Behavioural Neurology of Personality Disorders: A Bi-dimensional Model

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Abstract

This study explored a new scientific approach for analysing mental disorders, as a possible way to modernise Kraepelinian psychiatry, using neurobehavioral principles to develop a model of personality (and personality disorders), as an example. The model uses a two-dimensional approach (behavioural and pathophysiological) to define personality disorders, instead of the prevailing one-dimensional (behavioural) approach used in Kraepelinian psychiatry. The model is also biological, socio-neurodevelopmental, and dimensional (non-categorical) and aims to integrate with clinical principles to the extent possible. The model begins from a platform of three origins of personality and personality disorders: basic skills (visceral, physical, and emotional and social intelligence), maturity, and environment. The model incorporates modern discoveries of neurosciences and makes them more amenable to clinical practice.

Introduction

Personality disorder (PD) is a vital clinical concept that is crucial for everyday practice in mental health fields. It intersects vitally with almost all mental disorders and behaviour in general as well as every coping behaviour, include coping with mundane and physical health needs [1-4].

Despite the considerable body of publications and research in this field, clinicians still find it difficult to grasp and use the concept of PD in everyday practice. The dispute regarding the dimensional classification of PD in the DSM 5 is a good example of this [5-7]. Meanwhile, clinical diagnoses of individual patients are usually open to much disagreement between clinicians [8].

Many of the models of PDs have problems, including being too narrow in scope, being developed primarily for use in psychometric tests rather than clinical settings, or being excessively adapted to one particular theoretical model at the expense of other schools of thought. Another frequent criticism that these models are vague, open to subjectivity bias, and can be confused with cultural and social attributes that are independent of biological references. This problem has raised concerns about 'over-medicalization' of social and cultural phenomena [8-11].

The current study proposes an example of a model of PD that is more consistent with modern scientific thinking and more clinically meaningful. It also draws attention toward neurobehavioral approaches in studying 'functional' mental disorders. However, this provisional model is also open to further modifications and development.

The effects of specific anomalies on personality (e.g. particular genetic syndromes, neurological disorders, or environmental events) are beyond the scope of this model and better considered in the context of individual disorders. However, if there a specific such matter that is essential to explain further the model, it is addressed in a separate box.

The principle dimensions of the model

The primary biological principle: it has been established that neurobiological factors, including genetic factors, play a significant role in the aetiology of pd [12-18]. Further, several twin studies have found that traits related to positive aspects of personality, such as altruism and pro-sociality, are significantly heritable, although environmental factors continue to be the most significant influences in this respect [19-23].

That psychiatry frequently intersects with other fields of humanistic studies, such as psychology, sociology, philosophy, and even religion, does not change the nature of psychiatry as a medical discipline concerned primarily with biological phenomena.

Unfortunately, one of the difficulties with modern psychiatry in the 20th century—Kraepelinian Psychiatry—is the excessive reliance on behavioural symptoms (phenotype) as the main principle for diagnosis and classification of mental illnesses. This approach has partially created room for confusing primarily biological mental disorders with other, non-biological, similar phenomena. The approach may have also contributed to confusing mental disorders with other independent physical health problems with a similar behavioural presentation [24,25].

In recent decades, there has been a massive expansion in discoveries in neurosciences that make the biological principle possible and necessary. However, laboratory studies need complementary clinical, hospital-based, evidence for these studies to continue developing [26-28].

The neurobehavioural principle: This principle follows the traditional neurological and neuropsychological trends in using structural and functional models of the brain in understanding and classifying brain disorders. It also follows the 'Model of Hierarchical Complexity' [29] and the 'Spiral Dynamics' model [30] in understanding hierarchies and developmental models relevant to the development of

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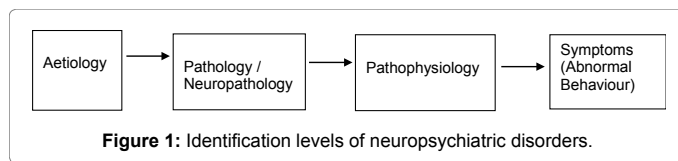
Figure 1: Identification levels of neuropsychiatric disorders.

personality and PDs.

Within this frame, mental disorders, like other neurological disorders, go through certain levels of evolution and have different state-based classifications (Figure 1). These levels are aetiology, neuropathology, pathophysiology, and symptomatology [31,32].

Kraepelinian psychiatry, including DSM and ICD classifications, relies predominantly on the behavioural level [symptoms] in the diagnosis and classification of mental illnesses. Although this was the best possible scientific system in Kraepelin's time, modern psychiatry can advance, especially with respect to the pathophysiological level [31,33-36].

Identifying psychiatric illnesses through behavioural changes and pathophysiology is one of the criteria of the neurobehavioral model used in this study. Such an approach should incorporate environmental factors, as they impact neural circuits (Figure 2) in the same way that trauma, heat exhaustion, and nutritional disorders are factors in classical neurological disorders.

Such a way of identifying mental health abnormalities could bring psychiatric phenomenology one step closer to the other landmarks in the pathology stages, i.e., the specific neuropathology and finally the specific neuro-aetiology.

The neurodevelopmental principle: Studies of genetic aspects of PDs, early expression of personality traits in childhood, human development studies, and other studies, constitute reasonably valid evidence that PDs are also neuro-developmental disorders. PDs have a primary biological (e.g. genetic) basis, start to express themselves in childhood, and they have stable characteristics during the whole life of the affected person [36-42].

Social developmental principle: There are many different strategies by which to address human development and personality development, e.g. intellectual, psychosexual, communicational, and moral. The current model intentionally uses the social axis of development as the most fundamental axis of development of humans, as it leads to the highest levels of functioning, i.e., creating a civilised society [43,44]. However, adopting the social axis as the core axis of development of personality does not mean neglecting other aspects of development or ignoring their direct or indirect significance (e.g. memory, cognitive learning, and motor coordination).

The clinical principle: A clinical approach is used in this model as a primary scientific tool to restructure academic data, to bridge the gaps in the published literature, and to avoid making this model more academic than necessary. One of the criteria for choosing the structures and systems in this model are how clinically relevant they are.

The dimensional principle: This model is meant to be primarily 'dimensional' and not 'categorical'. Individuals with PD can have any constellation of dysfunctional systems and subsystems, which make adopting one particular categorical diagnosis too restrictive [6,45-47]. However, this does not mean abandoning the categorical classifications yet, especially from the clinical needs point of view. Instead, the model marries both systems and avoids the limitations associated with either
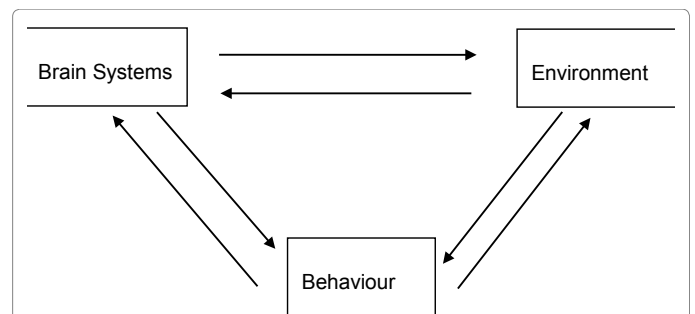

Figure 2: Interactions between biology, environment, and symptoms of neuro-psychiatric disorders.

[48-50].

The basic structures and components of the model

The brain as the organising centre of human functions can vary in complexity and uniqueness between individuals. This model divides brain functions into systems, subsystems, and microsystems, depending on the levels of complexity and centrality. The term 'systems' refers to major or global brain functions that try to achieve strategic goals, while 'subsystems and microsystems' refers to brain functions more limited in scope or influence.

This model also identifies basic determinants of personality that explain most of the features of personality functioning and PDs. These determinants are:

- Constitutional brain systems and subsystems

- Brain maturity
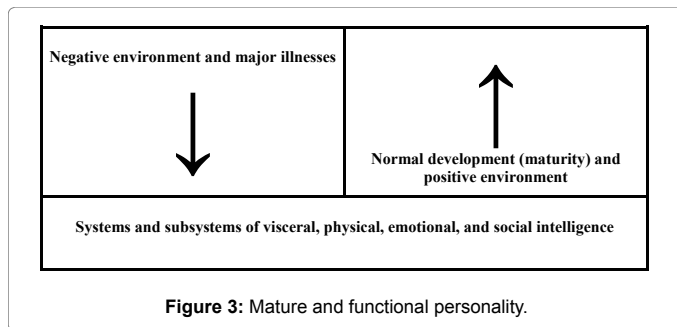
- Environmental influences on the brain

The main constitutional systems of the brain adopted in this model are

- Visceral intelligence

- Physical (object-related) intelligence

- Emotional (Individuality-related) intelligence

- Social (social abstract-related) intelligence

The above systems and their subsystems mature during development in the first two decades of human life. These maturity stages include

- Physiological autistic stages: Age 1–3 years

- Autonomic/visceral focused autistic stage: Age 0–1 year

- Physical/object-focused autistic stage: Age 1–3 years

- Narcissistic emotional stage: Age 3–5 years

- Social integration stages: Age 5–18+ years

- Concrete social stage: Age 5–10 years

- Narcissistic social stage: Age 10–15 years

- Symbiotic altruistic social stage: Age 15–18 years

- Expansive Altruistic social stage: Age 18+ years

While maturing, the individual also interacts with the environment, which can influence the brain systems as well as the maturity process in negative, positive, or other varieties of normality. Negative

Figure 3: Mature and functional personality.

environmental influences can create permanent or temporary changes in personality, depending on age, severity, and duration of exposure to the negative influence.

Details of the background neurobiological aspects of these systems or subsystems are too extensive and complex to be covered in the limited space used to describe this study. However, here, focus is on the clinical aspects of the neurobehavioural model adopted. References are provided to such background data, as appropriate (Figure 3).

Primary Systems (Intelligences)

The classifications of brain systems in this model are inspired primarily by Paul MacLean's triune brain theory [51]. However, many clinicians and neurobiology researchers have proposed the idea of 'multiple intelligence' [52-58].

The human brain is known to follow a distinct spatial and temporal pattern of maturation that begins with phylogenetically older posterior and inferior regions and then progressively extends to more anterior and superior regions [59-61]. That is, the brain stem and cerebellar regions myelinate before the cerebral hemispheres, and the frontal lobes myelinate last. This process may reflect regional patterns of functional maturation [62], consistent with the developmental stages and contexts mentioned above, and as explained in triune brain theory [51].

The model adopted in this study identifies the primary systems (intelligences) as specialised systems, processing specific types of data at the particular developmental stage to achieve strategic functions including identifying, monitoring, analysing, predicting, manipulating, responding, and learning about such types of data [51,63].

Another way to identify the primary intelligence is to trace the basic contexts the brain encounters during human developmental stages. One possible approach is to identify four particular functional and developmental contexts:

– The individual's body (visceral context), which is processed by **visceral intelligence.**

– The environment, which consists of objects and space (physical context) and is processed by **physical (object-related) intelligence.**

– The environment made of unique or significant individuals (emotional context), which is processed by **emotional intelligence.**

– The environment made of abstract (un-individualised) social bodies (social context), which is processed by **social intelligence.**

In this model, personality consists of the sum of the above dimensions: the four intelligences, including the effects of environment and maturity on them. Each type of intelligence enhances the others,

Figure 4: Integration between the four types of intelligence.
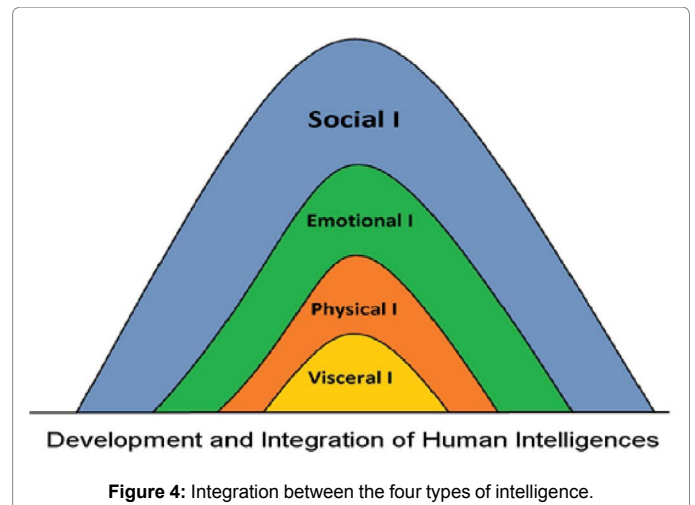
integrates with them, and adds to their efficiency (Figure 4) [51].

When a particular intelligence (system) fails to develop adequately, this failure is reflected in the literature in the form of developmental disorders, PDs, or learning disabilities. However, 'systems' are not the same as cognition, and intelligence in this model is not the same as intelligence as identified by academic abilities. A system or intelligence in this model must have two main characteristics:

- **Adaptive:** Supports adequate survival and functioning in the immediate environment.

- **Developmental**: Instrumental in facilitating further progression into higher forms of development to higher levels of social maturity.

Biological extremism: dimension-imbalance disorders

In this model, normal development necessitates a degree of balance between the four dimensions of personality that permit their main function, namely to create a civilised society. For example, a dysfunctional emphasis on 'visceral' needs could include misuse of psychoactive substance and extreme forms of sexual practices. Dysfunctional emphasis on 'physical' needs might include extreme forms of hoarding. However, the balance between social and emotional dimensions is of unique significance to human development. Those two dimensions are the foundations of two of the most important aspects of human functioning, namely emotional and social engagement. These dimensions play a vital role in the marked human advances that have occurred over a few thousands of years, compared to species that have lived in almost the same way for millions of years. Meanwhile, mental health problems shed light on other vital aspects of those dimensions, as pertaining to current concerns of humanity. Quantitatively, individuals who lack emotional intelligence (e.g. antisocial PD), those who lack social intelligence (e.g. schizoid PD), and those who lack both (e.g. autism) are far less functional than healthy individuals. From the balance perspective, individuals need adequate emotional intelligence to be capable of possessing adequate social intelligence. Having advanced social intelligence without adequate emotional intelligence (e.g. in anti-social PD) is still highly disabling. However, a lack of such balance in some forms of highly functional autism may reveal another unique phenomenon that resembles 'biological extremism'. If individuals have adequate or high physical intelligence and relatively low social and emotional intelligence, as in some cases of highly functional autism,

they try to compensate by using their high cognitive abilities to create better social functioning. In such cases, the newly developed social intelligence is more mechanical, being cognitively balanced rather than emotionally balanced (heartless social intelligence). When such individuals also have poor tolerance of stress and poor problem-solving skills, a behaviour akin to 'biological extremism' can emerge. Such individuals, when faced with a serious social challenge or when trying to adopt a complex social conviction, replace healthy social intelligence with this mechanical logic, which suits physical objects more than emotional or social reality. Examples from clinical experience and media reports include;

1. 'Mercy' killing of old parents to protect them from suffering for being too old and frail.

2. Setting fires to support the fire brigade and highlight their importance in society.

3. Attempting to kill numerous Christian politicians because they allow 'bad Muslims' to live in a Christian country.

The above forms of 'biological extremism' are usually influenced by other associated pathologies, such as strong obsessive traits.

It is also possible to argue that some forms of socially and culturally determined extremism develop because of adopting this autistic style of functioning—i.e., making social decisions using heartless mechanical logic, even if it stands in complete opposition to simple forms of empathy or appreciation of human feelings.

Subsystems

Each brain system (intelligence) contains subsystems and microsystems. Each single subsystem and microsystem serves a particular smaller function. When added, they together achieve the global function of the larger system as explained above. However, if one or two microsystems are dysfunctional, the larger system might not fail but it can be partially affected. Such partial failure can manifest itself in the form of stress or disturbed homeostasis and can trigger homeostatic responses or defences (including behavioural responses), which are usually more biological in nature, smaller in magnitude but more adaptive [64].

In this model, the focus is on systems and subsystems but not microsystems. 'Microsystems' are numerous and well covered in neurology, neuropsychology, and neurophysiology, and their details are beyond the scope of this study. Additionally, this model must focus on structures with relatively larger, unified, and integrative functions to sustain clinical meaningfulness.

It appears clinically valid to divide subsystems into two main groups:

– **Background supportive subsystems**: The first group of these subsystems is genetic and reflexive. However, they keep growing with maturity and environmental interactions and continue to perform their supportive functions in all stages of development.

– **Central executive subsystems:** These are highly specific to principle functions of large systems. They are central, directional, and qualitative in effect. The executive subsystems of early stages grow to become supportive background subsystem for later maturity stages.

Mental homeostasis and personality

Mental homeostasis is part of general physiological homeostasis in the body. It is the system that contains necessary parameters, monitors, and corrective mechanisms for any disturbances of a set biological equilibrium [65].

Clinically, mental homeostasis can be divided into 'internal (constitutional) homeostasis' where the equilibrium is directly maintained by internal factors and 'external (environmental) homeostasis' wherein the equilibrium is indirectly maintained by specific environmental factors [66].

Personal Homeostatic Patterns: Mental homeostatic parameters differ from one individual to another, which makes them a possible expression of personality or PDs. However, the concept of personality has a complex behavioural structure and larger environmental references. Homeostatic patterns are more limited; they are isolated from each other and largely reflexive.

Visceral Intelligence

This intelligence is focused on establishing several fundamental functions including:

– Establishing the child's body as an independent biological entity separate from the mother.

– Launching the basic biological subsystems, as written in the genetic code, and putting them in a working form consistent with basic survival modes.

– Enhancing human development by allowing the brain to use the basic visceral systems to evolve into qualitatively higher formats consistent with maturity.

The visceral subsystems will also form one basic part of the identification codes for the individual's biologically determined nature, which, in turn, will affect the individual's future choices, interactions, and tendencies.

Poor visceral intelligence can manifest itself as 'physical' health problems. However, if ignored or overlooked, it can also clash with the infant's general functioning in the environment and his or her development.

Background supportive subsystems (Table 1)

General alertness: The concept of 'alertness' in this model refers to sustained brain functions that help the individual to have adequate levels of awareness as well as preparedness to respond to the environment. In this model alertness (tonic alertness/tonic attention) does not mean vigilance (phasic alertness), as vigilance has extra elements related to expectation of danger and danger-related anxiety/fear [67]. Additionally, in this model alertness does not mean attention (executive attention) as executive attention is proactive rather than

S.No	Background Supportive Subsystem	Visceral Central Executive Subsystem
1.	Alertness	Proactive Sensory-Motor Subsystems
2.	Attention (Executive) Subsystems	Mirroring
3.	Filtering Subsystems	Clinging
4.	Capacity (for data processing) Subsystems	
5.	Drive Subsystems	
6.	Impulses Control Subsystems	
7.	Satisfaction/Temperament Subsystems	
8.	Fight–Flight Subsystems	

Table 1: Background supportive subsystem.

reactive, unlike alertness [68].

Clinical observation suggests that different individuals have different styles of alertness, which is observable from a young age, with some consequences for general functioning [69]. Slight abnormalities in alertness contribute to the formation of personality style and PDs, but severe forms would be part of major neuropsychiatric illnesses.

Individuals have a spectrum of alertness styles, which in addition to 'average' alertness include 'low', 'dissociative', 'enforced', and hyper-alertness levels.

Other patterns of alertness

Low alertness: This phenomenon is frequently present in disorders such as learning disability, autism, chronic schizophrenia, and dementia. However, it also possible to observe the phenomenon in individuals without such disorders, or with disorders that currently cannot be formally diagnosed, such as borderline PD [70]. It is more likely that such individuals have other primary or secondary difficulties including low drive or below average cognitive skills. If this is a genetically determined form of alertness, the individual has to cope by adopting their patterns of functioning to cope with this low alertness, which practically consists of slowing brain functioning down, avoiding highly challenging activities, and relying on external help. Other individuals might cope by increasing their low alertness by using their willpower, thus compensating in a similar way to hyper-alertness. This means that such individuals usually function either with a low level of alertness or in a hyper-alert state, with no intermediate option, which can be exhausting. Individuals with low alertness are more susceptible to complications including misuse of stimulant psychoactive substances, somatisation, or hypochondriasis as a way to enhance self-esteem, and these individuals have a higher chance of being misdiagnosed with depression if the issue of low alertness is overlooked.

Reinforced alertness: Some individuals are equipped with low, but still reinforced, alertness, via certain coping mechanisms as usually seen in ADHD [71-73]. It is possible that the brain compensates for low alertness by increasing brain stimulation through relaxing normal brain inhibitory mechanisms (e.g. filtering of perceptual data or stimuli, motor inhibition, emotional inhibition, and impulse control) to help capture more stimuli, enhance alertness, and subsequently preparedness [74,75]. In later developmental stages, these compensatory mechanisms turn into particular personality and behavioural trends that can lead to complications, such as over-dramatisation, misadventures, higher exposure to trauma and stress, a relative reduction in productivity due to procrastination, and higher vulnerability to abuse and exploitation [76].

Hyper-alertness: The balance between daily needs for alertness at times and dissociation at other times can be biologically shifted either way with consequences for personality functioning. In the case of hyper-alertness, the shift is toward increasing tonic alertness. This phenomenon can enhance some aspects of functioning (e.g. being more work focused, efficient, and committed) or be detrimental to functioning (e.g. being over-controlling and rigid). Hyper-alertness can also vary between mild and severe. The greater the severity, the greater the complications.

Dissociative alertness: In this case, the balance mentioned above leans towards dissociation and avoidance of functionality. Again, this characteristic can be positive at times (e.g. being laid back, relaxed, and friendly) or negative (e.g. lazy, day-dreamer, unfocused, and unreliable). This tendency can again range from mild to severe. One

important example of severe dissociative alertness manifests in cases of 'Pseudologia Fantastica', in which the individual becomes almost addicted to living in a fantasy world despite being cognitively able to differentiate between fantasy and reality [77].

Attention (executive): Attention is the ability to adequately screen and monitor internal and external data that are necessary for functioning. Infants start life with automatic attention to simple stimuli like light, sound, warmth, pain, and hunger. However, they gradually learn how to be selective to more relevant stimuli, such as data related to homeostatic disturbances like harmful stimuli [78]. Over time, attention as a function develops further and is used in developing other complex skills, including communication and social skills [79,80].

Part of this process is the ability to use filtering to differentiate between different categories of stimuli (i.e., selective attention) [81] and develop different simultaneous responses (i.e., divided attention) [82].

Individuals vary significantly in their levels of attention [79] both quantitatively and qualitatively [80]. During developmental years, attention becomes more and more selective to stimuli (Individualistic Triggers Map/Pattern), which could influence, consciously or pre-consciously, the individual's choices and responses.

Filtering (selective attention): 'Filtering' is the ability to ignore or isolate irrelevant or less relevant distracting data outside of the attention sphere, to permit functioning and processing relevant data and to maximise efficiency [68,83-85].

Most of the irrelevant data are totally ignored or removed from attention or even from consciousness. For example, the data that an individual is wearing a wrist watch or sitting on a black leather seat, may be removed while attention is directed toward more important matters.

However, some other distracting data are still labelled 'relevant' or 'partially relevant' but have to be temporarily isolated from the attentional sphere, as they are not priority data. Later, these isolated data may be brought back into attention, for adequate processing. For example, an individual might receive a remark from his or her supervisor during a busy working day, which the individual suddenly realises was an insult just before falling asleep (affect-biased attention) [86]. As for attention, data filtering depends on other brain functions like homeostasis, executive functions, memory, emotional labelling, and satisfaction.

Individuals vary widely in their basic or development-related filtering skills [78]. Some are quantitatively poor in filtering skills, such as individuals with ADHD, which makes them distractible and over-inclusive. In qualitative terms, individuals with poor affect-based filtering can be more predisposed to negative emotional states, including anxious and depressive reactions [87].

Adaptability (data processing): Adaptability is the brain's ability to manage data-related challenges and develop inner systems to either survive, manage, or control these challenges. It includes concepts like 'data processing', 'analysing', 'memory', 'learning', and 'problem solving'. However, at this stage, these are still simple, physiological functions rather than cognitive processes [88-90].

Academic success and intelligence measures (high IQ) can significantly reflect adaptability. However, such measures need other measures such as functionality, adaptability to the environment, and ability to progress further in maturity to establish their validity. The need for multidimensional measures to properly assess adaptability is

reflected in modern assessments of intellectual difficulties. Examples include the American Association on Intellectual and Developmental Disabilities (AAIDD), the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), and the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) [91-94].

Data processing capacity: 'Capacity' refers to how much data of any affective tone the brain can process at one time [95] before reaching the point of homeostatic disturbance or even becoming 'overwhelmed' [96].

When the mental capacity to process data is inadequate, this can initially lead to homeostatic disturbances or stress reactions. If the stress on mental capacity is severe enough to exceed certain thresholds, this can lead to **overwhelmed capacity**, when the individual fails to function cognitively, emotionally, and/or behaviourally, as is seen in dissociative reactions [97].

However, there is another related aspect that is receiving increasing clinical attention as a major risk factor, namely vulnerability to stress [36,98,99] or 'mental resilience' [100-102]. One particular concept that is relevant to both vulnerability to stress and resilience is that of a 'low threshold for overwhelmed capacity'.

Low threshold for overwhelmed capacity: The literature usually refers to this phenomenon in the context of studies of general vulnerability to stress, resilience, and risk factors for disorders like post-traumatic stress disorder [PTSD] and depression [103-105]. Individuals with such problems can become unable to tolerate an average everyday rise in the quantity or quality of challenging data. This includes both exciting and stressful data. Individuals with mild-to-moderate forms of this problem would normally be able to deal with such difficulties through coping skills like 'stress tolerance' and 'problem-solving'. However, severe cases might lead to coping difficulties including:

Excessive avoidance or **excessive suppression** of challenging data, which is usually associated with negative effects on mood and functioning.

Internal reinforcement of capacity: This includes excessive preparation, cognitively, emotionally, and via gradual exposure [106,107].

External reinforcement of capacity: This includes deliberately using external help when feeling vulnerable [108,109]. However, this carries with it the risk of over-dependence on others.

'Low threshold for overwhelmed capacity' is a significant vulnerability factor. Some individuals with this problem can develop serious pathology, such as PTSD or depression, in response to even low levels of stress or trauma. In some cases the point of becoming overwhelmed can be reached even due to positive events, such as a young child with a learning disability or autism having too many positive options from which to choose.

Drives: It is possible to use 'drives' interchangeably with other concepts like 'skills' and 'volition'. In this model, drives intersect with these concepts but are a more basic and static ability of the individual than skills, which are dynamic and rapidly evolving. Volition, is also avoided here as it can be confused with 'motivation'.

In this model, while motivation is used to mean the desire to reach a goal or satisfy a need, drives are used to mean the ability to transform motivation into an action. Motives then decide the direction of behaviour while drives decide the effort expended on the behaviour.

Drive states vary from 'placidity' to 'rage'. Disturbances of drive subsystems are usually referred to in the context of concepts such as 'clumsiness' (e.g. clumsy child syndrome) [110], dyspraxia [111-113], developmental coordination disorder [114], amotivational disorders [115], abulia [116], or apathy [117]. However, these concepts are also related to other acquired pathologies as well as abnormalities in other basic brain systems, such as cognitive abilities, mood, the capacity to process data, coordination, and learning.

Drives have many essential components including energy, momentum, executive skills, and recovery (before getting ready for the next task). All these factors can vary in individuals regardless of situational factors such as physical or mental disorders. This variation is expected to be reflected in functioning, coping style, and personality.

As functioning depends primarily on motivation and drives, those individuals who have high motivation and low or poor drive subsystems might suffer from chronic intrapersonal tension (homeostatic disturbance). Further, good insight into an individual's weaknesses in their drive subsystems and provision of adequate coping strategies can improve functioning and reduce homeostatic disturbances.

Impulse control

Biting point physiology: Many brain functions are reflexive in nature and innate or learnt. Some of these reflexes can work in opposition to each other. Then, the brain needs to maintain some form of healthy balance between such reflexes for efficient functioning. Maintaining such balance is crucial in executing smooth and precise management of triggers and responses. Associated functional and dysfunctional core mechanisms include suppression, inhibition, release, impulse control, and impulsivity [33,80,118,119].

The brain often functions by maintaining fine balance between different reflexes. This skill is reflected in concepts such as coordination [120], neuronal balance [121], or executive functions [80].

The balance between opposite responses can allow a less stressful, more convenient, and graded functioning. For example having a painful condition triggers the release of endorphins, which gently alerts the body to the threat and facilitates the action of protective mechanisms while preventing catastrophic responses to the pain, such as shutting down defences or collapsing. This aspect of physiology allows the body to maintain a higher degree of functioning after the painful condition is alleviated. That is, once the painful trigger is removed, the body is already provided with an effective dose of pain relief, namely endorphins, which helps restore functioning.

There are two main mechanisms involved in 'biting point physiology', namely 'impulse inhibition' and 'impulse release/acceleration'. Some individuals have congenital difficulties in this subsystem, including having inadequate impulse inhibition [80,122], which can lead to frequent, poorly controlled, reckless or impulsive responses. Other individuals have 'excessive impulse inhibition', which can lead to slow, inefficient responses and a higher level of stress, sometimes followed by explosive or out of control responses [123,124].

Satisfaction/temperament: Infants can express different levels of satisfaction and dissatisfaction [125]. Although such expressions are still simple, more reflexive and frequently emotionally inauthentic, they are still engaging and functional in promoting carer-infant attachment [126]. Infants can also vary in their responses to stimuli; while some are easily satisfied, others are easily dissatisfied by the same stimuli. This is a biologically determined, affective style (temperament) that exists since infancy and is associated with **particular behavioural patterns** that can

shape personality and influence parental engagement [127-129].

In this model, a modified classification of 'Temperament' is used that is based on Thomas and colleagues' study in 1963 [130-132]. In this model temperament is classified into:

- **Difficult Temperament:** Characterised by high sensitivity to negative data (difficult to please) and difficulty to be behaviourally conditioned (oppositional and/or hostile).

- **Easy Temperament:** Characterised by high sensitivity to positive data (easy to please) and easy to be behaviourally conditioned (amiable and/or congenial).

Both types of temperament can change in response to environmental influences. However, the propensity towards one particular affective style still plays a significant role in shaping behaviour. Oversensitivity to negative stimuli in individuals with negative temperament [133,134] may be a significant factor in developing negative affective phenomena in the future, such as depressive personality, anxiety, or depression [135,136].

Fight – flight reactivity: Infants can exhibit frequent patterns of either rage/aggression [137,138] or panic/fear reactions [139]. Brain centres involved in autonomic reactions like 'defensive rage' and 'panic' could be the centres for infantile reactions like aggressiveness and/or submissiveness. Defensive rage and panic subsystems could reflect the activation of hypothalamic nuclei in response to alarming stimuli. Such processes clearly involve other vital brain centres such as the amygdala and the brain stem, notably the midbrain's periaqueductal gray matter (PAG) [140-143].

Differential sensitivity of such centres could underlie biologically driven fight–flight (aggressiveness-submissiveness) reactivity in infants and, to some extent, later developmental stages of aggression (especially the impulsive type), submissiveness, and/or fear reactions [144,145].

Visceral Central Executive Subsystem

Proactive sensory-motor subsystems

These are the subsystems used to launch the individual's essential skills for interacting, processing, and management of the surrounding environment [146,147]. Sensory-motor subsystems use all background subsystems and microsystems such as screening, monitoring, categorising, memorising, and prioritising data. Additionally, microsystems are used for manipulating, responding, adjusting, coordinating, and personalising responses.

Details of both normal and abnormal sensory and motor systems are extensive and well covered in neurology and neuropsychology, especially at the microsystems level for issues such as sensory processing disorders. However, regarding neurodevelopmental disorders, the sensory-motor system as a developmental survival mechanism is unique in its functional identity and can be studied as a unitary system that plays a strategic role in human development and survival. In the initial stages of infancy, these are simple and reflexive functions that engage a limited repertoire of impulses. However, the process continues to develop, quantitatively as well as qualitatively, at all stages of development with progressive expansions in efficiency and richness, becoming activities like manipulation, experimentation, adventuring, and even leadership [148-152].

Mirroring

Mirroring is the function of mirror neurons in the brain, which develop an internal, mental image of external motor actions as observed in the environment [153-156]. Mirroring is one particular subsystem highly associated with sensory-motor functioning. It is the function that later develops into imitation, motor learning, and even empathy. In this stage, mirroring is automatic and physiological but nevertheless a vital component of sensory-motor functioning [157-159]. Mirroring, especially as manifested in imitation, can be deficient in neurodevelopmental disorders such as severe learning disability and autism [160].

Clinging

Clinging is another unique integral part of the sensory-motor system that has functional significance. Although researchers usually refer to this phenomenon as attachment [161-163], here the term clinging is preferred. While attachment sometimes suggests an interaction between two parties that involves emotional content, clinging is usually unilateral behaviour for self-centred reasons and does not necessarily need emotional involvement with a particular caregiver. Clinging is one sensory-motor activity of the infant that is crucial for survival and has significant clinical implications regarding both the infant's intrinsic factors as well as parenting-related factors. Clinging is lacking in autism and exaggeration of clinging can reflect a dysfunctional parental-infant relationship [164-166].

Physical/Object-Related Intelligence

This intelligence focuses on achieving the second part of biological autonomy, i.e., awareness and engagement with the physical world. Such awareness gives the child an independent self-identity as a biological being, relative to objects and space.

The core function of physical intelligence is to understand the characteristics of the physical world and be able to manipulate it for the benefit of the individual. These skills are necessary for survival, even if the individual lacks awareness of the emotional or social dimensions.

Poor physical intelligence usually exists in learning difficulties and it can generally be assessed via standard intelligence tests. However, physical intelligence is not the same as cognitive intelligence, as the primary function of physical intelligence is survival in the immediate environment and development towards integrative social functioning. A person with a very advanced scientific knowledge but who struggles in adaptive functioning and does not integrate well into society is considered to have less adequate physical intelligence than a person who does adapt and integrate, even if this second person is illiterate (Table 2).

Physical/object-related subsystems

In addition to the extant subsystems (visceral background and sensory motor subsystems) the following subsystems emerge to represent the development of this new dimension.

Object and space permanence: This is a vital skill that allows the child to identify objects as independent entities that exist in space and subsequently promotes a new level of engagement with the physical

S.No	Physical Central Executive Subsystem
1.	Object and space permanence
2.	Curiosity
3.	Imitation/mirroring
4.	Possessiveness

Table 2: Physical/object related intelligence.

world. Soon, the infant begins to also recognise his or her independence in relation to these objects and their surrounding space. The infant then starts to engage with the physical world on a different level and build his or her sensory-motor experiences on that basis [146].

Before such awareness, the infant probably cannot differentiate environmental stimuli from visceral stimuli. When beginning to learn about object and space permanence, the infant is also not yet aware of the difference between individuals and objects and probably treat all of them as objects. The infant is also likely to have confused corporal awareness [167,168]. The infant might fail to see that the mother's face and breasts are necessarily connected**.**

Curiosity: The infant starts to realise that objects possess unique sensory imprints and interaction patterns. Curiosity is then reflected as the infant's use of different sets of responses and manipulation skills. This process creates a general system of curiosity that will become a major drive in this stage and later stages [169-171].

Imitation: Part of this learning process is an imitation of objects' responses, including movements, sounds, and gestures. Here, objects also include humans perceived as objects. One particular vital imitation habit, imitation of sounds, will later transform into vocalisation, communication, social interactions, and empathy. [172-177]. Although this could be argued to be an extension of 'mirroring', it is qualitatively different as it is now intentional and targeted at an independent body [178].

Possessiveness: The infant soon develops a desire to possess the objects in his or her environment, especially objects that are related to basic biological needs. Later, this desire will be associated with envy and rivalry with others who possess other attractive objects. Possessiveness here is different from attachment and/or simple acquisitiveness. Possessiveness does not necessarily attribute a positive or significant role for the object, so much as the significance of the possessor's wishes. Possessiveness is also less functional and more regressive in nature [179].

Emotional / Individuality-Related Intelligence

The definition of emotional intelligence in this model is similar but not identical to prior definitions [180-182]. In this model, the fundamental function of emotional intelligence is to allow the child to appreciate and, gradually, treat themselves and others as unique individuals. Subsequently, once the individual starts to possess this skill, a new lifestyle emerges that incorporates caring, attachment, emotional communication, and emotional enjoyment.

The ultimate effect of such intelligence is helping the child to acquire one fundamental life force, namely basic trust; this provides unique assurance that not only is life worth living, but also worth fighting for [183-185].

Poor emotional intelligence usually exists in antisocial personalities and, if combined with poor social intelligence, in autism.

S.No	Emotional Central Executive Subsystem
1.	Theory of Mind (Internal and External)
2.	Emotional Enjoyment (Play)
3.	Emotional Care
4	Emotional Communication
5.	Attribution (Internal and External)
6.	Emotional Attachment

Table 3: Emotional intelligence.

Emotional intelligence subsystems (Table 3)

Theory of mind: While establishing a functional system of emotional attachments is the peak of emotional intelligence, theory of mind is its foundation. Theory of mind is the ability to appreciate the independent thoughts and feelings of oneself (**internal theory of mind**) and others (**external theory of mind**). These systems allow the child to develop personal feelings towards unique individuals in the child's life [151,186-189].

Internal theory of mind:

• **Emotional autonomy** takes place when young children start to develop theory of mind and begin to realise that their personal thoughts and feelings are independent of others. The child will also realise that any interaction between itself and others has to be a positive emotional experience or otherwise the engagement is negative and disturbing [190].

• **Insight (critical thinking/metacognition/consciousness)** is the ability to observe and judge one's own thoughts, feelings, intentions, and actions, especially from the point of view of others [191,192].

• **Remorse/guilt** is the ability to learn from one's own negative behaviour in a way that positively influences future behaviour [193].

External theory of mind:

• **Empathy** is the ability of the individual to not only observe the thoughts and feelings of other individuals but also identify with those feelings and thoughts, as if they were the individual's own, regardless of whether they are consistent with the feelings and thoughts the individual would experience in that same situation [151,194,195].

While theory of mind can be affected in various disorders, it can be seriously deficient in severe neuropsychiatric disorders such as autism, dementia, or schizophrenia [196]. Empathy, insight, and remorse can be deficient in other milder conditions (e.g. dissocial PD) [197,198].

In some disorders, theory of mind might become pathologically extended causing disturbing and dysfunctional feelings of 'alienation' from oneself and/or others, such as in PTSD [199-202] and borderline personality disorder [203,204].

Furthermore, empathy can become distorted and dysfunctional for other reasons. A conflict might arise between internal empathy and external empathy or the emotional and cognitive components of it [205,206]. This can lead to the development of unbalanced and distorted empathy. In some situations, external empathy becomes excessive at the expense of internal empathy and/or autonomy, such as in cases of pathological stalking by individuals with autism [207], and in pretentious behaviour exhibited in severe personality disorders (e.g. pseudologia fantastica). In other examples, empathy is supressed and/or distorted in favour of contradictory environmental and/or cultural parameters [208].

Play (emotional enjoyment): Play and enjoyable companionship are important aspects of neurobehavioral development [209,210]. The absence of these behaviours is suggestive of serious neurodevelopmental disorders like autism [211].

Enjoyment of the company of preferred individuals and a desire to maintain this companionship is one of the precursors for friendship and/or partnership in later developmental stages of individuals.

Emotional care: Emotional care is different from play due to the nurturing quality of the former. It is the inherited developmental

behaviour of caring for and supporting others as part of an altruistic or symbiotic attachment [51,212]. Examples include a child caring for a parent, a younger sibling, or a pet.

This function is vital for the development of future attachments and parenting skills. Lacking such a quality is again a sign of a possible neurodevelopmental disorder.

Emotional communication: This is the ability to establish meaningful verbal exchanges with people that reflect an appreciation of their unique individuality. This will later, in higher developmental stages, be complemented by abstract and social communication. Again, lacking such an ability is a sign of serious neurodevelopmental difficulty. This issue is frequently seen in milder forms of autism.

Attribution: In this model, attribution is as an innate tendency or bias by which negative events are attributed to internal or external factors. Individuals with **'Biased External Attribution of Negativity'** blame external factors for negative events, while individuals with **'Biased Internal Attribution of Negativity'** blame internal factors for the same negative events [213-216].

Individuals who rely primarily on external factors for their emotional homeostasis will avoid disturbing their main source of stability while explaining a negative outcome. Instead, they sacrifice less significant internal stability factors to explain that negative outcome. In contrast, individuals who rely primarily on internal factors for emotional homeostasis tend to blame external influences for negative outcomes. Both types of bias confuse socio-emotional reality and subsequently engender emotional and behavioural difficulties or vulnerabilities.

It is frequent to see biased external attribution of negativity in children with oppositional defiant disorder and conduct disorder. It is also seen in adults with Asperger's syndrome with difficult temperament as well as in some PDs, e.g. dissocial, paranoid, and narcissistic PDs. Biased internal attribution of negativity is common in PDs with high dependency traits.

Emotional attachments: Children reach their peak of emotional functioning when they manage to secure supportive emotional attachments. Such attachments are crucial for practical stability as well as further development [162,184].

Having emotional attachments is one of the most important aspects of human functioning. Subsequently, many mental health phenomena are associated with these attachments, e.g. mental health, functioning, coping, development, stress, pathology, and therapy.

Some patterns of emotional attachments: In this model, attachments are divided into two main types: emotional attachments to unique individuals in the environment and social attachments to abstract bodies that are recognised as a social concepts or groups, rather than as unique individuals. Examples of the latter include society, foreigners, and officials. Emotional attachments vary in context, quality, and intensity and can be classified in different ways [217-219]. The more regressive and maladaptive the attachment style, the more the vulnerability to behavioural and mental complications [220]. However, in this model, attachment styles are classified primarily from a neuro-developmental point of view, taking into consideration a lack of neurodevelopmental skills, regressiveness, and/or immaturity as aetiological factors for negative attachment styles and vice versa.

Emotional possessiveness: This is a form of dependent attachment but more regressive and less appreciative of the receiving party. Such attachments are usually seen among pre-school children towards their mothers. At this age, attachments are usually physiological but still developmentally functional. When such a style of attachment is adopted by adults, it is usually maladaptive and dysfunctional and can at times lead to abuse and aggression. Individuals who adopt this style of attachment are usually limited in emotional and social skills or even suffer from a chronic and pervasive sense of emotional insecurity, with or without attachment. However, some cultures can also allow, if not promote, this style of attachment as one of the social norms. Then, it remains pathological and dysfunctional but not as a biological phenomenon so much as a cultural or social phenomenon.

Possible subtypes include:

Hostile possessiveness: This subtype is frequently associated with both physical and emotional aggression. This can be seen at times in autistic patients towards their secure relations (e.g. parents).

Obsessional possessiveness (e.g. stalking): This is another familiar form of possessiveness. It is usually a passive attachment, but it can also become aggressive.

Passive/self-defeating possessiveness: This subtype is usually non-aggressive physically but still associated with intense forms of emotional pressure/blackmail and can be highly stressful from the point of view of the receiving party. This style can be seen in patients with passive aggressive personalities, especially if associated with high levels of hypochondriasis or self-harm.

Emotional dependence: Individuals with this type of attachment again feel chronically insecure, as in possessive attachment, but they frequently feel much less insecure in dependent relationships. They are also more passive than aggressive in their attachment styles; sometimes they even deliberately adopt an excessively passive approach as a way to stabilise the dependent relationship and they often become victims of abuse and/or exploitation from the other party. Possible subtypes include:

Anxious Dependence: These individuals actively seek dependent relationships as a way to manage their feelings of emotional insecurity.

Passive Emotional Identification (imitation): This is a form of over-identifying with others at the expense of functioning and emotional autonomy.

Passive Emotional Dependence: This type of individuals does not search for dependent relationships but do not have the skills to maintain their independence once in a relationship. Unlike other subtypes, such individuals can actively avoiding the relationship soon after starting it.

Symbiotic emotional attachment/dependence: This is a healthy form of emotional relationship, which is contingent on mutual emotional support for maintaining the relationship.

Possible subtypes include:

Companionship: In this relationship, the level of support is more limited but still positive and convenient to both parties. It is based on offering pleasant company as the basis of the relationship, as in some forms of friendship.

Partnership: This is a longer-term relationship based on mutually committed support, even against adversity. This is usually observed in marriage, families, and strong tribal relationships.

Unconditional emotional attachment (care): This is a form of relationship with unconditional commitment of support on one side

without any dependence or passivity, but on a voluntary basis. It is usually a highly altruistic form of attachment that is usually seen in parenting and highly committed charitable work.

Social/Mentation Intelligence

In this model, social intelligence is different from emotional intelligence. Social intelligence allows individuals to adequately engage with any parts of society that are not primarily represented by a particular person, face, or name. Social intelligence is the ability to engage with social constructs appropriately, in the context of establishments and bodies such as schools, strangers, foreigners, countries, religions, norms, neighbourhoods, governments, tax authorities, and police.

Social intelligence is usually used in synchrony with other intelligence. One example is dealing with strangers. This can start as a social exercise (e.g. meeting a customer) and end as an emotional one (taking personal care of the customer with a degree of empathy) if not a mixture of both (feeling friendship toward the customer without ignoring professional duties). The social dimension also adds further depth to the other dimensions. For example, territoriality in visceral intelligence becomes home in emotional intelligence and then homeland, country, or humanity in social intelligence.

Social intelligence is widely based on the ability of 'mentation' [51], including managing social abstracts. The relationship between mentation as a cognitive process and social intelligence as defined in this model is fairly close. In humans, the most important and frequently used mentation and abstract thinking are in using social abstracts and during social functioning. Social concepts are more abstract than concrete. The development of social intelligence begins at almost the same time children start to develop mentation and the two continue to develop in parallel [221]. The social brain circuits, when isolated from the emotional brain circuits as explained in this model, and the higher cognitive brain circuits share more or less the same areas of the neocortex, especially in the prefrontal cortex [222-224]. Disorders that cause deterioration of higher cognition and mentation also cause deterioration in social intelligence, as occurs in dementia [225-227].

The aim of social intelligence and mentation is to be able to appreciate the 'coherence' of life despite the complexity of the world.

Poor social intelligence together with poor emotional intelligence can be seen in different mental health and personality problems, especially in autism.

Social intelligence subsystems (Table 4)

Mentation: The concept of mentation refers to the ability to use abstract thought regarding both non-material and material items and to connect concepts together to form more meaningful and more predictable constructs. Mentation in a child develops into brain activities such as cognition, reasoning, analysis, problem solving, and general thinking in mature stages of development [51].

This process includes several vital mental processes including

- **Abstract thinking:** This is qualitatively superior to concrete or physical thinking. It is also realistic, empowering, and convenient for proper and efficient engagement in all aspects of life [228].

- **Relativistic thinking:** This is another rich and empowering part of thinking that allows the individual to understand the relative value of phenomena in relation to the context. This allows the individual to have a more realistic evaluation of such phenomena and to avoid over-generalisations. Such a process is essential in child development

S.No	Social Central Executive Subsystem
1.	Mentation {Abstract thinking, relativistic thinking, imagination (predictive thinking)}
2.	Social Anxieties (Separation anxiety, pubertal development anxiety, and socioeconomic-gap anxiety)
3.	Social Autonomy and Identity
4.	Social Communication
5.	Social Attachments

Table 4: Social intelligence.

during teenage years, so that individuals can better appreciate their potential and develop their own, new social identity [229-232].

- **Imagination (predictive thinking):** This is an extremely important survival mechanism, which consists of a continuous, usually preconscious, process of mental simulation to explore possible future scenarios, outcomes, and responses. Imagination does not only explore the immediate future but also the distant future; not only the current reality but also other possible future realities. Imagination is the main tool for human creativity. It is the characteristic that is most representative of the uniqueness of human mental abilities [233-235].

Physiological social anxieties: The awareness of social reality brings with it an awareness of social norms, social rules, social obligations, social power, and subsequently social anxiety [236]. Some of the main sources of social anxiety in childhood are:

- **Physiological separation anxiety:** This occurs as part of normal social development when the child starts to realise that his or her carers can disappear (leave, divorce, fall ill, die, or even willingly abandon the child). This can become one of the most overwhelming challenges to the child's basic trust during their natural development. Such anxiety usually resolves spontaneously through carers' support and more and better social awareness [237-239]. Unresolved physiological separation anxiety can contribute to the development of complications including pathological separation anxiety, social anxiety, and school phobia [240]. It can also be linked to adulthood anxieties [241,242].

- **Pubertal anxiety:** At the time of puberty, children realise that adult gender-related social roles (i.e. masculinity and femininity) are a major part of survival. This can be an overwhelming source of anxiety if the child cannot cope well with such new roles [243,244].

- **Socioeconomic-gap anxiety:** This is the anxiety in relation to one's background (social and economic status) in comparison to peers [245,246].

Social autonomy/social identity: This is the development of awareness, desire, motivation, and mechanisms to choose one's social identity in terms of social networks, social role models, and social choices, separately from external—especially parental—influences. This is again one of the most significant neurobiological developmental stages that allows the child to move into adulthood. It is also of significance for adolescents, the family, and the wider society due to what accompanies this process of socio-emotional tension and difficulties. Inability to complete this part of development is associated with serious issues with respect to maturity and social competence [247, 248].

Social communication: This is the ability to communicate with others while using abstract social concepts (e.g. loyalty, professionalism, duties, and law and order) while being able to appreciate the social context and social norms as perceived by others (e.g. talking to customers or professionals about business matters). This is higher quality than emotional communication, given that **it may be more** intellectual

and more professional, and is mainly focused on communication that recognises transfer of information is occurring between two or more unique individuals. However, there are forms of communication that can be either or both social and emotional (e.g. talking to strangers).

Social communication can be deficient in many mental health problems and PDs, such as in marked learning disabilities and autism.

Social attachments: Again, in this model, social attachments are different from emotional attachments as the former are based on social abstracts more than personal attachments. Examples of such abstracts are tribes, religious groups, political organisations, and professional or other special groups.

Patterns of attachment in this section concern relationships with others who are seen as representative of social groups. However, in many situations, the social attachments can be closely intertwined with emotional attachments. This may be the case for some work relationships, wherein individuals adopt both emotional and work-related roles.

In mixed attachments, failure of one type can conflict with the other, causing significant or challenging stress. For example, one might reject and try to disengage from a particular religious group while maintaining strong friendships with members.

Possible patterns of social attachments

Functional social attachments

a.   Symbiotic social attachments: This is the norm, from the biological and social point of view. Human beings are genetically designed to work in societies as long as they are more functional, emotionally and socially, in such settings. This applies to large as well as small social settings (e.g. in the workplace). Humans are also designed to reach their maximum potential only as members of a cohesive and integrative society. This is why the achievements of society can become far greater than the sum of the separate achievements of individuals, and hence how civilisation evolves. However, if individuals begin to feel that the social construct is no longer favourable to their comfort or productivity, the social attachments start to become stressful and unstable [249].

b.   Unconditional social attachments: In later mature stages, individuals can be happy to integrate into social groups even there is no direct benefit for them as individuals, such as in charity work.

c.   Functional social identification: This is a form of close adherence to the social idea or social body without disturbance of other social roles for enhancing social self-identification, self-esteem, and subsequently functioning. Examples include many religious, political, and professional affiliations.

Dysfunctional social attachments

Passive social dependence: This is a regressive form of social dependence wherein the individual passively and disproportionately glorifies and adheres to particular social disciplines, establishments, or representatives. Such adherence comes at the expense of functionality and the individual's basic needs, such as in extreme adherence to a bureaucracy that is both dysfunctional and disturbing to the person's emotional and social needs in the workplace.

Dysfunctional social avoidance: This can be an inherited or induced personality trait. Individuals become accustomed to having a heightened awareness of social risks and subsequently develop high baseline social anxiety whenever engaged in social activities. Subsequently, they consciously or pre-consciously avoid social engagements. This tendency becomes problematic once it jeopardises other basic needs.

Primary dysfunctional self-sufficiency: Individuals with such traits (e.g. in autism and, to a lesser extent, schizoid PDs) seem to have limited motivation for social integration. This is usually associated with exaggerated compensatory reliance on inner-circle physical and/or emotional activities.

Secondary dysfunctional self-sufficiency: This is primarily seen in chronically frustrated or depressed individuals who deliberately disengage from integrative social activities (usually without serious levels of social hostility), usually due loss of trust or due to chronic disappointment with social systems or values.

Maturity

This is the process through which the brain develops from childhood to adulthood. It is a crucial process in the quantitative and qualitative development of brain systems and subsystems so that they reach peak efficiency. Functional and positive engagement in the environment is essential to attain maturity. However, if such engagement becomes dysfunctional beyond certain coping thresholds, it can cause serious complications.

This part of the model is also elective, based on published personality development models in the literature, notably those of Eric Erickson [185], Jean Piaget [146], and Jane Loevinger [250]. It is also based on neurodevelopmental studies, including Paul MacLean's triune brain theory [51], and neuroimaging studies of brain development [59,61,251-254].

This model assumes that humans progress toward maturity by developing visceral intelligence first, followed by physical (object related) intelligence, emotional intelligence, and then social intelligence. Once started, each intelligence develops further in synchrony with the next intelligence, until they form one unified form of expressed personality, which consists of these four components of intelligence coupled with environmental experiences.

The principle effects of maturity (Table 5)

The above developmental appear designed to achieve certain basic foundations of social development that allow the individuals to fulfil their potential. These could include autonomy, basic trust, and coherence. These and other possible foundations of social development could be considered the central strategies for personal functioning. In this model, these foundations are multidimensional and functional at all stages of maturity. They need to be maintained in all aspects and levels of development and can also be lost at any level.

Autonomy [255,256]

This is the establishment of the individual as biological being with characteristics such as

- Being highly **resilient** and capable of survival even in the presence of serious environmental challenges.

- Being highly **self-sustaining** with an autonomy that is also largely inherent, multidimensional, adaptive, and progressive.

- Being highly **self-determined** with the ability to produce differential reactions in response to the same environmental stimulus.

Basic trust [183-185]

Basic trust necessitates that the individual feels, in principle, that

Regression	Stages of Normal Maturity		Maturity
	(I) **Physiological Autistic Stages** Age 1–3 years	**a.** **Autonomic/Visceral Focused Autistic Stage** Age 0–1 year	
		b. **Physical/Object-Focused Autistic Stage** Age 2–3 years	
	(II) **Narcissistic Emotional Stage** Age 3-5 years		
	(III) **Social Integration Stages** Age 5–18+ years	**a.** **Concrete Social Stage** Age 5–10 years	
		b. **Narcissistic Social Stage** Age 10–15 years	
		c. **Symbiotic Altruistic Social Stage** Age 15–18 years	
		d. **Expansive Altruistic Social Stage** Age 18+ years	

Table 5: The principle effects of maturity.

life is satisfying, positive/promising, worth living, and worth expending effort for.

Coherence

This is the brain capability that allows the individual to establish a functional construct of both personal and environmental data. This, in turn, makes the individual capable of understanding, predicting, and managing him or herself and the environment in a meaningful and purposeful way. Loss of this kind of coherence leads to cognitive, emotional, and functional disturbances, including confusion, insecurity, helplessness, and despair [257-261].

These core foundations of personality and functioning are usually affected in severe and pervasive neuropsychiatric disorders. Autonomy and coherence are usually compromised in advanced stages of dementia, brain injury, learning disability, and autism. Basic trust can be affected in post-traumatic stress disorder, borderline PD, and depression.

Maturity stages

Physiological autistic stage

Visceral autistic (physiological) stage: This is the stage within which the child is yet unable to develop object permanence to an adequate level; permanence usually occurs late in the first year [146]. Until that transition, the child's world seems to be formed primarily of his or her own body and largely ruled by the autonomic nervous system and reflexes, even while responding to external stimulation (e.g. during feeding or when smiling). It possible that during this stage, the external world seems to the infant to be merely a superficial sensory stimulus without independent existence of his or her own body [147]. The child's input consists primarily of sensory-motor activity, through which he or she gradually builds awareness and engagement skills with the external World.

In this stage, the child needs carers that fulfil his or her basic needs (e.g. eating and comfort), provide sensorimotor stimulation, and protection from stress or harm.

While some individuals with severe forms of neurodevelopmental disorders become trapped in this stage, normal adults can also regress to this stage with severe neuropsychiatric disorders (e.g. severe brain damage or severe dementia).

Object-focused autistic (physiological) stage: This stage gradually evolves after the infant develops the ability to process the concept of object permanence and subsequently space permanence. As such, the infant's world consists of its own body as well as other objects and the space they occupy. This automatically adds a new challenge to the infant who now needs to develop more skills to be able to assimilate and manage the new components that have entered his or her awareness.

In this stage, the infant clings more intensely to his or her caregivers. However, the infant is more likely to think of caregivers in a similar way to objects, without notable qualitative differentiation. This is why changes in caregivers at this stage do not greatly affect the infant's overall behaviour.

This stage is also characterised by the primacy of the visceral-physical dimensions of thought over emotional-social aspects. As mentioned above, some patients with severe neurodevelopmental disorders can never progress beyond this stage, while some mature adults can regress to the stage due to severe neuropsychiatric disorders, such as following brain injury or in the late stages of schizophrenia and dementia. Other mature adults can regress to this way of existence in the context of making negative cultural choices.

However, some individuals can continue to maturity while maintaining intensified attention to physical parts of the world at the expense of the social-emotional parts. An example of this is obsessional PD, which can seriously challenge the individual's emotional attachments. It is also possible that some adults with maturity problems

regress to this level as a defence mechanism or a comfort zone in certain circumstances.

Narcissistic emotional stage: This stage starts around the age of 3 years when the child gradually develops theory of mind. At this point, the child can recognise people in the environment as unique individuals, as distinct from different forms of objects, with their own thoughts and feelings, as the infant has his or her own. The child will soon also be able to appreciate and manage other's wishes, demands, and needs and compare them to his or her own. The final product of such a process is that the child gradually develops both internal (oneself) and external (others) theory of mind.

In the beginning, the child puts his or her needs and demands in a central position, and considers them far more important than the needs of others, who are usually the parents. Gradually, over a period of years, children begin to downsize their own emotional status, decentralise their needs, and increasingly appreciate those of others. The child might also assume that some objects, pets or toys also have a theory of mind and treat them as unique individuals, until the child gradually come to understand the difference between objects and people.

At this stage, the child needs the environment to enhance the functionality of this trend by enhancing the child's feelings of basic trust. Two main factors help in achieving this major survival need, namely the unconditional altruistic support of the parents and a lack of social awareness, including a lack of awareness of social restrictions or hazards. Those two factors allow children to reach a peak of positive emotional feelings that is necessary for healthy development of basic Trust. Losing basic trust at this stage—or indeed at any stage of development—can be very disturbing to motivation and survival skills, such as in borderline PD following chronic abuse in childhood.

Again, individuals can be trapped in this developmental stage in the context of neurodevelopmental disorders, as part of regressive neuropsychiatric disorders, as part of a personality disorder (e.g. histrionic PD), as part of maturity disorders, and under the influence of a negative or malfunctioning culture.

Social developmental stages: In these stages, the child starts to understand abstract concepts, including social abstractions.

Concrete social stage [5–11 years]: In this stage, the child's awareness of social concepts is fairly naive but functional. For example, they do not know why they should avoid talking to strangers, but they know that they have to do exactly that because their parents said so (blind obedience). The usual application of this level of social awareness is at school. Children gradually accept school as an independent establishment, accept its rules, and may also develop some form of positive attachment or loyalty to it. Children also tend to over-idealise the social status of others, including their parents or teachers, but also some strangers such as police or doctors, given the child's inadequate awareness of individual differences or limitations.

Concurrently, they begin to learn about some other social restrictions and hazards, such as criminals, punishment, poverty, loss, illness, divorce, and death. Carers need to support children during this time of challenging awareness as the children learn how to assimilate the new data about social restrictions, continue to maintain their basic trust, appreciate their existing social strengths, and learn how to develop additional strengths.

While the pathology attached to this developmental stage is similar the previous stage, there are some unique aspects. Cultural influence in regression to this stage is uniquely higher than in other stages. This

stage is characterised by high levels of compliance (blind obedience) with social rules and authorities, unlike the subsequent developmental stage (narcissistic social stage). Some families, schools, or even the police sometimes finds it difficult to manage such change in children. Then, consciously or preconsciously, these authorities advocate a culture of regression to this developmental stage to maintain obedience and avoid the challenges of the next stage. This can also occur at particular establishments that rely heavily on maximum compliance from their adult subjects to achieve 'adequate' performance (e.g. in the army, prisons, or heavily bureaucratised governmental establishments). However, from the neuro-developmental perspective, this form of compliance with social establishments is relatively regressive, inhibitive of individuals' development, and by definition is a significantly less functional and less efficient form of social performance. Literature regarding 'institutionalisation' [262] is a reminder of this form of social pathology.

Narcissistic social stage [11–18 years]: This stage begins when the teenage child begins pubescence, especially with the concurrent development of courtship behaviour and the attendant desire to attract the attention of the opposite sex. However, this is also the time when the teenager starts to develop relativistic thinking [219-222]. At this stage, the teenager learns that individuals, including parents, establishments, and concepts are all relative. That is, each have weaknesses, limitations, and are far from absolute, in contrast to how such individuals were considered in previous developmental stages.

This level of awareness, coupled with other major changes in the child's biology, is facilitates major changes in emotional and social functioning. The teenager usually develops an inflated sense of their own abilities and/or their own centrality due to their fast qualitative improvements in their biological characteristics, coupled with the newly attained knowledge of the limitations of others. This is aided by a new surge in mating instincts, which biologically provoke a higher degree of self-centrality and competitiveness.

This is also the time when the teenager starts to develop their own new independent social identity due to their increased relative confidence, and improved cognitive and socio-emotional skills. This allows them to make their own judgments, argue against others' judgments, make personal choices, develop higher-quality socio-emotional attachments, and start establishing their own social network.

During this stage, caregivers, parents, and teachers need to support the adolescents in completing this stage of development with the fewest possible social or emotional complications. The adult figures must provide support while coping with the issues associated with the adolescents practicing their newly emerging, sometimes awkward, independence on their caregivers.

Other than the usual developmental pathologies mentioned above, there are also unique complications attached to this developmental stage.

Some parents and establishments such as schools and the police find it difficult to cope with this stage of development, particularly if issues during the stage take years to resolve. These authority figures may then experience coping difficulties and consequently place unhealthy pressure on the teenager in this critical stage.

While puberty is usually a natural sign of adulthood and independence, such as starting one's own family and career, modern societies choose to slow such processes, resulting in extending the 'social childhood' beyond the 'biological childhood', which can create tension and increase

levels of stress experienced by adolescents [263].

As the process of puberty is already very complex and massive in scale, it has its own neurodevelopmental complications. Coupled with the previous difficulties, this developmental stage becomes a time when numerous neuropsychiatric and social complications tend to emerge [264].

Symbiotic altruistic social stage [15 years onward]: This stage usually starts with the teenager or adult establishing a committed partnership with full or relative independence from traditional carers. This stage can last for the rest of the adult's life with no further development, or it can develop further**.**

Emotional attachments in this stage are qualitatively different from the previous stage. In the narcissistic social stage, individuals are usually influenced by physical attractiveness and then companionship. In the symbiotic altruistic social stage, individuals are more influenced by partnership and then companionship, with physical attractiveness being of lower priority.

This stage is usually characterised by higher levels of independence from usual caregivers, but with mutual dependence on the partner. The difference is so noticeable that it signifies a higher level of maturity; this is how the 'new nuclear family' usually starts, with its extended social influence on larger society and culture.

This stage is characterised by more aspects of social independence including career, learning, work, and personal interests/hobbies, together with the previously attained social achievements, including an independent social identity and personalised social network.

Although this stage is one of the advanced peaks of development and maturity, it has its own difficulties. This stage contains an intense form of dependence on the partner. This, in a way, is an unavoidable form of vulnerability. If the partner or the partnership has major problems, severe complications can be reflected in the individual. This is one reason why some individuals deviate from this level of social development and develop instead fear of commitment. Some become too passive and dependent in the relationship to avoid loss of the partner's support, while others become too possessive to force the partner to stay loyal.

Expansive altruistic social stage (parenting/parenting-like experiences): This stage usually starts when the individual becomes a parent or develops a similar experience, such as when a teacher cares for students or a professional cares for vulnerable dependants.

This form of social development contains all the elements of the previous stage, except that there is much less mutual dependence and much more unconditional committed care towards the other party, i.e., the children in the example involving parents.

The ability to have such maturity is crucial for promoting the lifecycle of new children/dependents in their journey from childhood to adulthood. Subsequently, it is one of the crucial functions essential for developing a viable society and the promotion of 'life' itself.

This form of development, when it is functioning correctly, also serves well the committed caregivers/parents. Younger parents enjoy raising children, which establishes themselves as higher functional units of society and develops further their skills and resources, including the quality of their own symbiotic altruistic relationship. Older parents, while having a progressive decline in physical abilities that stop them from being able to enjoy physical pleasures of life, can instead enjoy life

via influencing newer generations and leaving a positive legacy. This means that they continue to survive as an idea after stopping to exist as physical beings.

In the meantime, this stage carries with it some vulnerability, if it does not function correctly. In this stage, the parents can be easily affected by the dependents' failure, as if it were their own. This creates the 'ultimate maturity paradox': while the expansive altruistic social stage is the highest maturity achievement in life, it also makes the parents most vulnerable to the influence of others (their children).

This developmental stage can have problems, including fear and avoidance of having such unconditional-giving relationships, which can be expressed by individuals avoiding having children or even deserting them. Another form of this problem is the 'ambitious parent syndrome', in which the relationship becomes reversed, whereby the parent uses his or her children to fulfil the parent's needs and ambitions.

Personality maturity disorders: The concepts of maturity and immaturity have been widely used in in everyday clinical practice. However, they are also widely used in the literature although in a different context and with different definitions [265-269].

In this model, immature personalities can function at mature levels in supportive circumstances. The difference is that when they are under significant levels of stress (e.g. when experiencing extensive fears) or when they relax their usual defences (e.g. while intoxicated with alcohol), they regress to one of the aforementioned developmental stages, as a form of comfort zone, wherein they feel most spontaneous, true to their nature, and most able to use the defence mechanisms that they accustomed to.

For example, individuals with immature personality who usually regress to the narcissistic emotional stage can still follow different patterns of behaviour at different times. Under positive pressure, they behave in a more mature way, although not consistently or spontaneously, for it is not a well-developed behavioural platform. Concurrently, the behavioural patterns of the comfortable regressive zone keep emerging occasionally, usually in the form of impulsive reactions or slips of the tongue. These individuals, when they are relaxed or less inhibited by circumstances, feel no need to activate their defensive coping mechanisms and start to behave in a similar fashion to how children behave in their narcissistic emotional stage. In times of stress, such individuals may also regress to this developmental stage, especially if the stress level is severe enough to overwhelm their coping strategies.

According to this model, if the individual has a regressive comfort zone, expansions in developmental stages can be diagrammatically expressed as a vase-shaped developmental pattern, exemplified by a wide base and tall narrow neck. In contrast, individuals with normal developmental patterns have their extended developmental zone in the expansive altruistic stage, which can be can be diagrammatically expressed as a mushroom-shaped developmental pattern, exemplified by a wide top and narrow stem (Figure 5).

Maturity (or immaturity) disorder is a concept has some similarity with the concept of personality regressiveness or PD, but is still qualitatively and quantitatively different from both concepts.

While the main aetiological factors in PDs and neuropsychiatric repressiveness are biological, the main aetiological factor in maturity disorders is environmental (cultural or rearing patterns). PDs and neuropsychiatric repressiveness are usually more pervasive and tend to exist in most social circumstances, while maturity disorders are
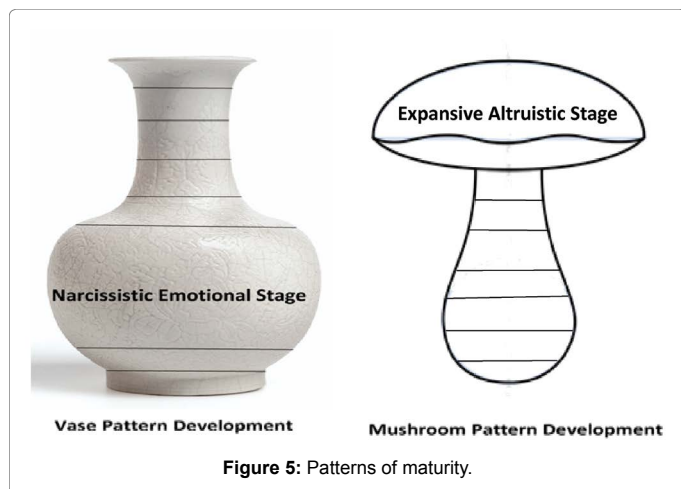
Figure 5: Patterns of maturity.

much less pervasive. Positive pressure, such as cultural or personal support, can be somewhat effective and rapid in helping an individual with maturity disorder to adopt more mature behavioural patterns, while this is not usually the case with biologically determined PDs or neuropsychiatric repressiveness.

It is still perfectly possible that an individual can have immaturity disorder, PD, and a mental disorder at the same time, and these three phenomena could be interconnected aetiologically to each other. A good example of the interaction of the three factors is in anorexia nervosa, i.e., clinging to a childish physique and avoiding an adult lifestyle, while having prominent obsessional personality traits, as well as pathological disorders like a phobia of fatness, obsessive compulsive disorder, or anxiety.

Note that, maturity disorders should not be confused with **physiological regression,** which is normal, intentional behaviour that is used to enhance functionality. Being incapable of functional regression is usually a sign of a problem in personality, such as rigidity. The usual examples of functional regression include

- Regressing to behaviour akin to the autistic (visceral) stage during sleep and copulation to be able to engage well, enjoy, and relax in the process.

- Regressing to behaviour akin to the autistic (object-focused) stages while in public transport. That is, being withdrawn, avoiding gazing at others, and focusing on one's own personal space or objects (e.g. mobile phone), to avoid being too intrusive toward someone who is physically so close.

- Regressing to behaviour akin to the narcissistic emotional stage, i.e., being funny and carefree, while playing with young children.

- Regressing to behaviour akin to the narcissistic social stage, e.g. being defensive and adhering to a close social network, when in a new environment where the individual does not feel safe or comfortable.

Environment

Studying the specific environmental factors or specific environmental effects on the development of normal or abnormal personality is beyond the scope of this study. The positive environmental factors or effects are also not covered. However, the attention here is mainly directed to the general and universal adverse effects of environmental factors on personality and personality development (Table 6).

Environmental Negative Developmental Factors(primarily psychological)	
1.	Deprivation of care
2.	Negative cultures (including negative rearing patterns)
3.	Stress (especially overpowering stress)
4.	Trauma (damaging to core effects of maturity)

Table 6: Environmental factors.

Deprivation

Any lack of essential supportive environmental factors that is necessary for personality development is considered a deprivation and could cause serious stress, and arrest or deviate personality development from its natural course [33,270-273].

Deprivation might take the form of a lack of essential stimulation, a lack of support against challenges, or stress during development. The harmful effects of deprivation can vary widely in their impact depending on the severity, duration, and developmental stage. The harmful effects of deprivation will be more damaging if they take place during the biologically determined critical periods, within which the damage is usually irreversible, especially if it is not associated with compensatory or corrective measures [274,275].

Negative cultures (including negative rearing patterns)

Certain rearing patterns and general cultures, from a neurodevelopmental view, promote a pattern of development behaviour that is perceived to be beneficial [276-278]. Such cultural choices can nevertheless sometimes be unhealthy from the neurodevelopmental point of view, such as promoting behavioural patterns consistent with the concrete social stage beyond its natural age as a way to maintain blind obedience to authority or to avoid adventurous behaviour and risks. Another way to differentiate positive culture from negative culture is to assess the effect of any culture on the foundations of personality functioning, namely autonomy, basic trust, and coherence.

When rearing patterns or a culture enforce such developmental changes, it is usually without the intention of causing deprivation, stress, or trauma. Individuals in these cultures can adopt behaviour that would be regressive in another culture, but without any underlying biological cause. Subsequently, such behaviour can change by moving out of the culture that promotes it, to a different culture that adopts a different pattern of behaviour.

Cultures usually promote patterns of behaviour that are consistent with one or more other forms of normal human developmental stages, but not necessarily in the exact age range. As mentioned above, some heavily structured establishments promote behaviour akin to the concrete social stage to enhance discipline and consistency. Some migrants adopt behavioural patterns similar to the narcissistic social stage in their new environments, especially in the first generation, due to feelings of insecurity and a need to protect their cultural identity from dissolving in the new culture. Other sections of society frequently adopt behavioural patterns consistent with the emotional narcissistic stage as a way of being funny and friendly, especially if they attend regular activities compatible with such attitudes, such as professional entertainers and people frequently involved in raves and parties.

Note that culturally promoted developmental behavioural patterns differ from other forms of social pathology that are very important but not part of this model. For example, poverty and social exclusion trigger aggression and deviant behaviour [279] and systemic oppression can cause self-destructive behaviour or terrorism [280]. This model also does not consider other social pathologies, such as how social stresses

can cause or precipitate biological mental disorders [281] or how people with biological mental disorders function as social groups, such as patients in mental asylums [251].

Overpowering stress

Overpowering stress is stress of such severity that it renders healthy coping mechanisms ineffective. In this model it differs from positive stress, which although challenging, enhances healthy functioning. It is also different from manageable negative stress that can be addressed by healthy coping mechanisms.

The effect of overpowering stress on personality development is to initially induce transient pathological coping mechanisms, such as denial, regression, and self-destructive behaviour. Beyond a certain limit, this overpowering stress can lead to permanent or near-permanent deviations in the development of personality, i.e., PDs. Furthermore, it may also cause severe complications, including mental and physical illnesses [282-284].

Trauma (psychological)

Trauma, especially as related to personality development, is a much more destructive type of stress. This may be due to the exceptional nature of the trauma, its severity, its chronicity, or because it impacts an exceptionally vulnerable individual who has relatively limited defences, either due to constitutional or age-related factors.

The effect of trauma can be exceptionally severe because it does not only overwhelm defences, but also cause long-term damage or loss of one or more of the core effects of maturity, i.e., autonomy, basic trust, and coherence. Such a situation leads to the development of PDs, with or without associated mental (and possibly physical) health disorders. One well-recognised type of such PDs is the borderline PD, especially when associated with sexual abuse in childhood [285,286].

As well established, human-caused (especially intentional) and human-related traumas (especially grief) have a much more severe impact on mental health, including personality and development, than other stresses like natural disasters. This supports the assumption that the social developmental axis can be central in human development [287-291].

Conclusion and Clinical Implications

The main purpose of this model was to introduce a neurobehavioral, bi-dimensional approach for analysing mental health problems, which is more efficient than extant models and compatible with recent scientific developments in the neurosciences. This model is just one example of a new approach that is open to changes and improvements.

The main essence of the new approach is to use one more strategic aspect of mental disorders and add it to the current main aspect used in Kraepelinian psychiatry, i.e., adding the pathophysiological dimension to the extant behavioural dimension. This approach has been used with respect to neurological disorders like epilepsy for almost a hundred years and has significantly helped all aspects of scientific developments in epilepsy.

By adopting this approach, the model tries to avoid confusing the biological factor in PDs with the other factors and to avoid the previous, over-inclusive and vague, 'categorical' systems for the classification of mental illnesses and replace them with a more academically and clinically advanced 'dimensional' system. The model also tries to build a better-established connection between clinical practice in mental health and the rapidly evolving scientific discoveries in neurosciences regarding mental disorders.

In this study, the new model is not intended to replace the current categorical system, so much as opening a door to new thinking. However, a good application of this model could help formulate a better use of current diagnoses of PDs and add more specificity and clinical details that might compensate for the weaknesses of current models.

If this approach is accepted by academic and clinical communities, it might help to develop a new and more accurate understanding of mental health problems. The hope is that improving our scientific strategies will lead to more accurate diagnostic criteria and more specific classifications of psychiatric disorders. This, in turn, will hopefully lead to the discovery of more specific assessment methods and more specific treatments.

Conflict of Interest

There is no conflict of interest regarding the publication of this paper.

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