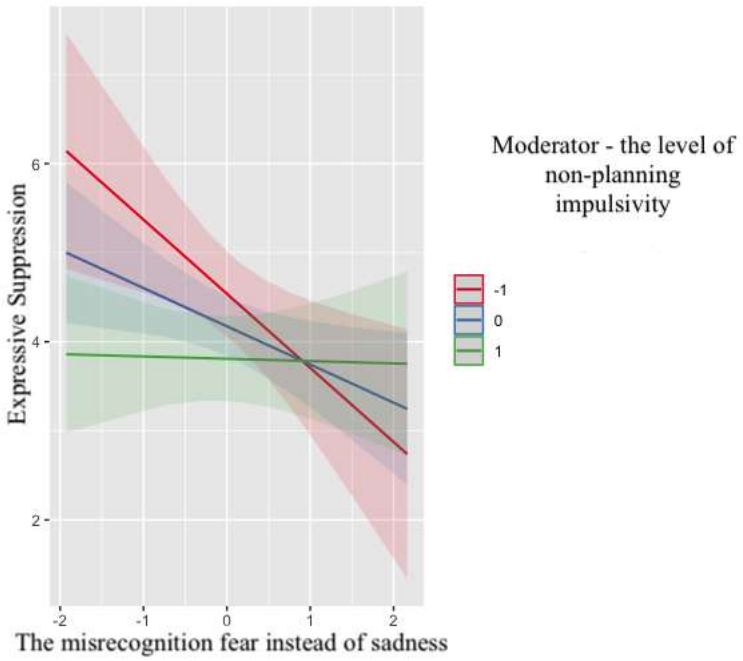


*Figure 15 – Graph of the moderation effect as the level of non-planning impulsivity on the relationship between the misrecognition fear instead of sadness and the tendency to Expressive Suppression*

Statistically significant independent variable effect and moderation effect persisted after adding control variables *F*(6, 24 = 4.15, p = .005, adj. R2 = .387, (b = -0.40 (0.17), p = .027; b = -0.36 (0.15), p = .028; accordingly). However, there was no statistically significant effect of interaction between them (b = 0.35 (0.18), p = .060), (Table 43).

*Table 43. Results of moderation analysis as the level of non-planning impulsivity with control variables (a)*

| Indicators | B (SE) |
|---|---|
| Misrecognition fear instead of sadness | -0.40 (0.17)* |
| Level of non-planning impulsivity | -0.36 (0.15)* |
| Age | 0.03 (0.03) |
| Gender | 0.72 (0.32)* |
| Education | -0.46 (0.20)* |
| Interaction between moderator and independent variable | 0.35 (0.18) |
| Adj. R2 | .387 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

There were statistically significant the moderation effect as *the level of non-planning impulsivity*, the effect of the misrecognition fear instead of surprise on emotion regulation strategy Expressive Suppression and effect of interaction between the moderation and independent variable *F*(3, 27 = 7.64, p< .001, adj. R2 = .399, (b = -0.48 (0.15), p = .004; b = -0.35 (0.15), p = .025; b = -0.43 (0.15), p = .006, accordingly). According to Figure 16, as the level of non-planning impulsivity increased, the relationship between the propensity for Expressive Suppression and the misrecognition fear instead of surprise became more negative. In other words, the higher the severity of non-planning impulsivity in the clinical group, the more the misrecognition fear instead of surprise, the lower the propensity for Expressive Suppression.

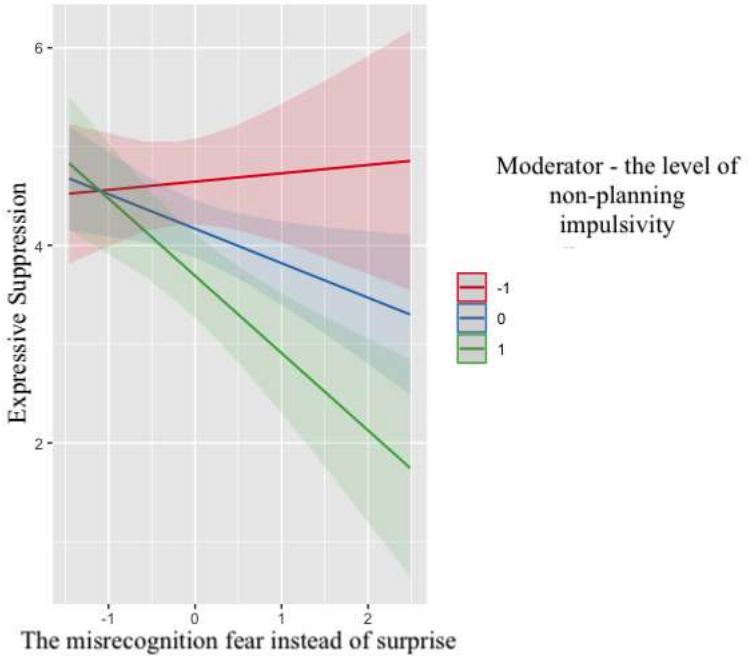


*Figure 16 – Graph of the moderation effect as the level of non-planning impulsivity on the relationship between the misrecognition fear instead of surprise and the tendency to Expressive Suppression*

Statistically significant moderation effect and effect of interaction between the independent and moderator variable were preserved after addicting control factors *F*(6, 24 = 5.38, p = .001, adj. R2 = .467, (b = -0.48 (0.15), p = .003; b = -0.40 (0.15), p=.010; accordingly). However, there was no statistically significant effect of the independent variable (b = -0.25 (0.15), p = .120) (Table 44).

*Table 44. Results of moderation analysis as the level of non-planning impulsivity with control variables (b)*

| Indicators | B (SE) |
|---|---|
| Misrecognition fear instead of surprise | -0.25 (0.15) |
| Level of non-planning impulsivity | -0.48 (0.15)** |
| Age | 0.05 (0.02) |
| Gender | 0.19 (0.32) |
| Education | -0.34 (0.18) |
| Interaction between moderator and independent variable | -0.40 (0.15)* |
| Adj. R2 | .467 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Moderator – personality traits (SD3)**

**Level of Psychopathy**

The moderation effect as *the level of Psychopathy*, effect of the misrecognition disgust instead of fear on emotion regulation strategy Putting into perspective and the effect of interaction between the moderator and the independent variable were statistically significant $F(3, 27 = 5.35$, p = .005, adj. R2 = .303, (b = -1.59 (0.58), p = .009; b = 1.94 (0.54), p = .001; b = 1.56 (0.74), p = .045, accordingly). As the degree of Psychopathy increased, the relationship between Putting into perspective and the misrecognition disgust instead of fear became more positive. In other words, the higher the level of Psychopathy and the greater the misrecognition disgust instead of fear, the higher the propensity for such an emotion regulation strategy as the Putting into perspective (Figure 17).

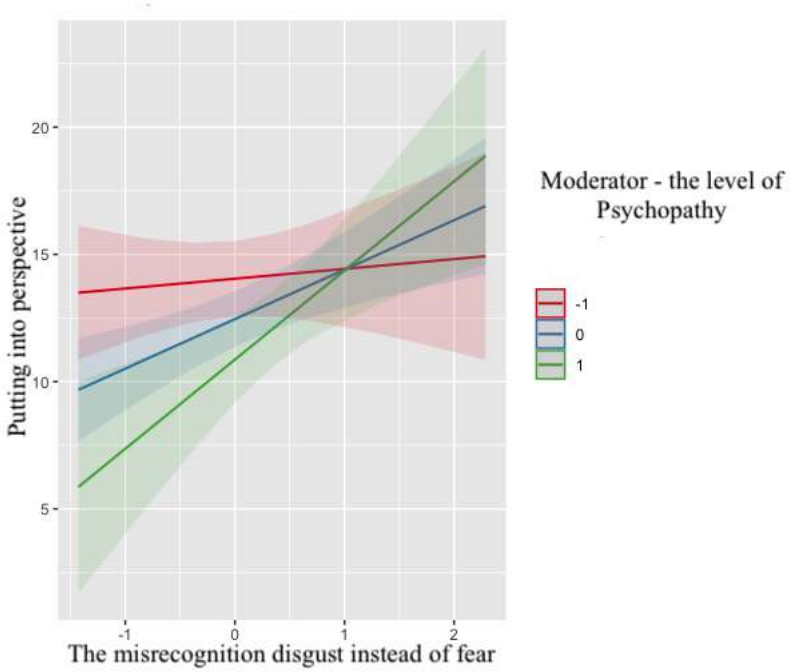


*Figure 17 – Graph of the moderation effect as Psychopathy on the association between the misrecognition disgust instead of fear and ER strategy – Putting into perspective*

According to Table 45, both the independent variable effect and the moderation effect remained statistically significant, but there was no statistically significant interaction between them after control variables are added to the model $F(6, 24 = 2.60$,

p = .044, adj. R2 = .242, (b = 2.03 (0.58), p = .002; b = -1.54 (0.69), p = .036; b = 1.47 (0.80), p = .079, accordingly).

*Table 45. Results of moderation analysis as Psychopathy with control variables*

| Indicators | B (SE) |
|---|---|
| Misrecognition disgust instead of fear | 2.03 (0.58)** |
| Level of Psychopathy | -1.54 (0.69)* |
| Age | -0.02 (0.10) |
| Gender | -0.78 (1.15) |
| Education | 0.55 (0.72) |
| Interaction between moderator and independent variable | 1.47 (0.80) |
| Adj. R2 | .242 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Thus, Hypothesis 5 did not find confirmation for the group of substance users.

*3.2.5.2 Moderation analysis in BPD patients*

Only 4 significant results were obtained for the BPD group.

**Moderator – characteristics of impulsivity (BIS-11)**

**General level of impulsivity**

There were statistically significant the moderation effect as *the general level of impulsivity*, the effect of the misrecognition surprise instead of disgust on emotion regulation strategy Cognitive Reappraisal and interaction between the moderation and independent variable effects *F*(3, 28 = 7.26, p = .001, adj. R2 = .378, (b = -0.42 (0.12), p = .002; b = -0.29 (0.13), p = .029; b = 0.25 (0.12), p = .040, accordingly). According to Figure 18, as the general level of impulsivity increased, the relationship between the propensity for Cognitive Reappraisal and the misrecognition surprise instead of disgust became less negative. In other words, the higher the general level of impulsivity, the greater the misrecognition surprise instead of disgust, the lower the propensity for Cognitive Reappraisal, and the relationship is weak.

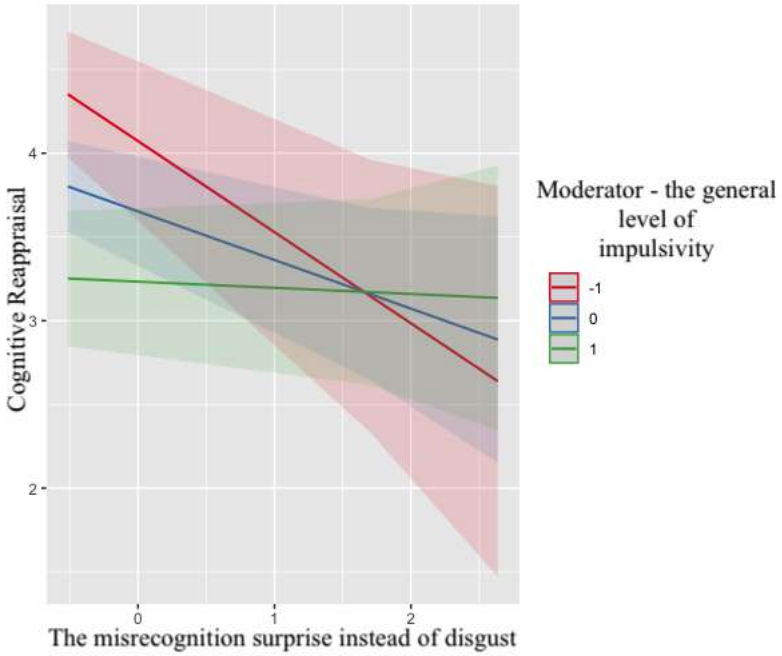


*Figure 18 – A graph moderation effect as of the general level of impulsivity on the relationship between the misrecognition surprise instead of disgust and the tendency to Cognitive Reappraisal*

Adding control variables to the Model led to the fact that the statistically significant moderation effect and the effect of the independent variable remained *F*(6, 25 = 4.15, p = .005, adj. R2 = .379, (b = -4.32 (1.21), p = .001; b = -2.88 (1.29), p = .035, accordingly). However, their interaction was not statistically significant (b=1.93 (1.46), p = .197), (Table 46).

*Table 42. Moderation Analysis results as general level of impulsivity with control variables*

| **Indicators** | **B (SE)** |
|---|---|
| Misrecognition surprise instead of disgust | -2.88 (1.29)* |
| General level of impulsivity | -4.32 (1.21)** |
| Age | -1.28 (3.03) |
| Gender | 4.78 (3.28) |
| Education | -3.39 (2.08) |
| Interaction between moderator and independent variable | 1.93 (1.46) |
| Adj. R2 | .379 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Moderator – personality traits (SD3)**

**Level of Narcissism**

The Moderation effect as the level of Narcissism, the effect of the misrecognition surprise instead of disgust on emotion regulation strategy Acceptance, and the interaction of the moderator effect and the effect of the independent variable were statistically significant *F*(3, 28 = 3.40, p = .032, adj. R2 = .188, (b = -1.15 (0.53), p = .039; b = 1.63 (0.62), p = .014; b = -1.97 (0.70), p = .009, accordingly). As the degree of Narcissism increased, the relationship of Acceptance and the misrecognition surprise instead of disgust became less negative. In other words, the higher the level of the Narcissism trait and the greater the misrecognition surprise instead of disgust, the lower the propensity for the RE strategy Acceptance. It is worth noting that the relationship is weakly expressed (Figure 19).

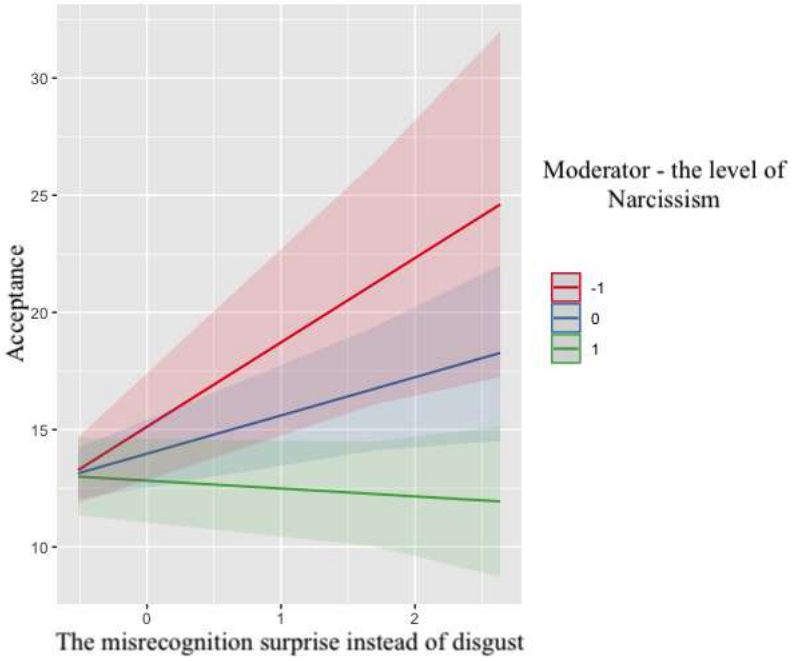


*Figure 19 – Graph of the moderation effect as the level of Narcissism on the association between the misrecognition surprise instead of disgust and RE strategy – Acceptance*

However, after adding control variables to the Model, the statistically significant moderation effect and the effect of the independent variable and the interaction between them ceased to be significant *F*(6, 25 = 3.52, p = .012, adj. R2 = .328, (b = -

0.22 (0.58), p = .704; b = 0.68 (0.68), p = .321; b = -1.19 (0.71), p =.107, accordingly), (Table 47).

*Table 47 Moderation analysis results as the level of Narcissism with control variables*

| Indicators | B (SE) |
|---|---|
| Misrecognition surprise instead of disgust | 0.68 (0.68) |
| Level of Narcissism | -0.22 (0.58) |
| Age | -0.11 (0.11) |
| Gender | -0.55 (1.26) |
| Education | -1.49 (0.84) |
| Interaction between moderator and independent variable | -1.19 (0.71) |
| Adj. R2 | .328 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

**Moderator – levels of anxiety and depression (HADS)**

**Anxiety level**

There were statistically significant the moderation effect as *the anxiety level*, the effect of the misrecognition anger instead of sadness on emotion regulation strategy Blaming other and interaction between the moderation and independent variable effects *F*(3, 28 = 3.43, p = .030, adj. R2 = .191, (b = 1.01 (0.49), p = .048; b = 1.07 (0.49), p = .038; b = 1.15 (0.51), p = .032, accordingly). According to Figure 20, as the level of anxiety increased, the relationship of Other-blame and the and the misrecognition anger instead of sadness became more positive. In other words, the higher the level of anxiety, and the greater the misrecognition anger instead of sadness, the greater the propensity for Other-blame.

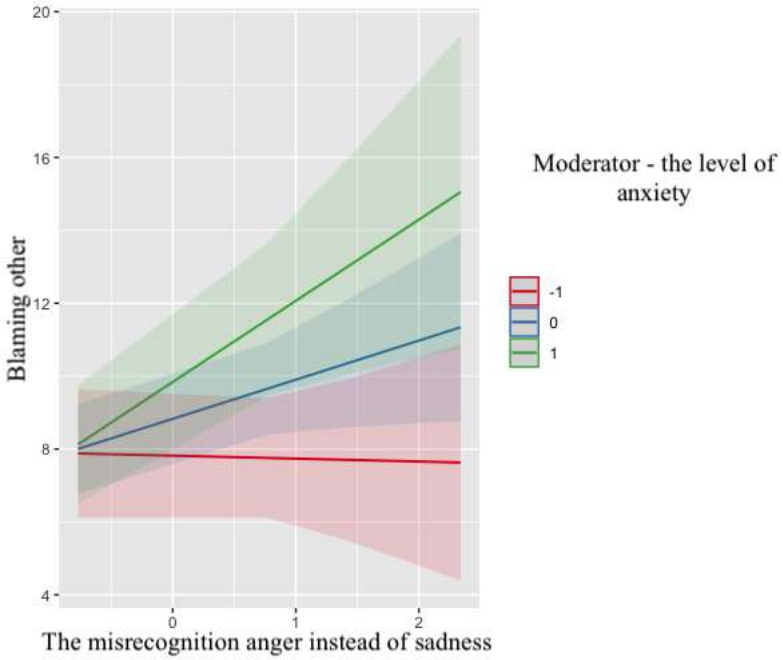


*Figure 20 – Graph of the moderation effect as the level of anxiety on the relationship between the misrecognition anger instead of sadness and the tendency Other-blame*

The statistically significant effect of the independent variable remained after adding control factors to the model $F(6, 25 = 5.27$, p = .001, adj. R2 = .452, (b = 2.00 (0.48), p < .001). However, the statistically significant moderation effect and effect interaction between it and the independent variable were not preserved (b = 0.78 (0.41), p =.069; b = 0.80 (0.44), p = .080, accordingly), (Table 48).

*Table 48. Results of moderation analysis of anxiety with control variables*

| **Indicators** | **B (SE)** |
|---|---|
| Misrecognition anger instead of sadness | 2.00 (0.48)*** |
| Level of anxiety | 0.78 (0.41) |
| Age | 0.12 (0.10) |
| Gender | 1.78 (1.09) |
| Education | 1.98 (0.68)** |
| Interaction between moderator and independent variable | 0.80 (0.44) |
| Adj. R2 | .452 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

The moderation effect as the level of anxiety, the effect of the misrecognition fear instead of anger on emotion regulation strategy Catastrophizing, and the interaction of the moderator effect and the effect of the independent variable were statistically significant $F(3, 28 = 8.25$, $p < .001$, adj. $R2 = .412$, ($b = 2.03$ (0.56), $p = .001$; $b = 1.63$ (0.56), $p = .007$; $b = 2.05$ (0.59), $p = .002$, accordingly). As anxiety levels increased, the relationship between the RE strategy Catastrophizing and the misrecognition fear instead of anger became more positive. In other words, the higher the level of anxiety and the greater the misrecognition of anger instead of sadness, the greater the propensity for the maladaptive emotion regulation strategy Catastrophizing (Figure 21).

There was one outlier that went beyond the boundary of 1 in this model. After removing it, the Model did not change significantly, the data in Figure 21 are shown without removing the outlier.

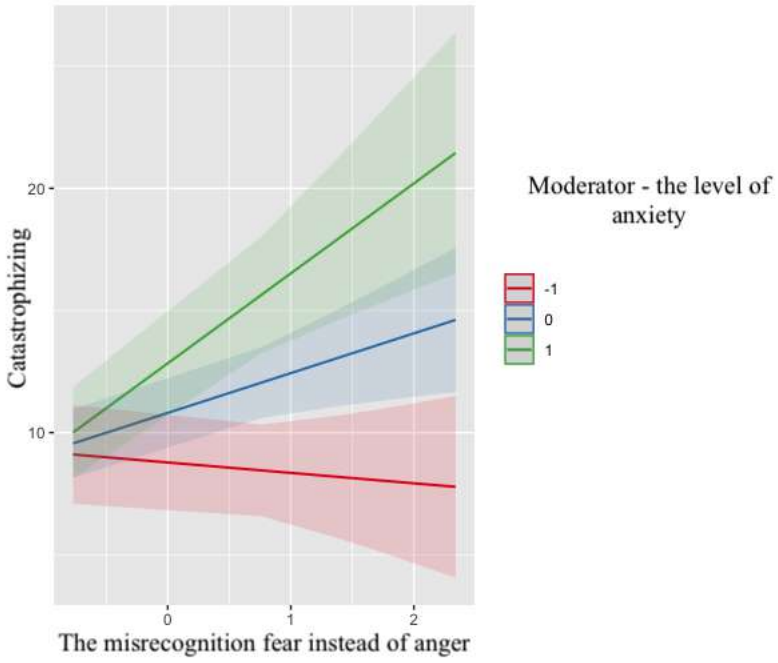


*Figure 21 – Graph of the moderation effect as the level of anxiety on the relationship between the misrecognition fear instead of anger and the tendency to Catastrophizing*

Adding control variables to the Model as gender, age, and educational level led to the fact that the statistically significant effect of the independent variable, the effect of the moderator, and their interaction was preserved $F(6, 25 = 4.52$, $p = .003$, adj. R2

= .405, (b = 1.92 (0.67), p = .008; b = 1.92 (0.58), p = .003; b = 1.88 (0.62), p = .005, accordingly), (Table 49).

*Table 49. Results of moderation analysis of anxiety with control Variables*

| Indicators | B (SE) |
|---|---|
| Misrecognition fear instead of anger | 1.92 (0.67)** |
| Level of anxiety | 1.92 (0.58)** |
| Age | -0.01 (0.13) |
| Gender | -2.02 (1.53) |
| Education | 0.29 (0.97) |
| Interaction between moderator and independent variable | 1.88 (0.62)** |
| Adj. R2 | .405 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE – standard error*
*«*» p<0.05, «**» p<0.01, «***» p<0.001*

Hypothesis 5 suggested that impulsivity characteristics, personality traits and levels of anxiety and depression would act as moderators in the association between of emotion misrecognition and emotion regulation strategies, partially supported by control variables for the BPD patient group. However, it did not find confirmation for substance users' group.

To summarize Chapter 3, patients with substance dependence, substance users, and BPD patients differ from controls in their accuracy of sadness recognition, as well as in the misrecognition disgust instead of sadness. These results supported Hypotheses 1 and 3. However, Hypothesis 2 has not been confirmed. Adding control variables led to the fact that the group difference for the speed negative emotion recognition became an artifact. Hypothesis 4 has been confirmed only for the group of patients with BPD: these participants were characterized by a difference from the control group in the characteristics of impulsivity and personality traits that characterize the Psychopathy scale. Also, patients with BPD differed from substance users and healthy controls in such an ER strategy as Cognitive Reappraisal. Hypothesis 5 was confirmed for chemical dependence patients, with impulsivity characteristics, personality traits and levels of anxiety and depression acting as moderators in relation to misrecognition of emotions and emotion regulation strategies in this clinical group. Hypothesis 5 was not

confirmed in the substance-using group, but was confirmed in the BPD group, namely that anxiety levels acted as a moderator in linking misrecognition of emotions and maladaptive emotion regulation strategies.

# CHAPTER 4. DISCUSSION

## 4.1 Facial emotion recognition (accuracy and speed)

The results obtained in the present study showed the impairment of the recognition of sadness is characteristic of all clinical groups. Besides, patients with BPD and substance users do not differ in the accuracy and speed of recognition of all 6 basic emotions. In our study, participants with the syndrome of dependence had combined use of psychoactive substances, therefore, in the discussion of the results, we cannot use differentiation according to the preferred psychoactive substance. Our results are consistent with, and partly confirm, other studies. For example, M. Foisy et al. provide data on impaired recognition of the emotion of sadness in alcohol addicts (Foisy et al., 2007). There is also evidence of impaired fear and disgust recognition in alcohol addicts (Donadon, Osório, 2017), as well as impaired disgust and fear recognition in methamphetamine addiction, which were associated with dysfunctional personal beliefs (Hanegraaf et al., 2020). In addition, dysfunctional personality beliefs were associated with lower emotion recognition in cocaine addiction (Albein-Urios et al., 2019).

Our results partly confirm those of a study by M. H. Fernandez-Serrano et al., which showed impairments in the recognition of sadness, anger, fear, and disgust in individuals with multiple substance dependence syndrome. Moreover, this study provides additional evidence for the stability of emotion recognition deficits that persist after a period of abstinence of 3 to 20 months (Fernández-Serrano et al., 2010). The results of emotion recognition for the substance users and for the BPD group of the present study connect with other works. For example, A.P. Eastwood et al. report data on decreased sensitivity to sadness and fear after drinking alcohol (Eastwood et al., 2020). The study by M. Leganes-Fonteneau et al. showed that adolescents who abuse alcohol have difficulties to recognize sadness (Leganes-Fonteneau et al., 2020). The present study connects with the meta-analysis by L. Hanegraaf et al., which revealed a significant deficit in the ability to identify emotions by facial expression and draw conclusions about the mental state of other people in both BPD and chemical addictions (Hanegraaf et al., 2021). At the same time, our data do not confirm the results of the

study by N. R. Herr and E. P. Meier (Herr, Meier, 2021), in which no differences were found between patients with BPD and healthy controls. Perhaps, the static stimuli for studying recognition emotions, as well as a smaller number of participants in the sample influenced the difference in results.

The design of this study did not imply the ability to directly establish whether the identified impairments in the recognition of emotions of the negative spectrum by facial expression are a predictor or a consequence of the development of chemical dependence. However, it is possible to make cautious assumptions the results of this study, in the author's opinion, reinforce the notion that regular use of psychoactive substances can lead to impairments in emotion recognition. K. Kuypers et al. note that even a single dose of cocaine impairs the recognition of negative emotions (anger and disgust) in high-intensity terms (Kuypers et al., 2005). E.K. Leiker and co-authors in their neuroimaging study of adolescents showed different parts of the brain are involved in the emotion recognition, depending on the type of PAS consumed. Signal activity was inside the ventromedial prefrontal cortex and medial occipitotemporal gyrus in alcohol users. And signal activity was inside in the rostromedial prefrontal cortex, including the anterior cingulate gyrus in cannabis users (Leiker et al., 2019). In addition, the same results were obtained in adults (Alba-Ferrara et al., 2016). The severity of alcohol consumption was associated with a decrease BOLD in the left lower parietal zone, when recognizing fear, compared with a neutral facial expression (Leiker et al., 2019).

The author of the study also did not found impairment in the speed of emotion recognition in the group of patients with the syndrome of dependence and in the group of participants with BPD. The results of the present study do not support the findings of L. Kemmis et al. on delayed emotion recognition in substance users (Kemmis et al., 2007).

There is evidence that in patients with alcohol dependence, a deficit in the ability to recognize the emotions of others leads to impaired perception of social signals, prevents adequate and adaptive behavior, and thus contributes to the relapse of chemical dependence (Rupp et al., 2017). K. Rupp et al. note impaired recognition of

emotions by facial expression is a neurocognitive risk factor that should be considered in the treatment of alcohol dependence (Rupp et al., 2017). In addition, the authors point to a negative relationship between the success of treatment and the ability to recognize emotions by facial expression.

In one of the few Russian studies shown people who have a more developed ability to recognize and verbalize their own feelings better than other subjects recognize emotions that are difficult to recognize by facial expression and have a higher general an indicator of the accuracy of emotion recognition. This result partly confirms the idea of a relationship between the ability to recognize one's own feelings and the impressive ability of a person (Moskacheva, Kholmogorova, 2014).

### 4.2 Misrecognition of emotions

One of the important findings of our study is the misrecognition disgust instead of sadness for chemically dependent individuals, participants with psychoactive substances, and patients with BPD. It is consistent with P. Fonagi's mentalization theory and R. J. Blair's hypermentalization theory. P. Fonagy and P. Luten argue that the diagnosis of borderline personality disorder is associated with a low threshold for activation of the attachment system and deactivation of controlled mentalization, associated with a violation of the ability to distinguish between the mental state of oneself and others, which leads to hypersensitivity and increased susceptibility to the emotions of other people (Fonagy and Luyten 2009). R. J. Blair argues people with a personality disorder typically find other people's fear and sadness inherently disgusting, that is, unable to sympathize with them (Blair, 2006). The present study is also consistent with the hypermentalisation model (Sharp et al., 2013). Hypermentalization is the excessive attribution of intentions and thoughts to other people (Ballespí et al., 2019). The misrecognition disgust instead of sadness can be explained by heightened sensitivity to rejection from other people. It can be assumed that individuals with harmful substance use recognize self-disgust when the interlocutor is sad. Recent studies have shown that hypermentalization may be characteristic not only for patients with BPD, but also for psychopathology in general (McLaren et al., 2022; indirectly – Fediukovich, Trusova, 2023 (a)). The present study

also confirms the data of the study by J. Unoka et al. Patients with BPD in this study more often attributed disgust to other negative emotions (Unoka et al., 2011).

According to some reports, people with alcohol dependence tend to misidentify emotional expressions as hostile (Fernández-Serrano, 2010). There is an assumption that the dopaminergic neural system, which is also involved in the formation of incentive motivation and the pursuit of reward, is responsible for recognizing anger (Lawrence, 2007). According to a meta-analysis, the toxic effect of alcohol on the integrity of neurons may explain the deficit in emotion recognition, since structural changes in brain regions important for emotion recognition are a consequence of excessive alcohol consumption (Bora and Zorlu, 2017). On the other hand, there were studies demonstrating that neurocognitive deficits may have a genetic origin and lead to a greater predisposition to alcoholism and to the development of anomalies in brain regions that are responsible for recognizing emotions (Donadon, Osório, 2017). In addition, there is evidence that the long allele of the serotonin transporter gene, which is a key neurotransmitter involved in the functioning of the amygdala, is a genetic risk factor for psychopathy (Glenn, 2011).

Many scientists believe the neurological basis for impaired emotion recognition is dysfunction of the amygdala in personality disorder (Blair, 2003). A meta-analysis has shown a decrease in the bilateral volume of the hippocampus and amygdala is characteristic of patients with a personality disorder (Ruocco et al., 2012). A moderate decrease in the volume of these brain structures was also characteristic of people who had undergone post-traumatic stress disorder (Ahmed-Leitao et al., 2016), as well as a decrease in the left hippocampus in patients with PTSD who experienced physical abuse (Bremner et al., 1997). Moreover, the amygdala is involved in emotion recognition processing regardless of psychopathology (Phelps and LeDoux, 2005) and damage to it leads to impaired interpretation of the intensity of the emotion of fear in others (Adolphs, 1999)

### 4.3 Emotion regulation and individual psychological characteristics

In the present study, no differences were found in emotion regulation strategies, impulsivity characteristics, and personality traits between the chemical dependence

group and substance users after adjusting for control factors such as gender, age, educational level, levels of anxiety and depression. However, for the group of participants with BPD, differences were found from the control group and substance users in such an emotion regulation strategy as Cognitive Reappraisal, the general level of impulsivity, the level of attentional impulsivity, motor impulsivity, non-planning impulsivity, and personality traits, including the description of the Psychopathy scale.

In other words, patients with BPD are not inclined to use such an emotion regulation strategy as Cognitive Reappraisal. Participants with BPD may be characterized by a mild degree (since the data obtained on the Psychopathy scale do not exceed the normal level) of the following personality traits: egocentrism, rebelliousness, conflict behavior, violation of social norms. Cognitive Reappraisal is an adaptive emotion regulation strategy allows a person to reason about complex events from a rational perspective. According to the results, patients with BPD are less likely to use this emotion regulation strategy, which means that in difficult situations for them, they can resort to emotional evaluation of events. Our data partially agree with several other works (Crowell, 2009; Fossati et al., 2013). Emotion dysregulation and interpersonal communication problems have been shown to be characteristic of patients with personality disorder (Deckers et al., 2015; Herr et al., 2013; López-Pérez, McCagh, 2020). There is an assumption impaired emotion recognition may be one of the factors of violation of emotional regulation, and as a result – behavioral disorders. Often when experiencing strong emotions and misunderstanding them, many patients turn to maladaptive strategies such as self-harm or substance abuse (Gunderson et al., 2018).

Although the literature describes emotion dysregulation is characteristic of substance-dependent individuals and substance abusers, our results showed no difference in ER strategies compared to controls. In contrast, participants with substance use were also more likely to engage in such an ER strategy as Cognitive Reappraisal, a change in attitude to a situation that allows you to change the emotional response like the control group. Such results are sparse (e.g. Azzi et al., 2021). V. Azzi and co-authors offer a new concept of Metacognition. Metacognition demonstrates a

perseverative thought process that includes psychological skills, knowledge, experience, and is subdivided into positive and negative beliefs (Wells, 2002). These beliefs lead to potential threat avoidance and the tracking of certain thoughts, which sometimes leads to inadequate coping strategies if dysfunctional thought processes arise. As for positive metacognitions, they consider the "helpfulness" of thinking and cognitive strategies (for example, "Alcohol helps me gain control over my thoughts and emotions"), while negative metacognitive beliefs imply the uncontrollability or "harmfulness" of thoughts (for example, "I can not to control my thoughts about drinking, not to stop drinking as soon as I start) (Spada, Wells, 2008). Indeed, there were suggestions that psychoactive substances act as emotion regulation (Spada et al., 2007). Moreover, in 2013, M. Spada et al. suggested that dysfunctional metacognition mediates and predicts the relationship between emotion regulation and substance abuse, and may also lead to addiction (Spada et al., 2013). However, further studies are needed to confirm this hypothesis.

Participants with BPD showed increased levels of all characteristics of impulsivity: general impulsivity, attentional impulsivity, motor, and non-planning impulsivity compared with healthy participants. An increased level of impulsivity is a major symptom of BPD and can also lead to self-destructive behavior (self-harm, suicidal behavior, etc.) (Berlin et al., 2005).

The personality traits of the Short Dark Triad (SD3) suggest specific patterns of interpersonal interaction. In this study, we were interested in assessing the severity of these traits in clinical groups and their possible association with impairments in emotion recognition. Concerning the severity of such personality traits, differences with healthy respondents were obtained only in the group of patients with BPD and only on the scale of Psychopathy, which implies selfishness, lack of empathy, irascibility, and aggressiveness. However, results of BPD group are not beyond 30 score. In other words, the BPD group has only a mild degree of this personality trait.

## 4.4 Moderation effect

### Moderator as characteristics of impulsivity

In the group of patients with substance dependence, the more pronounced the level of motor impulsivity and the misrecognition sadness instead of happiness, the higher the tendency to Self-blame. Our results can complement the theory of mentalization (Fonagy and Luyten, 2009). It can be assumed that people with chemical dependence, when misrecognizing sadness instead of happiness, tend to expect negative emotions from other people in relation to themselves, which can lead to blaming themselves (“They are disappointed in me, I’m to blame”), and an increased level of motor impulsivity only strengthens and reinforces this connection. As noted by P. Fonagy and his colleagues, mentalization is established in the context of security and is violated with insecure attachment and/or severe psychological trauma (Fonagy, 2008). On the contrary, the greater the general level of impulsivity and the misrecognition sadness instead of happiness, the lower the tendency to Self-blame. This result may be because the level of impulsivity includes other characteristics of impulsivity, and this relationship seems to be more complex than we might think. The mechanisms of the emotional sphere are so complex and detailed moderation models are required to understand the seemingly ambiguous result. After all, this result may just be random. Also, the level of motor impulsivity influences the relationship between misrecognition of sadness instead of disgust and the strategy of regulation of emotions Rumination: the higher the level of motor impulsivity and the misrecognition sadness instead of disgust, the lower the tendency to constantly think about thoughts and feelings associated with the experienced difficult situation. It is possible that patients with chemical dependence can avoid the emotion of disgust towards themselves from other persons, and such an ER strategy as Rumination (constant thoughts about their feelings in relation to the experienced situation) can cause emotional pain, which in turn, may lead to relapse. In other words, this connection may be secondary in the mentalization of patients with chemical dependence, and the use of psychoactive substances became a substitute in the regulation of their emotions, that is, it regulates and muffles emotional pain. Indeed, there are suggestions that psychoactive substances

act as emotion regulation (Spada et al., 2007; Spada et al., 2008). Also, the higher the level of non-planning impulsivity and the more the misrecognition fear instead of happiness, the less the tendency to Cognitive Reappraisal (conditionally adaptive ER strategy) - changing attitudes towards the experienced situation. According to research, the level of impulsivity is a moderator between intention and behavior in substance abuse (Moshier et al., 2013). P. Hasking and L. Claes point to possible transdiagnostic mechanisms between harmful alcohol use, eating disorders and impulsivity, emotion dysregulation and alexithymia (Hasking, Claes, 2020).

In the group of persons with substance use, the moderator interaction as impulsivity and misrecognition of emotions were not preserved after control factors were considered. However, a statistically significant moderation effect as a level of non-planning impulsivity on Expressive Suppression was preserved. In other words, the higher the level of non-planning impulsivity, the lower the tendency to Expressive Suppression. There is evidence that difficulty in controlling impulsive behavior and lack of emotional awareness have been associated with behavior leading to alcohol consumption in men in response to strong negative emotions or emotional uncertainty (Dvorak et al., 2014). Similar results were obtained in the present study and in the group of patients with BPD - the general level of impulsivity is negatively associated with Cognitive Reappraisal: the higher the level of impulsivity, the lower the tendency to change attitudes towards the experienced situation. Some studies highlight the link between emotion dysregulation and impulsivity, suggesting that emotion regulation may be an important factor to consider when evaluating individuals at higher risk of developing chemical dependence (Schreiber et al., 2012). Numerous studies have linked emotional state to impulsivity characteristics and addictive behaviors. Such studies have shown that smoking and unhealthy eating increase during periods of stress (Shi et al., 2011; Greeno and Wing, 1994), and alcohol is often used to regulate positive and negative moods (Cooper et al., 1995). In addition, increased levels of anxiety and an inability to tolerate emotional discomfort are highly predictive of substance use problems (Howell et al., 2011; Cheethman et al., 2010; Wu et al., 2011). The relationship between impulsive behavior and emotional state is supported by

neuroscience research, which has shown that the prefrontal cortex and the amygdala play a key role in the regulation of emotions (Oschner and Gross, 2005; Ray and Zald, 2011), as well as in impulsive behavior, behavior for decision making, risk taking, motor control and reasoning (Zeeb et al., 2010; Bechara et al., 2000; Hinvest et al., 2011; Krawczyk et al., 2011).

There is also evidence that increased activation of the dorsal anterior cingulate gyrus is associated with increased impulsivity (Brown et al., 2006), as well as with subjective emotional states and experiences, pain perception (Phillips et al., 2003). Thus, it is possible that increased activation of this pathway may lead to increased levels of impulsivity, and that such individuals may require higher activation of regulatory mechanisms (Brown et al., 2006) to control impulsive responses to emotional stimuli.

**Moderator as anxiety level**

According to the present study, in the group with chemical dependence, the level of anxiety as a moderator influences the relationship between erroneous recognition and maladaptive ER strategy. The higher the level of anxiety and the more the misrecognition happiness instead of anger, the higher the tendency to Catastrophizing (exaggeration of the significance of the event and its negative consequences). Interestingly, in the group of patients with BPD, a significant result of the moderation analysis was also obtained with a tendency to Catastrophizing: the higher the level of anxiety and the more the misrecognition anger instead of sadness, the more pronounced the tendency to exaggerate the significance of the event and its negative consequences. This result also complements the model of mentalization (Fonagy and Luyten, 2009) and hypermentalization (Sharp et al., 2013), namely, the misrecognition of anger instead of sadness can be explained by increased alertness in people with BPD and the expectation of aggression from other people, which triggers the mechanism of maladaptive regulation of emotions – exaggeration of the significance of the event and negative consequences. It is worth noting a recent meta-analysis by E. Bora, which indicates that BPD should not be considered as the result of an anomaly in the development of the nervous system. Increased sensitivity to negative or threatening

social cues in BPD may be associated with neuroplastic changes in normally developed sociocognitive brain networks in response to intense negative interpersonal experiences (Bora, 2021).

**Moderator as depression level**

A statistically significant effect of the level of depression as a moderator on the relationship between misrecognition of emotions and ER strategy was found only in the group with chemical dependence. The higher the level of depression and the more the misrecognition sadness instead of happiness, the lower the tendency to Self-blame. It can be tentatively assumed that when the misrecognition sadness instead of the correct emotion of happiness, chemically addicted people tend to expect negative emotions and disappointment towards themselves but are less inclined to blame themselves. The feeling of blaming yourself can be so strong that it is replaced by blaming others. Foreign colleagues have shown that traumatic events and a maladaptive parenting style contribute to the severity of depression symptoms (Wingo et al., 2010). There is also evidence that people with depressive symptoms resort to substance use to cope with negative emotions (Cooper et al., 1995, Schuckit et al., 2006). It has been shown that increased levels of depression are not only associated with substance use, but may contribute to this behavior (Conner et al., 2009).

**Moderator as personality traits**

In the substance-dependent group, a personality trait such as Narcissism (egocentrism, demonstrative behavior to attract the attention of others, sensitivity to criticism, expectation of others to treat oneself differently) affects the relationship between misidentifying happiness instead of sadness and a tendency to refocus on planning. In other words, the lower the severity of the traits of Narcissism and the more the misrecognition happiness in the direction of sadness, the lower the tendency to think about what next steps are best to take in relation to what happened. In addition, the level of Narcissism also negatively affects the tendency to Catastrophizing: the higher the level of Narcissism, the higher the tendency to exaggerate the significance of the event. Also, the higher the severity of Psychopathy (egocentrism, conflict,

emotional coldness, irascibility), the lower the tendency to think about what next steps are best to take in relation to what happened (Refocusing on planning).

Numerous studies have shown that psychopathic traits are associated with substance use and addiction (Smith and Newman 1990; Jonason et al. 2015; Sellbom et al. 2017). According to neuroimaging studies, psychopathic traits (especially antisocial deviant traits) in healthy individuals are positively associated with striatal activity during expectation of monetary reward and amphetamine use (Bjork et al., 2012; Buckholtz et al., 2010). Given that these brain responses can similarly predict problematic drug attraction, striatal hyperreactivity may contribute to drug use in patients with prominent features of Psychopathy (non-clinical) (Heitzeg et al., 2014; Büchel et al., 2017). In the present study, many respondents with chemical dependence had a criminal history. Interestingly, a neuroimaging study on a similar sample found that high-severity psychopathy individuals with a long history of drug use showed lower sensitivity to drug cues (Denomme et al., 2018).

In relation to the group of substance users, after considering the control variables, the negative effect of the level of Psychopathy on the ER strategy was preserved. other situations. M. Brand et al. (Brand et al., 2016; Brand et al., 2019) suggest that the severity of symptoms of potential addictive behavior is reinforced by affective and cognitive mechanisms, such as dysfunctional coping style and dysfunctional emotion regulation.

Psychopathic traits are also associated with addictive behaviors other than substance use, such as problematic social media or Internet use (Chung et al., 2019; Lee, 2019; Sindermann et al., 2018). Based on the idea of E. Wegmann and M. Brand (Wegmann, Brand, 2019), the direct impact of Narcissism on problem behavior in social media use illustrates a more reward-oriented path. An inability to cope with emotions may be associated with a dysfunctional coping style and may also indicate a more fear-based approach where individuals with maladaptive personality traits try to compensate for this dysfunctional emotion regulation strategy through social media, resulting in repetitive behavior and their problematic use.

The results of the present study regarding impulsivity characteristics, anxiety levels and personality traits as a moderator in connection with misrecognition of emotions and ER strategies in substance-dependent individuals, patients with BPD, as well as in substance users are new since we have not found similar studies in the SCOPUS and RSCI database.

The present study supports the suggestion that emotion recognition is an important prerequisite for emotion regulation (Gross, 2007). Impaired emotion recognition can affect RE strategies, i.e. lead to misunderstanding and a different interpretation of the emotional signals of another person, and this, in turn, can lead to the use of maladaptive emotion regulation strategies, which can contribute to a decrease in social adaptation (In-Albon et al., 2013). Often when experiencing strong emotions and not understanding them, many patients turn to maladaptive strategies such as self-harm or substance abuse (Gunderson et al, 2018). The ability to perceive and understand emotions can influence social interaction by helping people interpret internal and social cues, thereby enabling emotional self-regulation and social behavior (Suveg and Zeman, 2004). In the present study, we have tried to consider the main factors most associated with addiction and borderline personality disorder, such as the level of impulsivity, personality traits, levels of anxiety and depression, which can potentially act as moderators. Let us depict this graphically (Figure 22). However, the connection between emotion recognition disorder and the choice of emotion regulation strategies can be influenced by other factors that were not accounted in this study. For example, according to S. Herpertz's model, emotional sensitivity is worth considering (read more, Herpertz, 1995). Also, elements of socio-cognitive information processing (hostile attribution bias, lability, and negativity), but the authors consider their model in the context of aggressive behaviour (for details, Lemerise, Arsenio, 2000). More research is needed, and models need to be refined to examine the relationship between impaired emotion recognition and maladaptive emotion regulation strategy.

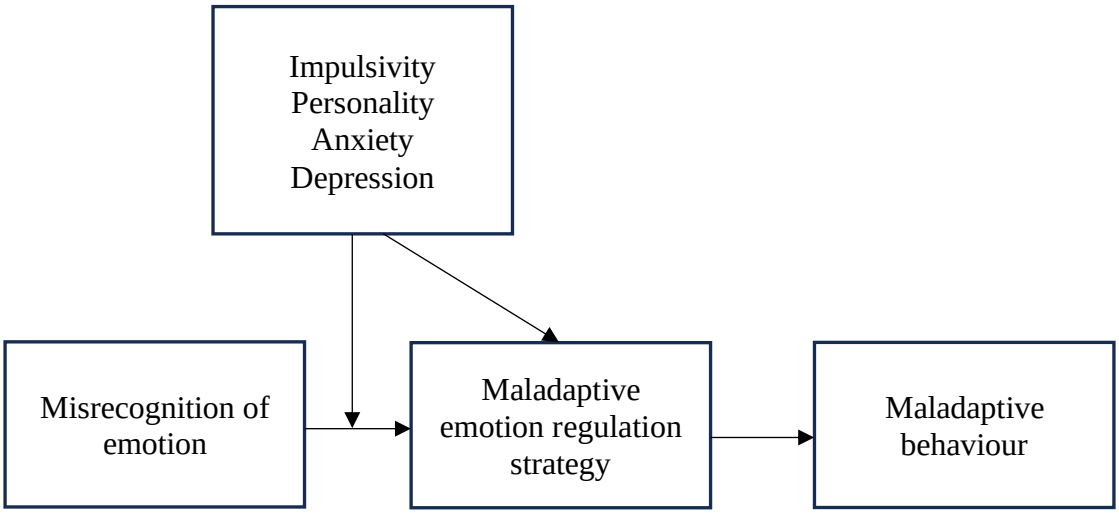


*Figure 22 - A general model of the relationship between misrecognition of emotions and emotion regulation strategies*

## CONCLUSIONS

The results of our research allowed us to draw the following conclusions:

1. Patients with the syndrome of dependence, substance users, and BPD patients differ in impaired recognition of sadness accuracy from healthy controls. The accuracy of recognition of happiness, anger, fear, disgust, and surprise in the clinical groups corresponds to the control group.
2. The study showed that the speed of emotion recognition in patients with the syndrome of dependence, substance users, and patients with BPD does not differ from that in healthy controls. Many other factors influence the speed of emotion recognition, such as impulsiveness.
3. All clinical groups demonstrated the misrecognition disgust instead of sadness.
4. All characteristics of impulsivity and personality traits, characterised by the Psychopathy scale (emotional coldness, conflict), differ only for the group of patients with BPD compared with healthy controls and substance users.
5. Substance users and healthy controls are characterised by a strategy of regulation of emotions called Cognitive Reappraisal (changes in attitude towards past situations).
6. In the group of patients with the syndrome of dependence, the moderators of the relationship between the misrecognition of emotions by facial expression and emotion regulation were characteristics of impulsivity, personality traits and level of depression, which was not observed in the other groups.
7. The level of anxiety as a moderator of the relationship between the misrecognition of emotions by facial expression and emotion regulation in the groups of patients with the syndrome of dependence and the group of patients with BPD.

# GENERAL CONCLUSIONS

Emotion recognition by facial expression and emotion regulation strategies are important components of the complex cognitive-emotional processing that underlies the establishment and maintenance of interpersonal relationships, including attachment relationships, as well as any form of social interaction aimed at adaptation.

The question of whether emotion recognition is a primary deficit in relation to chemical dependence or a consequence of the disease remains unexplored. Although the design of our study did not involve a direct study of this issue, we indirectly addressed it and presented both theoretical and empirical evidence in favour of each opinion. Our study also expands the notion that impaired recognition of the accuracy of sadness and the misrecognition disgust instead of sadness may be markers for both drug users and the diagnosis of borderline personality disorder. It is possible that the role of sadness recognition impairment underlies the formation of substance abuse and exists along with other psychopathological and individual psychological features. In addition, the effect of PAS itself should be considered; even systematic use without the syndrome of dependence can lead to a decrease in the recognition of emotions by facial expression.

The present study highlights the importance of emotion recognition and regulation in the development and maintenance of BPD, as well as in the development of addiction. Impaired emotion recognition can lead to misunderstanding and a different interpretation of another person's emotional cues, and this, in turn, can lead to the use of maladaptive emotion regulation strategies, which can contribute to reduced social adjustment as well as relapse into addiction. The present study is one of the first to investigate the possible moderation role of impulsivity characteristics, levels of anxiety and depression, and Dark Triad personality traits in relation to misrecognition of emotions and emotion regulation strategies. The findings of this study allow us to optimise comprehensive programmes of clinical and psychological interventions at different stages of addictive disorders with a focus on individual strategies of emotion regulation and features of interpersonal interaction in the context of understanding the emotional state of the other person.

## LIST OF ABBREVIATIONS AND SYMBOLS

**ACC –** Anterior cingulate cortex

**ACTH –** Adrenocorticotropic hormone

**AUD –** Alcohol use disorder

**BOLD** – Blood-oxygen-level-dependent

**BPD** – Borderline personality disorder

**EI** – Emotional Intelligence

**EPN** – Early posterior negativity

**ER** – Emotion regulation

**ERP** – Event-related potential

**HC** – Healthy control

**LPC** – Late positive components

**LPP** – Late positive potential

**PAS** – Psychoactive Substances

**PFC** – Prefrontal cortex

**PTSD** – Post-traumatic stress disorder

**RDoC** – Research Domain Criteria

**RSCI** – Russian Science Citation Index

**PSD** – patients with the syndrome of dependence

**ToM** – Theory of Mind

**VTA** – Ventral tegmental area

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# APPENDICES

## Appendix 1. Informed consent

ID:_____

### Informed consent

to participate in the study "Emotion regulation and recognition of emotions in people who use psychoactive substances."

The research team of the Faculty of Psychology of St. Petersburg University invites you to participate in a psychological study aimed at assessing emotion regulation and recognition of emotions in people who use psychoactive substances. The study was approved by the Ethics Committee of St. Petersburg State University in 2020. Leader – Anna Vladimirovna Trusova (Ph.D., Associate Professor of the Department of Medical Psychology and Psychophysiology).

WHAT WILL HAPPEN IN THIS STUDY

If you agree, we ask you to fill out several questionnaires and complete the task on a computer, which will take you about 60-90 minutes. The questions will focus on your emotional state, emotion regulation and emotion recognition. You will be one of approximately 70 people who will be invited to participate in this study. Before you decide to participate in this study, we would like to provide you with information about this study, about what awaits you and about the possible risks.

VOLUNTARY PARTICIPATION

Your participation in the study is voluntary. You can choose not to participate in this study now or refuse to continue to participate at any stage without any negative consequences. Your participation depends entirely on your decision. If you receive any treatment, your decision will not affect it.

CONFIDENTIALITY

The questionnaires that you fill out will receive an individual identification number. Your name, surname and position will not be mentioned anywhere in

connection with the information that you provide. All results will be presented only in the general array, and not individually. All data collected during the research will be available only to the research team.

RESEARCH PROCEDURE

You will be asked several questions about your life history and offered several psychological questionnaires. You will also be asked to go through an experimental computer program that involves recognizing emotions on faces of other people. Based on the results of this study, publications are planned in scientific and psychological publications.

POSSIBLE DISADVANTAGES

Potential risks for research participants are associated with psychological discomfort from the questionnaire questions. Some of the interview questions may touch upon personal and / or emotionally difficult topics, as well as issues of professional competence. The authors of the study made every possible effort to eliminate or minimize the risk of adverse consequences for study participants. Also, filling out questionnaires and tests will require some work from you, which can cause some fatigue. Remember that you can opt out of the study at any stage. This study does not imply emergency situations, however, in the event of such, you will be provided with professional psychological assistance.

POSSIBLE ADVANTAGES

Participation in the study does not imply that the respondent will receive monetary or material compensation, or any other direct benefit. However, the information obtained during this research may be beneficial for you and for other people in the future. However, you may not receive any benefits from participating in this study.

Attention! At the end of the study, participants may be provided with information about the overall results of the study. If you have a desire to familiarize yourself with your individual results, you can contact the performer of the study at the phone number listed below.

PROBLEMS AND QUESTIONS.

You can contact one of the researchers by phone:

+7 (911) 246-64-79 Fedyukovich Ekaterina Igorevna (clinical psychologist, research performer).

(812) 412-72-71 Trusova Anna Vladimirovna (Ph.D., Associate Professor of the Department of Medical Psychology and Psychophysiology, head of the research).

This study has been reviewed and approved by this Committee of St. Petersburg University, where you can contact if you have any questions from the research participant [phone 8 (812) 327-7969, irb.spsu@yandex.ru].

CONFIRMATION OF INFORMED CONSENT TO PARTICIPATE IN THE RESEARCH

*By signing this informed consent form, I acknowledge that I have read and understood the purposes, procedure, methods, and possible disadvantages of participating in the study. I had the opportunity to ask all my questions. I received satisfactory answers and clarifications on all questions that interested me in connection with this study. I give my consent to participate in the study.*

| | |
|---|---|
| Signature of participant | Date: «____» _____2020 |

*I explained the informed consent form above to the respondent and answered all the respondent's questions regarding participation in the study. His (her) decision to take part in the study is not imposed by anyone, but is conscious and voluntary, about which consent has been obtained.*

| | |
|---|---|
| Signature of researcher | Date: «____» _____2020 |

Key: translated from Russian.

## Appendix 2. Patient Examination Card (List of Fixed Parameters)

1. ID
2. Gender
3. Age
4. Education: -no; -elementary education; - incomplete secondary education; - secondary education; - incomplete higher education; - higher education.
5. Employment status: - student; - working with lower qualification; - manager; specialist; -state employee; - other; - unemployed.
6. Marital status: - single; - married; -divorced; - widower/widow.
7. Children: -yes; -no.
8. Do you drink alcohol?
9. Do you take drugs? If so, which ones?
10. Diagnosis ICD-10 / Presence of a psychiatric diagnosis
11. Presence of psychotic episodes
12. The presence of burdened heredity
13. Age of formation of addiction syndrome
14. Duration of the disease
15. Account remission
16. Duration of current remission
17. Criminal record

## Appendix 3. Hierarchical regression results for sadness recognition speed (Study 1).

| Sadness recognition speed, radians, ms | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -392.02 (114.42)** | -286.23 (170.59) |
| Age | - | 14.47 (14.15) |
| Gender | - | 124.64 (146.79) |
| Education | - | -46.68 (98.40) |
| Anxiety | - | 13.74 (19.97) |
| Depression | - | -15.85 (21.71) |

| | | |
|---|---|---|
| General impulsivity | - | -11.16 (7.42) |
| Adj. R2 | .235 | .249 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

## Appendix 4. Hierarchical regression results for anger recognition speed (Study 1).

| Anger recognition speed, ms | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -430.37 (125.33)** | -243.03 (163.62) |
| Age | - | 27.00 (13.57) |
| Gender | - | 191.61 (140.80) |
| Education | - | -148.81 (94.40) |
| Anxiety | - | 2.98 (19.16) |
| Depression | - | -10.90 (20.83) |
| General impulsivity | - | -17.25 (7.12)* |
| Adj. R2 | .236 | .425 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

## Appendix 5. Hierarchical regression results for fear recognition speed (Study 1).

| Fear recognition speed, ms | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -328.70 (92.58)** | -203.46 (133.50) |
| Age | - | 18.49 (11.08) |
| Gender | - | 3.58 (114.88) |
| Education | - | -92.25 (77.00) |
| Anxiety | - | 22.87 (15.63) |
| Depression | - | -12.06 (16.99) |
| General impulsivity | - | -11.29 (5.81) |
| Adj. R2 | .249 | .310 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

## Appendix 6. Hierarchical regression results for disgust recognition speed (Study 1).

| Disgust recognition speed, ms | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -316.75 (105.23) | -152.61 (120.86) |
| Age | - | 11.56 (10.03) |
| Gender | - | 265.15 (104.00)* |
| Education | - | -123.81 (-266.61) |
| Anxiety | - | 47.95 (14.15)** |
| Depression | - | -20.55 (15.38) |
| General impulsivity | - | -22.57 (5.26)*** |
| Adj. R2 | .187 | .527 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

## Appendix 7. Hierarchical regression results for Attentional impulsivity (Study 1).

| Attentional impulsivity | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -3.11 (1.25)* | -2.22 (1.83) |
| Age | - | -0.08 (0.15) |
| Gender | - | 1.32 (1.55) |
| Education | - | -0.88 (1.05) |
| Anxiety | - | 0.37 (0.20) |
| Depression | - | 0.11 (0.23) |
| Adj. R2 | .130 | .164 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

## Appendix 8. Hierarchical regression results for Other-blame (Study 1).

| Other-blame | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | 1.50 (0.67)* | 2.85 (1.03)* |
| Age | - | 0.09 (0.09) |
| Gender | - | 0.51 (0.89) |

| | | |
|---|---|---|
| Education | - | -0.92 (0.59) |
| Anxiety | - | 0.02 (0.12) |
| Depression | - | -0.03 (0.13) |
| General impulsivity | - | 0.05 (0.05) |
| Adj. R2 | .104 | .060 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

## Appendix 9. Hierarchical regression results for Psychopathy (Study 1).

| Psychopathy | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -4.06 (2.37) | -0.12 (3.10) |
| Age | - | 0.01 (0.26) |
| Gender | - | 2.69 (2.67) |
| Education | - | -0.59 (1.79) |
| Anxiety | - | 0.52 (0.36) |
| Depression | - | -0.24 (0.39) |
| General impulsivity | - | -0.37 (0.13) |
| Adj. R2 | .052 | .283 |
| p-уровень значимости модели | .096 | .019 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*

## Appendix 10. Hierarchical regression results for Happiness recognition speed (Study 2).

| Happiness recognition speed, ms | Model 1<br>B (SE) | Model 2<br>B (SE) |
|---|---|---|
| Group | -67.67 (26.02)* | -30.68 (28.85) |
| Age | - | 10.54 (4.28)* |
| Gender | - | -92.64 (44.23) |
| Education | - | 4.80 (30.55) |
| Anxiety | - | -10.78 (5.92) |
| Depression | - | 1.97 (6.20) |
| General impulsivity | - | 7.08 (2.43)** |
| Adj. R2 | .051 | .154 |

*Key: Adj. R2 – adjusted R2, B – regression coefficient, SE - standard error*

*«*» p<0.05, «**» p<0.01, «***» p<0.001*