

A Psychoanalytic Perspective on the Neuropsychological Impact of Anabolic Steroid Abuse: The Role of Bio-Neurofeedback as a Therapeutic Tool

Claudio Lombardo*

Independent Researcher, Degree in Psychology, in Food and Nutrition Sciences, in Organizational and Managerial Sciences, Italy

*Corresponding Author

Claudio Lombardo, Independent Researcher, Degree in Psychology, in Food and Nutrition Sciences, in Organizational and Managerial Sciences, Italy.

Submitted: 2024, Nov 10; Accepted: 2024, Dec 05; Published: 2024, Dec 12

Citation: Lombardo, C. (2024). A Psychoanalytic Perspective on the Neuropsychological Impact of Anabolic Steroid Abuse: The Role of Bio-Neurofeedback as a Therapeutic Tool. *J Emerg Med OA*, 2(1), 01-06.

Abstract

The abuse of anabolic androgenic steroids (AAS) is a complex phenomenon rooted in deep psychological and neurophysiological conflicts. Individuals who use AAS often have a history of childhood trauma or adverse experiences that influence their emotional and neurobiological regulation. In this context, Peter A. Levine's literature on trauma and its bodily manifestations offers a unique perspective for understanding how trauma is stored somatically and can be reprocessed through body-focused interventions. Levine's Somatic Experiencing theory emphasizes the importance of procedural memory and the recovery of bodily sensations in addressing the psychobiological effects of trauma. This research explores the integration of psychoanalytic and neuroscientific models to analyze the behavior of AAS users, with a particular focus on the influence of childhood trauma and unconscious dynamics. An innovative approach proposed is the use of bio-neurofeedback, which could facilitate the regulation of neurophysiological imbalances and promote greater body awareness. The therapeutic implications of these interventions are supported by evidence showing how somatic techniques can effectively regulate the nervous system and reprocess traumatic memories. Through a multidimensional perspective, this article examines the psychological and neurophysiological roots of AAS abuse, proposing an integrated model combining bioneurofeedback and psychotherapeutic interventions to address psychobiological dysfunctions. By linking Tustin's psychoanalytic models with Levine's neuroscientific contributions on the role of implicit memory and somatic regulation, this analysis provides an articulated theoretical framework for understanding and treating this complex issue.

1. Introduction

The use of anabolic androgenic steroids (AAS) is a growing phenomenon with significant implications for the physical and mental health of the individuals involved. While the use of these substances is often interpreted as a simple pursuit of aesthetics or athletic enhancement, the resulting psychological and neurophysiological implications suggest a much more complex picture. Numerous studies highlight that AAS users face not only physical risks, such as cardiovascular issues and liver damage, but also significant psychological distress, including anxiety, depression, and behavioral dependence [1].

Anabolic androgenic steroids are commonly used to increase muscle mass and improve athletic performance, but their impact extends far beyond the physical sphere. Recent studies suggest that body perfectionism, fueled by grueling training sessions and performance-enhancing substance. This could represent a

strategy to address psychological tensions rooted in childhood. Specifically, the hypothesis focuses on the use of the body as a tool to manage deep anxieties stemming from early traumatic experiences, relational difficulties, or emotional deficiencies (ibid.). The construction of an idealized body, far from being mere vanity, can represent a mechanism to compensate for deep insecurities. Scientific literature highlights the connection between compensatory narcissism and childhood traumas, such as familial rejection, the inability to establish boundaries between oneself and others, and unresolved psychological conflicts. For example, body perfectionism can emerge as a response to an environment perceived as hostile, aiming to project a sense of control and security externally [2].

The use of steroids is proposed as an unconscious strategy to address unresolved childhood traumas. Emotional scars may manifest as a need to symbolically strengthen the body, perceived

as weak or vulnerable. This perspective offers a new paradigm for understanding and addressing the behavior of athletes who abuse AAS.

2. Literature Review

The adverse effects of anabolic steroids are well documented in the scientific literature. Studies have shown that AAS abuse is associated with significant behavioral changes, including increased aggression, depression, and psychotic syndromes [1,3]. These adverse effects are often more pronounced in young people, a particularly vulnerable group susceptible to social influences and the search for identity models.

2.1 Clinical and Psychoanalytic Aspects

Clinical cases report how steroid use can be associated with complex psychological dynamics, including:

- **Body Perfectionism:** a tool to avoid emotional "contamination," often fueled by compulsive training (Pope et al., 2013) [4].
- **Body Dysmorphia:** not as a primary cause but as a symptom of psychological distress linked to the discrepancy between real and idealized body images [5].
- **Secondary Dependencies:** anxiety, psychotropic drug use, or eating disorders accompanying this obsessive quest for perfection [6].

Psychoanalytic analysis interprets these behaviors as unconscious attempts to manage deep conflicts, such as the search for parental approval or the handling of complex unconscious fantasies. In this sense, the body becomes a "shield" against perceived emotional danger, but this shield comes at a high cost, both mentally and physically.

2.1.1 Misdiagnoses

Athletes who use anabolic drugs (e.g., bodybuilders, weightlifters, etc.)—or individuals striving for a powerful physique—are often victims of misdiagnoses that interpret their behaviors as simple manifestations of body dysmorphia or body image disorders. However, as Tustin (1981) emphasizes, their journey is influenced by complex psychological dynamics, including the construction of a "bodily fortress" to protect themselves from deep anxieties [7]. The discrepancy between the ideal self-image (forms) and the perceived self-image (shapes). It fuels both a vigorous motivation in training and a constant sense of discomfort. This cognitive process, rather than resolving the conflict, exacerbates it, leading to increased distress that manifests as body dysmorphia. However, this dysmorphia does not represent a primary cause but rather a consequence of a mental framework centered on the need for control and perfection [5].

Extreme training, dietary restrictions, and the use of performance-enhancing drugs become tools for managing such anxieties. Kanayama et al. (2009) highlight that these behaviors are often linked to deep insecurities and early relational traumas, such as the need for parental attention or competition for social recognition [1]. Specifically, the psychoanalytic work of Frances Tustin (1986)

explores how individuals with a fragile self tend to construct physical and psychological barriers to avoid the sensation of "being invaded" [8].

Clinical cases demonstrate that some individuals perceive their body as a battleground, catastrophizing even minor physical imperfections, such as slight water retention or an imperfect muscle shape [6]. Psychoanalytic therapy, as suggested by Lacan (1977), works on the "phantasm" that sustains desire, shifting the focus from the external pursuit of perfection to the management of inner anxieties and the resolution of unconscious conflicts [9]. This approach enables understanding the body as a symbol of relational difficulties and addressing issues at their root.

3. Symptom Layering between the "Me" and "Not Me"

According to Piacentino et al. (2015), AAS abuse among athletes is driven not only by the pressure to compete but also by psychological vulnerabilities [10]. These individuals tend to display reduced coping mechanisms when facing adversity, reflecting childhood traumas or deficits in early relational experiences. The symptom layering observed in bodybuilders who struggle to differentiate the "me" from the "not me," a concept developed by Frances Tustin, represents a critical element in the psychoanalytic analysis of such behaviors. According to Tustin, individuals falling within an autistic order exhibit fragility in the formation of their self, which drives them to seek protective spaces and build barriers to avoid feeling invaded [7]. This mechanism, observable in practices like exhausting workouts, drastic diets, and excessive use of performance-enhancing drugs, is not driven by a mere search for danger but rather by the necessity to minimize an internal threat perceived as greater.

In this sense, the quest for control over external threats becomes a strategy to confront deep internal anxieties, often rooted in Oedipal fixations or early relational traumas. The use of objects by autistic individuals, as described by Tustin, illustrates how such individuals fail to establish a "bridge" between the self and the non-self. This bridge, which remains incomplete for the autistic child due to the terror of losing the object (such as the maternal nipple), underscores a dynamic of insecure attachment and compensatory manipulation aimed at stimulating and controlling hidden aspects of their body rather than forming relationships [8]. This same dynamic can be transposed to the extreme behaviors of bodybuilders, where the construction of physical barriers and the manipulation of the body represent attempts at protection against the sense of psychological precariousness.

3.1 Further Insights

The psychoanalytic concepts of "me" and "not me," introduced by Frances Tustin, describe the difficulty, in some individuals, of differentiating their self from the external world—a condition often associated with early traumatic experiences. These concepts can be integrated with neuroscientific models that explore the sense of self and sensory integration. Neuroscience highlights that the self emerges through the integrated processing of sensory,

bodily, The integration of bodily and emotional signals is a process involving specific brain areas, such as the insular cortex and the anterior cingulate cortex [11].

The difficulty in distinguishing between "me" and "not me" can be explained by dysfunctions in interoceptive regulation, which refers to the brain's ability to monitor internal signals such as heartbeat and respiration. These dysfunctions have been observed in individuals with childhood trauma or developmental disorders, such as autism spectrum disorder (Seth, 2013) [7]. The insular cortex, which integrates internal and external signals, may be either hyperactive or hypoactive in these individuals, making it challenging to perceive the boundary between self and environment. This condition is further explained through models like the "predictive brain theory," which posits that the brain constantly constructs predictive representations of the self and the external world. In individuals with sensory integration difficulties, these representations are compromised, leading to states of anxiety and insecurity. Integrating these neuroscientific models with Tustin's work allows us to understand how the body and brain contribute to the construction of the self and how these processes can be disrupted in the presence of trauma.

These insights offer practical implications for therapeutic interventions, such as bio-neurofeedback, which aims to restore neurophysiological balance and improve bodily awareness, strengthening the sense of self. The use of these techniques allows for addressing self-differentiation difficulties in an integrated manner, combining psychoanalytic and neuroscientific perspectives.

4. From Psychoanalysis to Siegel's Window of Tolerance

Life experiences, rigid upbringing, and family constraints can shape behavior and psyche, pushing individuals toward compensatory dynamics such as body perfectionism or academic and professional success. An emblematic example is Carlo, whose excessive studying is not just an adaptation to parental demands but an unconscious form of revenge: his self-imposed and painful sacrifice becomes a means to punish his parents by forcing them to recognize his distress. These vengeful patterns are reflected in his adult life, where work-related discomfort retains the same structure (S. Finzi, 1996). Similarly, the case of a woman raised by an authoritarian father illustrates how the obsession with perfection and control are defensive strategies to manage frustration and rejection. Her transformation from an "ugly duckling" to a "swan" is driven by an unconscious desire to escape her father's judgment, but the result is narcissistic rigidity, where every action is calibrated to gain external approval [12].

These behaviors can be explained by dynamics of "incestuousness," not as an act but as a psychic bond that holds back inner energy, leading to compensation through training, studying, or the pursuit of perfection. This blockage, described by Finzi, reflects a sense of incompleteness or a deficit of knowledge, where frantic activity becomes a way to anesthetize deep anxieties. Siegel, in

the model of the Window of Tolerance, helps us understand how these individuals oscillate between hyperactivation and emotional collapse. Perfectionism and the need for control are not limited to body image but extend to a psychic construction that represents an autonomous world. However, this apparent independence often masks colonization by internal psychic forces, which transform dreams and ideals into tools of escape rather than change, as demonstrated by the case of Piero and his use of substances to cope with anguish.

5. Intervention Proposal: The Role of Bio-Neurofeedback in Restoring Neurophysiological Balance

Bio-neurofeedback is an innovative approach that uses brainwave monitoring to regulate psychophysiological states. Before initiating psychotherapy, this technique allows for calming the body and balancing neural responses, creating a solid foundation for subsequent psychological work.

Recent studies suggest that bio-neurofeedback can significantly reduce symptoms associated with post-traumatic stress and emotional disorders [13]. This approach is particularly useful for individuals with impaired coping mechanisms, helping them establish an internal sense of security. Bio-neurofeedback represents an emerging therapeutic option to address the psychophysiological issues associated with anabolic androgenic steroid (AAS) use and the underlying psychological dynamics. This technique relies on monitoring brainwaves and regulating them, helping individuals develop greater awareness of their physiological states and restore neurophysiological balance—a balance often disrupted in this population.

The neurophysiological equilibrium in AAS users is frequently compromised, with significant effects on mental health. AAS abuse alters neurotransmitter levels such as serotonin and dopamine, increasing the risk of anxiety, depression, and aggression [1]. These substances also interfere with the hypothalamic-pituitary-adrenal (HPA) axis, destabilizing stress regulation. Studies suggest that excessive physiological arousal contributes to a sense of internal vulnerability, prompting individuals to use exhausting training and rigid diets as control strategies [5]. Bio-neurofeedback and psychotherapeutic interventions focusing on emotional regulation are promising tools for restoring neurophysiological balance in these individuals, improving psychological and behavioral well-being.

5.1 How Does Bio-Neurofeedback Work?

Using sensors applied to the scalp, bio-neurofeedback records brain electrical activity in real time. The collected data is then displayed to the patient as visual or auditory signals, allowing them to consciously modify their mental states. This process aims to:

5.1.1 Reduction of Physiological Hyperactivation

AAS users often exhibit alterations in the hypothalamic-pituitary-adrenal axis and irregular levels of neurotransmitters such as serotonin and dopamine, making them vulnerable to anxiety,

aggression, and depression. Bio-neurofeedback helps regulate neural responses, reducing hyperactivation associated with chronic stress and improving the autonomic nervous system's ability to relax [13].

5.1.2 Increase in Emotional Resilience

The emotional fluctuations common in these individuals can be mitigated through bioneurofeedback sessions. By observing and modulating brainwaves in real time, patients learn to stabilize their emotional states, enhancing their ability to manage external stimuli and reducing reliance on exhausting training or performance-enhancing drugs to achieve a sense of control.

5.1.3 Prevention of Stress and Muscle Dysmorphia Cycles

Bio-neurofeedback enables patients to recognize and break dysfunctional cycles that drive them toward compensatory behaviors such as compulsive training or dietary restrictions. By providing continuous feedback on brain activity, this technique teaches individuals to identify and manage states of hypervigilance or dissociation.

5.1.4 Integration with other Therapies

When combined with psychotherapy, bio-neurofeedback can enhance analytical work on childhood trauma or patterns of unconscious revenge, helping patients explore the roots of their anxieties. This integration is particularly beneficial for addressing deep-seated distress related to insecurities or difficult family relationships.

5.2 Bio-Neurofeedback and Childhood Trauma Associated with Neurophysiological Dysfunctions

According to Peter A. Levine, traumatic memories are often encoded not at the explicit level but at the implicit level, anchored in bodily sensations, motor patterns, and physiological responses [14]. Through bio-neurofeedback, it is possible to facilitate greater bodily awareness by helping patients monitor and directly regulate the activation of the autonomic nervous system. This is particularly relevant for cases where patients struggle to verbally access their traumatic experiences. Using physiological signals such as heart rate variability, skin conductance, and brain activity, bioneurofeedback helps identify bodily states associated with implicit memories and develop new selfregulation methods [15].

This technique integrates effectively with somatic approaches such as Somatic Experiencing, as both aim to restore a sense of safety within the body. Levine emphasizes that gradually addressing the somatic traces of trauma without overloading the nervous system allows for safe and effective reprocessing [16]. By regulating physiological activation, bio-neurofeedback supports the integration of traumatic memories, transforming automatic responses of hyperactivation or dissociation into states of greater balance. Additionally, clinical studies indicate that bio-neurofeedback can significantly reduce symptoms of Post-Traumatic Stress Disorder (PTSD) and improve bodily awareness, enabling patients to recognize their physiological responses

to trauma and develop more effective coping strategies [17]. These findings underscore the potential of bio-neurofeedback as a key component of an integrated intervention that includes psychoanalytic and neuroscientific models.

The psychological roots of AAS use, as suggested by psychoanalytic perspectives, are often tied to childhood traumas and difficulties in emotional regulation. Bio-neurofeedback proves particularly useful in:

- **Establishing a Sense of Internal Safety:** by regulating hyperactivation of the autonomic nervous system, this technique helps reduce symptoms like chronic anxiety and emotional tension.
- **Facilitating Trauma Reprocessing:** by preparing the patient for more effective psychotherapy, reducing physiological and emotional barriers to change.
- **Supporting the Management of Body Dysmorphia and Perfectionism:** these disorders can be linked to altered body perception and psychophysiological dysregulation, which bioneurofeedback helps to correct.

5.2.1 Childhood Trauma and its Impact on the Nervous System and the HPA Axis

Childhood traumas have a profound impact on the nervous system, altering its development and regulation. Early experiences, including abuse, neglect, or relational dysfunctions, directly affect the autonomic nervous system (ANS) and stress circuits, causing persistent dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis. This dysregulation often manifests as either a hyperactive or insufficient response to stress stimuli, increasing vulnerability to disorders such as anxiety, depression, and impulsivity. Studies by Van der Kolk (2014) have shown that individuals with a history of trauma exhibit significant alterations in brainwaves: an increase in beta waves, associated with hyperactivation and anxiety, and a reduction in alpha waves, linked to relaxation and calmness [18]. These changes make it difficult for the brain to return to a balanced state after a stressful event.

HPA dysregulation, as described by Gunnar and Quevedo (2007), contributes to a state of chronic hyperarousal, characterized by overproduction of cortisol or, in some cases, a suppressed stress response [19]. This state of perpetual alertness can negatively affect memory, learning, and cardiovascular health. Moreover, the continuous imbalance of the HPA system can interfere with the consolidation of an internal sense of safety, making individuals particularly vulnerable to developing dysfunctional compensatory strategies.

Bio-neurofeedback proves especially useful in treating these dysfunctions, as it allows for real-time monitoring of brain electrical activity and provides feedback to regulate dysfunctional patterns. For instance, through targeted exercises, patients can learn to reduce beta activity and increase alpha activity, improving their ability to relax and handle stressful stimuli. This modulation is crucial for restoring the neurophysiological balance disrupted

by childhood trauma. The integration of this technique with psychotherapeutic interventions, such as trauma reprocessing, offers a holistic approach to addressing both the psychological roots and the neurophysiological manifestations of trauma.

5.2.2 Scientific Evidence

Existing studies highlight the particular effectiveness of bio-neurofeedback for trauma-related and emotional stress disorders:

- **Thiblin and Petersson (2005):** Demonstrated that this technique significantly reduces symptoms of Post-Traumatic Stress Disorder (PTSD), often observed in individuals with a history of childhood trauma [13].
- **Gruzelier (2014):** Emphasized the role of bio-neurofeedback in optimizing cognitive functions and alleviating emotional symptoms, making it a suitable tool for patients dealing with complex internal conflicts [20].
- **Hammond (2005):** Reported clinical improvements in areas such as anxiety, depression, and disorders related to emotional dysregulation, highlighting its application in complementary psychoanalytic interventions [21].

5.3 An Integrated Approach

Using bio-neurofeedback as a preliminary phase to psychotherapy allows the creation of a solid neurophysiological foundation upon which psychological work can be built. This integrated approach can include:

- **Psychoeducation:** Raising patient awareness about the impact of trauma and stress on brain function and bodily awareness.
- **Bio-Neurofeedback Sessions:** Reducing physiological hyperactivation and promoting more balanced mental states.
- **Psychoanalytic or Cognitive-Behavioral Psychotherapy:** Addressing deep dynamics and cognitive distortions within a psychophysically stabilized environment.

6. Discussion

The results presented indicate that the use of anabolic androgenic steroids (AAS) is often rooted in unresolved childhood trauma, leading to deep psychological conflicts and neurophysiological imbalances. Scientific literature, including the perspectives of Tustin and Siegel, links difficulties in differentiating "me" and "not me" with alterations in sensory integration and neural responses to emotional stimuli. These factors contribute to a distorted perception of the bodily self and obsessive perfectionism, making AAS use associated with psychological distress such as anxiety, depression, and aggression. Kanayama et al. (2009) highlight that AAS abuse can lead to dependencies and behavioral changes [1]. Pope et al. (2013) connect muscle dysmorphia to deep insecurities and body image disorders. Studies by Olivardia et al. (2000) underline how AAS use can stem from childhood trauma and narcissistic needs for control [6]. Tustin (1981) examines psychological barriers, suggesting that the construction of the ideal body serves as a defense against inner fears [7].

Bio-neurofeedback emerges as a promising intervention, allowing patients to regulate brainwaves and restore neurophysiological balance. Studies indicate significant reductions in symptoms such as anxiety and body dysmorphia, along with improvements in emotional resilience. However, the effectiveness of bio-neurofeedback depends on its integration with other therapies, such as psychoanalytic or cognitive-behavioral psychotherapy, to address the psychological roots of distress.

Standardization of intervention protocols and further research are necessary to evaluate long-term outcomes. Using bio-neurofeedback as an initial therapeutic step could represent a breakthrough in treating disorders related to AAS abuse, especially in populations with childhood trauma.

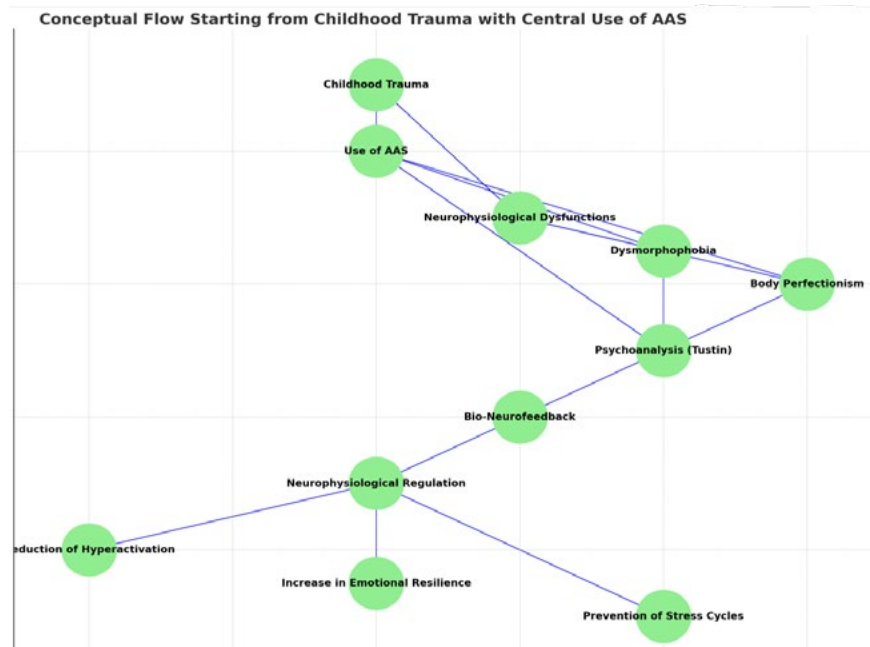


Figure 1

The figure illustrates a conceptual flow starting from childhood trauma, with the use of AAS (anabolic androgenic steroids) as the central node. The diagram connects topics such as neurophysiological dysfunctions, body dysmorphia, body perfectionism, and interventions like psychoanalysis (Tustin) and bio-neurofeedback. Other connections involve neurophysiological regulation, reduction of hyperactivation, increased emotional resilience, and the prevention of stress cycles. The blue lines represent relationships between key concepts.

7. Conclusions

This article proposes a new paradigm for understanding the abuse of anabolic androgenic steroids, linking it—though not universally—to childhood trauma and neurophysiological dysfunctions. The integration of bio-neurofeedback into therapeutic pathways offers an innovative strategy to regulate psychobiological imbalances and improve individuals' overall well-being. By combining brain monitoring with psychotherapeutic interventions, it is possible to address not only the symptoms but also the underlying causes of these behaviors. Neurophysiological regulation creates optimal conditions for a comprehensive healing process that integrates emotional balance with mental health [22-25].

References

1. Kanayama, G., Hudson, J. I., & Pope Jr, H. G. (2009). Features of men with anabolic-androgenic steroid dependence: A comparison with nondependent AAS users and with AAS nonusers. *Drug and alcohol dependence*, 102(1-3), 130-137.
2. Goldfield, G. S., Blouin, A. G., & Woodside, D. B. (2012). Body image, disordered eating, and anabolic steroid use in male bodybuilders: A review. *International Journal of Eating Disorders*, 32(3), 291-296.
3. Bertozzi, G., Salerno, M., Pomara, C., & Sessa, F. (2019). Neuropsychiatric and behavioral involvement in AAS abusers. A literature review. *Medicina*, 55(7), 396.
4. Scarth, M., Westlye, L. T., Havnes, I. A., & Bjørnebekk, A. (2023). Investigating anabolic-androgenic steroid dependence and muscle dysmorphia with network analysis among male weightlifters. *BMC psychiatry*, 23(1), 342.
5. Grieve, F. G. (2007). A conceptual model of factors contributing to the development of muscle dysmorphia. *Eating disorders*, 15(1), 63-80.
6. Olivardia, R., Pope Jr, H. G., & Hudson, J. I. (2000). Muscle dysmorphia in male weightlifters: A case-control study. *American Journal of Psychiatry*, 157(8), 1291-1296.
7. Tustin, F. (1981). *Autistic States in Children*. London: Routledge.
8. Tustin, F. (1986). *Autistic Barriers in Neurotic Patients*. London: Karnac Books.
9. Lacan, J. (1977). *Écrits: A Selection*. New York: Norton.
10. Piacentino, D., D Kotzalidis, G., Del Casale, A., Rosaria Aromatario, M., Pomara, C., Girardi, P., & Sani, G. (2015). Anabolic-androgenic steroid use and psychopathology in athletes. A systematic review. *Current neuropharmacology*, 13(1), 101-121.
11. Craig, A. D. (2009). How do you feel—now? The anterior insula and human awareness. *Nature reviews neuroscience*, 10(1), 59-70.
12. Castiglia, G. (1990). *Frances Tustin. Barriere autistiche nei pazienti nevrotici*. Roma: Borla.
13. Thiblin, I., & Petersson, A. (2005). Neuroendocrine and behavioral effects of anabolicandrogenic steroid use. *The Journal of Steroid Biochemistry and Molecular Biology*, 93(25), 133-139.
14. Levine, P. A. (2015). *Trauma and Memory: Brain and Body in a Search for the Living Past*. North Atlantic Books.
15. Payne, P., Levine, P. A., & Crane-Godreau, M. A. (2015). Somatic experiencing: using interoception and proprioception as core elements of trauma therapy. *Frontiers in psychology*, 6, 93.
16. Levine, P. A. (2010). *Healing Trauma: A Pioneering Program for Restoring the Wisdom of Your Body*. Sounds True.
17. Heller, D. P., & Heller, L. S. (2002). Somatic Experiencing In the Treatment of Auto Accident Trauma. *The USA Body Psychotherapy Journal*.
18. Van der Kolk, B. A. (2014). The body keeps the score: Brain, mind, and body in the healing of trauma.
19. Gunnar, M., & Quevedo, K. (2007). The neurobiology of stress and development. *Annu. Rev. Psychol.*, 58(1), 145-173.
20. Gruzelier, J. H. (2014). EEG-neurofeedback for optimising performance. I: A review of cognitive and affective outcome in healthy participants. *Neuroscience & Biobehavioral Reviews*, 44, 124-141.
21. Hammond, D. C. (2005). Neurofeedback treatment of depression and anxiety. *Journal of Adult Development*, 12, 131-137.
22. Freud, S. (1920). *Beyond the Pleasure Principle*. London: The International Psychoanalytical Press.
23. McEwen, B. S. (2007). Physiology and neurobiology of stress and adaptation: central role of the brain. *Physiological reviews*, 87(3), 873-904.
24. Sapolsky, R. M. (2004). *Why Zebras Don't Get Ulcers: The Acclaimed Guide to Stress, Stress-Related Diseases, and Coping*. New York: Henry Holt and Company.
25. Siegel, D. J. (1999). *The Developing Mind: How Relationships and the Brain Interact to Shape Who We Are*. New York: Guilford Press.

Copyright: ©2024 Claudio Lombardo. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.