The psycho-periodic cube

Mehmet Emin Ceylan[a], Alper Evrensel[b,*], Aslıhan Dönmez[b], Barış Önen Ünsalver[c],
Fatma Duygu Kaya Yertutanol[b], Ahmet Mete Çom[d]

[a] *Departments of Psychology and Philosophy, Üsküdar University, İstanbul, Turkey*
[b] *Department of Psychology, Üsküdar University, İstanbul, Turkey*
[c] *Vocational School of Health Services, Department of Medical Documentation and Secretariat, Üsküdar University, İstanbul, Turkey*
[d] *Freelance Developer, İstanbul, Turkey*

ABSTRACT

The current diagnostic classification systems in psychiatry have been developed primarily for evidence-based clinical decision making with both categorical and dimensional approaches having their own advantages and disadvantages. Efforts have been made to improve these classification systems, and we are now at the point where we must expand beyond the one-dimensionality of these systems. In this paper, we propose that psychiatric disorders can be arranged in a three-dimensional classification system according to the degree of dysfunctions on three specific axes in a way that is similar to the arrangement of chemical elements according to their atomic weights in Mendeleyev's periodic table. For the three axes, we chose externalization, drive, and attention to represent the three-dimensional descriptions of mental health, namely, well-being in social, motivational, and cognitive areas, respectively. Throughout the paper, we explain our reasons for choosing these three axes and compare our hypothesis with categorical diagnostic systems as well as Cloninger's dimensional diagnostic system using personality disorders, affective disorders, and schizophrenia as the specific diagnostic samples.

Introduction

Throughout the history of science, a classification system has frequently been required of all disciplines. A typical example is Mendeleyev's periodic table of chemical elements. In addition to being a summary of developments in chemistry until that day, Mendeleyev's table has also provided new ideas for future developments in chemistry. Put simply, periodic tables provide a total mental arrangement as a creative summation of the scientific developments up to that point in time.

Despite its extraordinary development, the human mind is more inclined to sum knowledge rather than retain the whole knowledge, and these summaries form the foundation for future information. The same holds true in psychiatry. For this purpose, diagnostic classification systems such as the Diagnostic and Statistical Manual of Mental Disorders (DSM) and International Classification of Diseases (ICD) have been developed. In clinical research, the diagnoses play important roles in seeking to understand the etiology and course of a disorder, identify effective and cost-effective treatments, and make evidence-based clinical decisions.

While the DSM-I and DSM-II were based on information about the etiology and psychodynamic formulation of the disorders, this information was excluded from the DSM-III. The DSM-IV then emphasized an evidence-based approach to diagnosis [1]. As a result, the names of the disorders in the DSM classification system were as common and meaningless as birth names. For example, there are thousands of people named Jane in the world, yet each "Jane" is a different person. The same is true for Major Depressive Disorder in that the term refers to a specific patient, not the disorder. Hence, the DSM-V added a dimensional component to each of the traditional categorical diagnoses in the DSM.

In the categorical systems, there are criteria and rules regarding the numbers and patterns of criteria required for a diagnosis. A patient either meets or fails to meet the relevant criteria for a specific diagnosis, and accordingly, a yes/no (categorical) diagnostic decision is rendered. By contrast, a dimensional system acknowledges that there may be clinically important individual differences among those who fall above and those who fall below a categorical dimensional threshold. Thus, rather than rendering only a single, dichotomous judgment regarding the presence or absence of a diagnosis, individual patients are rated on a quantitative dimension [2].

The relative advantages and disadvantages of categorical and

* Corresponding author at: Uskudar University, NP Brain Hospital, Saray Mah, Ahmet Tevfik İleri Cad. No: 18 Ümraniye, İstanbul, Turkey.
E-mail address: alper.evrensel@uskudar.edu.tr (A. Evrensel).

dimensional approaches to classifying psychopathology have been a matter of debate for many years [3,4]. Kendell and Jablensky note that carefully defined categorical diagnostic criteria have resulted in significant improvements in at least four domains of psychiatry: (1) diagnostic agreement (reliability) and communication; (2) more precise criteria and instruments based on those criteria, which have now become the norm in research; (3) teaching based on an international reference that provides a worldwide common language; and (4) public access to diagnostic definitions; together, these improve communications with patients [5]. Perhaps the greatest disadvantage of a categorical system is its limitations, both clinical and statistical, imposed by the forfeit of clinical information, which is an inherent problem when labeling patients based solely on whether their signs and symptoms collectively rise above a defined threshold [2].

Practicing clinicians are accustomed to adopting a dimensional perspective, e.g., severity of illness, in clinical practice to develop a treatment plan and assess clinical progress. This permits the creation of patient-specific diagnostic profiles across illness and helps to ensure that treatment efforts address the full range of current psychopathology [2]. This is especially true with respect to "psychosis". Evidence is provided on a continuum of psychosis ranging from self-reported, infrequent psychotic symptoms in the general population, to schizotypal personality disorder, and, finally, to full-blown psychosis, which results in a diagnosable primary psychotic disorder [6]. A categorical approach would dismiss many individuals who do not fulfill the criteria for schizophrenia, even though they exhibit psychotic symptoms. Bipolar spectrum is a similar example [7]. Perhaps the greatest disadvantage of a dimensional system is the increased complexity in clinical communication. As dimensional approaches strive to rate severity both within and across areas of psychopathology, rather than a single diagnosis, the conceptual structure is of a profile of scores representing the level of pathology in several illness domains. While this increases the amount of relevant clinical information conveyed by the diagnosis, it does not lend itself to simple communication [2].

Efforts have been conducted to improve these classifications systems, and these efforts have reached a certain maturity. We are now at the point where we must expand beyond the one dimensionality of these systems. In this paper, we propose that psychiatric disorders can be arranged in a three-dimensional classification system according to the degrees of the dysfunctions on three specific axes, a system similar to the arrangement of chemical elements according to their atomic weights on the periodic table. The World Health Organization defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity [8]. Parallel to this definition, it can be said that mental health is a state of complete social, motivational, and cognitive well-being, and accordingly, the three axes were selected based on this definition. The three axes we defined are (1) externalization, which reflects the functional level in the social arena; (2) drive, which reflects functionality with respect to motivation; and (3) attention, which forms the basis of cognitive well-being.

We describe each of the proposed three axes, provide an example of dysfunction at each axis in terms of classical categorical psychiatric diagnoses, and compare our view with Cloninger's dimensional approach to psychopathology. A representation of the three-dimensional psycho-periodic cube (PPC) can be found at http://www.psychocube.com.

Externalization

Externalization refers to the transition from being totally dependent on the mother to being in a position where one connects with the objects of the outside world. The human newborn, who is totally dependent on the mother for nurturing, is at a symbiotic state since he cannot differentiate between himself and the objects around him, and at the same time, is not aware of this dependence. As he grows, certain objects from the outside world are internalized into the psychic structure, and

he builds a sense of self based on these internalized objects. Now, since he can differentiate between himself and the objects in the outside world, he can also choose whether to approach or avoid objects in the outside world. We named this change process as externalization.

Externalization is said to be at an optimum level if the following conditions are met:

1) With regards to connections with other(s):
a) The differentiation between "me" and "other" is realistic. For example, "I am a continuum despite my biological/psychological changes and despite being surrounded by constantly changing time-space-people."
b) There is a relation, not a dependence, with outside objects.
c) One can relate to outside objects, e.g., other people, without violating their boundaries.
2) With regard to connections with oneself:
a) One can realize the needs of his soul and body and attempt to fulfill them.
b) One can relate to outside objects without violating his own boundaries.
3) One has reached an optimal level of existence that has developed on the basis of his genetic coding and consistent with the needs of the environment. Hence, there will be no further major developmental changes, but there will be continual minor adjustments.
4) The levels of novelty seeking and harm avoidance are reciprocally balanced.

To achieve externalization, (1) there must be a highly curious internal nucleus that exhibits seeking behavior, and (2) there must be outside objects that can be internalized.

Furthermore, there may be problems with externalization if

- There are not enough objects in the outside world.
- The objects in the outside world are perceived as harmful.
- The internal nucleus is not curious enough to externalize.
- The internal nucleus is too curious to externalize.
- The needs of the internal nucleus cannot be realized.

The steps of externalization of the internal nucleus of human beings is summarized by Ceylan [9] as follows:

Absolute internality

The newborn has a symbiotic relation with the mother. It is said he is in the "mother's cave". Even though the newborn is no longer in the womb he is still totally dependent on the mother not just for feeding but for being taken care of on every aspect of living. In a way the baby is now in a cave when he is taken care of and protected by the mother. This period coincides with the oral stage of psychosexual development [11].

Relative internality

The baby begins to separate from the mother and leave the "mother's cave", but instantly returns to the mother when he faces an extraordinary/unexpected stimulus from the outside world. This separation from the mother results in the ability to walk. This period coincides with the passage from the oral stage to the anal stage of the psychosexual development [11]. The strange situation experiments that are used to test Bowlby's attachment theory represent a good example for this stage [10].

Relative externality

The baby begins to leave the "mother's cave", explores his surroundings, and returns to the cave. The rules of the mother's cave apply

Table 1
Problems of Externalization Related to Personality Disorders Compared with Cloninger's psychobiological model of temperament and character (modified from [25]).

Cluster	DSM definition	Cloninger's model	Level of externalization
A	Odd Eccentric	Low RD	Low: Does not feel the need to externalize (schizoid); outside objects are unreal/magical (schizotypal); too suspicious to externalize (paranoid)
B	Dramatic Emotional Erratic	High NS	High: Needs objects in the outside world to use as toys (antisocial, narcissistic); self-approval (histrionic); avoid-approach pattern (borderline)
C	Anxious Fearful	High HA	The need to externalize is high, but the ability to externalize is low because of lack of social skills (avoidant); strict interpersonal rules (obsessive); need to attach to other to exist (dependent)

to the outside world. This stage coincides with the ending of the anal stage and the beginning of oedipal stage[11] as the "internal representations" of the attachment theory have been formed [10].

Absolute externality

The toddler no longer has the need to return to the "mother's cave" every time as he now has his "own cave". The rules of the mother's cave apply partially to his cave, and new rules are added from the outside World. This period coincides with the ending of the oedipal stage and continues throughout life [11].

The externalization process parallels the maturation of the bodily systems. The development of a human newborn begins at intrauterine life and continues outside the uterus. While most of the bodily systems are immature at birth, the most mature systems at birth are those needed for survival, such as primitive reflexes. Over time, the bodily systems pass through a developmental process that parallels the needs of the outside world. If the internal nucleus is not externalized, the result is an imbalance of homeostasis of the organism, which may cause death. For example, if a human fetus is not born after 40 weeks of pregnancy, meconium aspiration and death may occur. For this reason, we contend that externalization is one of the main axes of human life. Just as the roots of a plant seek water and the leaves of the plant seek sunlight, all systems of a human infant seek externalization, and all organs and systems differentiate, organize and stabilize according to the process of externalization. This differentiation occurs at different times and at different rates according to the different systems. Some systems have a parallel process. For example, the myelination of the nervous system parallels the intense production of antibodies in the immune system [12], whereas the gastrointestinal, endocrine, skeletal-muscle, and nervous systems continue to develop after birth.

The development of the nervous system includes the disappearance of the primitive reflexes, the myelination of axons, the development of autonomous control of the sphincter muscles, the hierarchical organization of the brain, the specialization of the sense organs and, accordingly, the formation of the psychic structure. The psychic structure is reflected through the nervous system and by its interactions with the other bodily systems. For example, the psychosexual development of an infant, as described by Freud [11], parallels the development of specific bodily systems.

The development of the human brain is a structurally and functionally non-linear process wherein higher-order association cortices mature only after the lower-order somatosensory and visual cortices, the functions of which are integrated, are developed and wherein phylogenetically older brain areas mature earlier than newer ones [13].

An example of externalization problems – personality disorders

In DSM-IV-TR personality disorders are on axis II. In our proposed PPC system we place personality disorders on the three different axes of the cube with the other psychiatric diagnoses. We regard the personality disorders and other psychiatric disorders on a continuum. As explained previously the degree of externalization mainly reflects how the interpersonal relations and the person's relation with himself are

regulated. It is widely accepted that interpersonal problems are a central area of difficulty among those with personality disorders. Object relations theorists posit that self-other representations are formed in early relationships, particularly between the infant/child and the primary caregiver, and that these cognitive representations play a central role in personality development [14,15]. Emotions and expectations attached to these representations are critically important determinants of functioning in interpersonal relationships [16]. Attachment theorists posit that children, based mostly on interactions with primary caregivers, develop internal models of the self and others that guide expectations and beliefs in relationships, particularly in times of stress [17]. The biosocial model, developed especially for borderline personality disorder by Linehan [18], suggests that an underlying biological vulnerability to emotion dysregulation, i.e., high sensitivity and reactivity to emotional stimuli and slow return to baseline after emotional arousal, transacts with environmental stressors, i.e., invalidation, to contribute to emotional and interpersonal impairments. More recent theories of interpersonal dysfunction in personality disorders point to problems in social cognition, such as perceptual biases, theory of mind difficulties and social problem solving [19]. These reports correspond to our idea of the steps of externalization of the internal nucleus of human beings as described earlier. Taking into account these enlightening ideas about the reason for interpersonal difficulties among those with personality disorders, we summarize our understanding and ideas about the problems of externalization with respect to the DSM-IV-TR's personality disorders in Table 1. Additionally, Table 1 includes a comparison of our hypothesis about externalization with Cloninger's psychobiological model for temperaments.

The relation between Cloninger's psychobiological model with externalization

According to Cloninger's neurobiological learning model, temperament is understood as an automatic emotional response that is relatively heritable and stable [20–25]. The three genetically inherited and independent temperamental dimensions are as follows [21]:

(1) Novelty Seeking (NS): This refers to the exhilaration and excitement NS individuals experience to novel stimuli or cues for potential rewards. NS individuals are characterized by excitability, curiosity, enthusiasm, and impulsivity, and they tend to become easily bored and easily angered.

(2) Harm Avoidance (HA): HA refers to marked worry or anxiety in response to signals of punishment. It is the tendency to be cautious, apprehensive, pessimistic and easily fatigued and is characterized by having a fearful disposition.

(3) Reward Dependence (RD): RD refers to a dependence on social approval and attachments. It includes the tendency to be sociable, sensitive, dependent and persistent and is characterized by attachment issues.

Later, a fourth variable, persistence, was separated from RD. These dimensions are conceptualized as heritable biases in the activation, inhibition, maintenance, and persistence of behaviors, respectively, and

reflect the individual differences in percept-based habits and skills [24].

More recent works from Cloninger's group have focused on character development. The three temperamental variables are thought to account for the behavioral and interpersonal style of individuals, whereas the character variables, namely, self-directedness (SD), co-operativeness (C), and self-transcendence (ST), are related to functional outcomes [23].

Previous works exploring Cloninger's model of personality disorders have repeatedly found that Cluster A personality disorders are associated with low RD, Cluster B personality disorders are associated with high NS, and Cluster C personality disorders are associated with high HA [26–31].

A summary of Cloninger's model and a comparison with our hypothesis regarding externalization problems in personality disorders are presented in Table 1. We posit that an optimal degree of novelty seeking is necessary for externalization, as novelty seeking creates a curiosity towards the outside objects. However, an optimal degree of harm avoidance is also required, since harm avoidance is necessary to avoid dangerous/harmful objects. Finally, degree of reward dependence is needed to build boundaries between internalized objects and the internal nucleus and to differentiate between oneself and the internalized objects. Accordingly, these three temperamental dimensions form the foundation of healthy externalization, and the balance among them indicates the degree of externalization. That said, an imbalance in any one of the three dimensions affects the degree of externalization. In turn, the degree of externalization, which is believed to be affected negatively by personality disorders, determines an individual's functionality in social relationships (Fig. 1).

Drive

In this paper, the term drive refers to the innate and acquired skills that are necessary to create and maintain homeostasis in the constant changing internal and external milieus.

If a person's drive is at an optimum level:

1) He uses mature defense mechanisms.
2) He engages in seeking a target, determining the target, following the target, and monitoring and managing the process to reach the target. If confronted with an obstacle in his attempt to attain the target, he identifies solutions to overcome the obstacle or, if it is impossible to overcome the obstacle, he finds a new target.

The following abilities and skills are needed to attain an optimum level of drive:

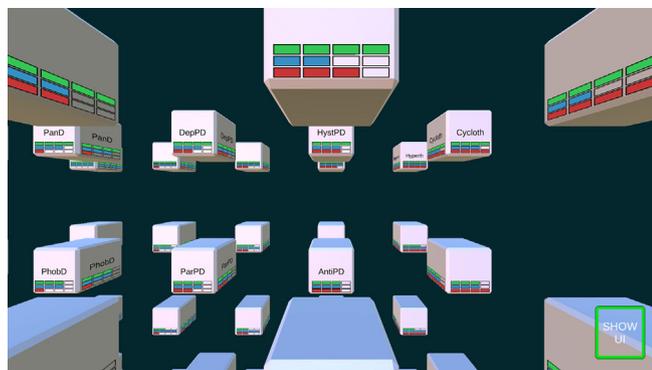a) A degree of curiosity, life energy and persistence are needed to seek and follow the target.

Fig. 1. The position of the Dependent personality disorder (DepPD), Hystrionic personality disorder (HystPD), Paranoid personality disorder (ParPD) and Antisocial personality disorder (AntiPD) in the psycho-periodic cube.

b) The ability to learn and an optimum IQ (intelligence quotient) are needed to identify ways to follow and reach the target and to learn from mistakes.
c) The ability to assess reality. For example, is the target attainable? Is the target congruent to the person's past and future expectations?
d) An optimum level of EQ (emotional intelligence), the ability to regulate the affective state and to delay gratification.
e) Social skills and SQ (social intelligence) are needed to obtain social support and build cooperation with others while striving to reach the target.
f) Self-esteem is needed as it contributes to one's inner sense of being loved and valued.
g) Compassion is needed as it strengthens the inner richness and thus increases the ability to have allies while striving to reach the target.

In the event of optimal drive strength, the person will maintain his sense of well-being and his functionality even when faced with adverse life events. The autobiographies of many famous people from the arts and sciences fields are good examples of strong functionality despite negative childhood experiences and low socio-economic backgrounds. Furthermore, many psychiatric disorders are the result of isolation from daily activities, which, in turn, results in a decrease in one's drive. For this reason, we propose that drive should be the second main axis of the PPC.

In this paper, drive is reflected in the strength of accomplishment, and as such, it requires energy. Whereas the necessary energy comes from the life energy of the organism, it is supplied by the various abilities and skills of that organism, as described above. While much of this energy is innate, a small part of it develops with the help of environmental factors, and thus, it is a form of epigenetic phenomena. While drive is not the ego strength as described by classical psychoanalytical writings, it incorporates and requires ego strength. In this sense, it may be perceived as having the potential to guide one's life.

In general, psychiatric disorders occur when the person cannot drag his life, but rather is dragged by life. If we consider life as a flat plateau with hills in some parts, the person can drag his life (or he thinks that he can drag his life) across the flat areas. When he is faced with hills, if he does not possess an optimum level of drive, he can no longer control his life and instead is dragged by life. This situation may eventually lead to a psychiatric disorder. It is important to predict the possible hills (prediction error) and modify one's behavior according to these possible hills. If the prediction error is minimised, then the hills can be easily overcome. The prediction error can be minimised by repeated experience, which results from persistence. However, if the individual is not persistent, he may easily give up after the first prediction error, which then decreases the strength of his drive. Accordingly, it can be concluded that the strength of one's drive is closely related to his ability to predict error and be persistent. The predictive processing framework (PPF) approach states that one of the brain's main tasks is to infer the sources of different incoming signals from the signals themselves and create a hypothesis about the outside world. It is hypothesized that the brain minimises prediction errors to conserve free energy [32,33]. Dysfunctions of PPF as a model for psychiatric disorders were suggested in previous work [34,35].

Similar to a skillful driver who does not lose control of his car even under difficult external conditions, such as a bad road, a person who possesses an optimum level of drive strength does not lose control of his behavior, emotions, or cognition under difficult conditions. Therefore, we propose that drive is the problematic axis in affective disorders.

Affective disorders as an example of drive problems

Drive is a critical factor in two major affective disorders, major depressive disorder and bipolar disorder. A major depressive episode is characterized by a lack of motivation, low self-esteem, anhedonia, mood dysregulation, and cognitive and social dysfunctions. These

symptoms individually and collectively decrease the individual's strength of accomplishment and life energy, i.e., his drive. Loss of pleasure and interest in nearly all activities (anhedonia) is closely related to drive and is one of the core features of a major depressive episode [36]. Similarly, feelings of inadequacy and hopelessness, which are core symptoms of depression, result from low self-esteem, which is necessary for optimal drive strength [37] and is also closely related to relapse and suicidality [38]. Impairment in mood regulation [39,40], which is described as a vulnerability to develop a depressive state and an inability to disengage from that state [41], may negatively impact drive and is also a core feature of a major depressive episode. Memory deficits, difficulty in concentration [42–44], and indecisiveness, which are the most frequent cognitive dysfunctions seen in a major depressive episode, may cause a decrease in the social and daily functioning of patients [42–45] and, hence, may also decrease drive strength.

A manic episode is characterized by an increase in self-esteem, problems with affective regulation, cognitive symptoms, a decrease in social functioning, and problems differentiating between reality and fantasy, again, all symptoms that are closely related to drive. Whereas a manic person has sufficient life energy, he has difficulty applying this energy in productive and appropriate ways. Hence, in a depressive episode, one's drive decreases, whereas in a manic episode, the individual has difficulty appropriately applying his drive. Elevated self-esteem in manic patients results from the increased processing of internally generated evaluative information about the self [46]. However, bipolar patients exhibit a deficit in the use of habitual emotional regulatory strategies [47]. The finding that difficulties associated with inhibitory control and memory continue even after remission in bipolar patients suggests that cognitive dysfunction may be a trademark of bipolar disorder [48], and moreover, this cognitive dysfunction seems to negatively affect both occupational and social functioning of those with bipolar disorder [49].

Given these results, we posit that drive, as the second axis of PPC, is negatively affected in affective disorders (Fig. 2).

The relation between Cloninger's psychobiological model with drive

We further theorize that that persistence, which is the fourth temperamental dimension and is separated from Reward Dependence in Cloninger's dimensional approach [50], and self-directedness, one of the three character dimensions [23], are closely related to our concept of drive.

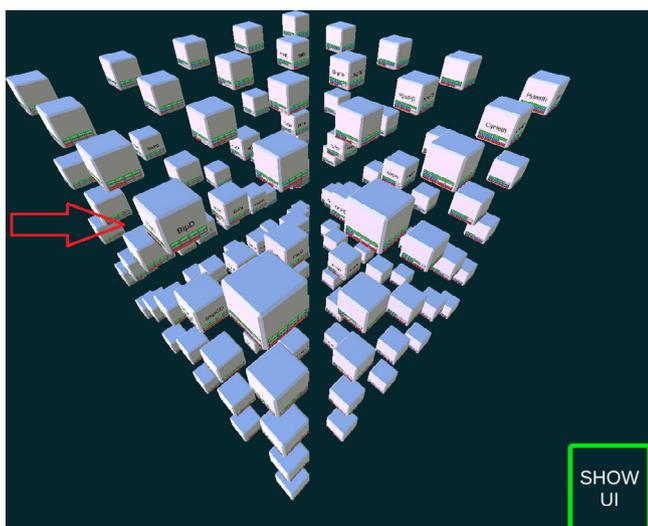SD is described as the ability to regulate and adapt behavior to the demands of the situation to achieve one's personally chosen goals [50]. This is closely related with our definition of drive. Low self-directedness is defined by poor impulse control and weak ego strength and is characterized by irresponsibility, purposelessness, helplessness, and low self-acceptance [25], which correlates with our definition of low drive strength. A recent meta-analysis of temperament and character dimensions in patients with mood disorders, i.e., bipolar disorder and major depressive disorder, has concluded that low SD may be a trademark for both given that it continues even after remission and is also observed in unaffected siblings [51].

A high level of drive denotes an insistent and persistent approach. Persistence includes a tendency to continue the behavior even when faced with frustrations and obstacles and to not give up easily on one's objectives. Persistence can be highly adaptive with stable, intermittent reward patterns, but maladaptive when reward contingencies change frequently [50]. Persistent individuals are eager, ambitious, and determined overachievers, all definitions that align with our definition of drive. Studies have found that there is a significantly lower level of persistence in those with bipolar disorder and with major depressive disorder [52] and that this low persistence has been found to be related with more frequent suicide attempts [53] and residual manic symptoms [54].

Attention

Attention may be considered as a foundation or as a precursor of many neurological and cognitive functions. Attention helps one filter out the distracting environmental stimuli and focus on the relevant stimuli by exploiting all cognitive sources. In this paper, we use the term attention in a broader sense than the classical neurocognitive writings. Accordingly, in this paper, attention includes the following abilities and skills:

1) Insight: This implies a focus on the self and includes the ability to appreciate the current situation, to remember and know one's self history, and to predict the near future. Insight is a reflection of one's body, mind, and feelings.
2) Outsight-A: This includes attention to others and helps to answer the following questions: Who is the other? What is his current situation? What may have happened to him in the past? What may happen to him in the future?
3) Outsight-B: This includes an attention to concepts and orientation and helps to answer the following questions: What time is it? Where am I? Whom I am with?
4) The ability to know the relationship between oneself and another. It helps to answer questions such as "Is he a friend or an enemy?" and "Do I know him?" This function of attention is closely related to Theory of Mind.
5) The ability to sustain attention. This ability is necessary for one to complete tasks, and it helps to consolidate long term memory.
6) The ability to shift attention: This is necessary when more important stimuli occur, i.e., one must shift from the less relevant to the more relevant.
7) The ability to make plans: This function of attention is closely related to executive functioning.

Attention contributes to self-regulation by creating voluntary control over thoughts, emotions, and behaviors. Accordingly, this understanding of attention supports the idea that disturbances in attention may cause or may be caused by psychopathologies [55,56]. Consider, for example, a person whose attention is totally absent. A lack of any degree of attention results in continuous problems with object relations, may cause the person to become socially isolated, may lead to major depression, and may cause the individual to withdraw back from all objects. Thus, a lack of attention will cause a person to become someone without any objects. If there is no attention, there are no

Fig. 2. The position of the Bipolar disorder (BipD) in the psycho-periodic cube (red arrow).

objects. This, of course, is an extremely severe condition, and as such, it is not in accordance with a healthy life. Therefore, we conclude that attention helps us to build object relations and contributes to our sociality, which is why we chose attention as the third axis of PPC.

Attention is determined to be an important cognitive function for building steady object relations. In particular, outsight-A, which is the ability to know and understand one's relationship with others, is essential for developing steady object relations. With respect to attention deficits, there is also a repeated difficulty with regard to object relations. The term "repeated" is important because, if there is an optimum level of attention, then the mistake committed when facing the object for the first time will not be committed when facing the object for a second or repeated times. Sustained attention allows us to modify responses according to the needs of the object. Attention can be considered a tool for objective measuring. If the person does not have possess this objective measuring capacity, dysmetria related to object relations can occur and may cause problems when attempting to meet the needs of objects/others

Attention is also closely related to insight. Insight into illness, or "clinical insight," involves the awareness of the illness and the attribution of symptoms to the disease and is necessary for treatment compliance. Where it is the crucial diagnostic criterion for psychotic disorders, it has been found to be affected by many psychiatric and neurological disorders, such as bipolar disorder [57], anorexia nervosa [58], dementia [59], and Alzheimer's disease [60]. Furthermore, clinical insight significantly correlates with quality of life, psychosocial functioning, less severe symptomatology, better therapeutic compliance, and fewer readmissions [61]. Another form of insight is "cognitive insight", which is described as the capacity to distance oneself from erroneous beliefs and the ability to make a correct evaluation of one's interpretation using the external feedback of others [62]. Both cognitive and clinical insight are closely related to attention, executive functions, and working memory [63–65].

Although cognition is important, Cloninger did not include it when describing his dimensional model. Nonetheless, attention is an important cognitive function that may be affected by almost any psychiatric disorder. Accordingly, from among the disorders, we choose schizophrenia to explain the problems at the attention axis of our PPC, given that, based on its broad definition, attention is affected in many ways in schizophrenic patients (Fig. 3).

Schizophrenia as an example of attention problems

Abnormalities in both sustained attention [66–68] and attentional set-shifting [69–74] have been reported in schizophrenic patients, and several studies have suggested a correlation with a worse prognosis and a poorer quality of life [75,76]. Sustained attention deficits seem to be independent from medications [77]. It has been determined that there are significant functional differences in the various regions of the brain that are related to the attention system in schizophrenia [78]. A reduced attentional performance has also been highlighted in non-affected relatives of schizophrenic patients [79,80], and thus it has been proposed as a candidate endophenotype for schizophrenia [81–83]. Attention specifically and cognition in general may increase the risk of developing psychosis among high-risk individuals [84–87].

Thus, attentional deficits are important with regard to the onset and the prognosis of schizophrenia is schizophrenic patients. Studies have been conducted to understand the possible mechanisms of attentional deficits in schizophrenia. Among them, the dysregulation of thalamic sensory transmission plays a leading role. For example, as the human brain cannot simultaneously process all of the stimuli and information it receives, attentional mechanisms are needed to filter out the irrelevant stimuli and information. This filtering process of conscious perception, which is possibly embedded in the thalamocortical networks, must be performed by an efficient and well-organized inhibitory mechanism.

The best candidate for this filter is the thalamic reticular nucleus (TRN). The TRN plays a pivotal role in dynamic attention by controlling thalamocortical synchronization [88]. In animal experiments, the corticofugal glutamatergic pathways have emerged as powerful regulators of a variety of subcortical mechanisms [89,90], where the dorsal and ventral striata appear to play major roles in the feedback loops controlling the thalamic filter function. These loops appear to be important regulators of wakefulness and psychomotor activity. A deficient filter function will lead to an overload of sensory input to the cerebral cortex and hyperarousal and may ultimately cause a breakdown of the integrative capacity of the cerebral cortex and psychosis [91].

It has repeatedly been argued that there is a dysregulation of thalamic sensory transmission in schizophrenia [88,91–94]. In schizophrenia, the impact of sensory input on the self-organization of thalamocortical activity may be generally reduced, and as a result, the processes underlying perception can become uncoupled from sensory input, particularly during times of hyperarousal. Hence, this uncoupling may lead to the domination of the attentional mechanism and the

Fig. 3. The position of the Schizophrenia (Sch) in the psycho-periodic cube.

emergence of hallucinations. Excessive neural noise in specific thalamic nuclei may cause hallucinations in schizophrenia. Nicotinic receptor abnormalities, dopaminergic hyperactivity and glutamate-receptor hypofunction are reconciled with a model of psychotic symptom generation that places crucial emphasis on the dysfunction of the reticular thalamic nucleus [92].

Hallucinations, which are a common symptom in schizophrenia, may reflect a dysfunction of the attentional control networks that then leads to the inappropriate interpretation of ambiguous percepts [95]. Attentional control networks include the following:

(1) Default Mode Network (DMN): The DMN includes the medial prefrontal, medial temporal, posterior cingulate, and lateral parietal cortices as well as the precunues [96,97]. The DMN is related with task-independent thought and mind wandering.
(2) Ventral Attention Network (VAN): The VAN includes the superior frontal cortex, anterior insula, and temporo-parietal junction [95]. The VAN mediates the activation of other networks and engages attention to salient stimuli.
(3) Dorsal Attention Network (DAN): The DAN includes the frontal eye fields, the dorsolateral prefrontal and parietal cortices as well as specific areas of the striatum, e.g., the caudate nucleus [98,99]. The DAN is associated with voluntary orienting and cognitive information processing.

Impairments in neural communications between the external world and the DAN would therefore lead to an over-reliance on other attentional networks to interpret ambiguous stimuli. When DAN is underactive, exogenous perceptual information cannot be utilized to update the interpretation of ambiguous percepts. A hallmark of schizophrenia is the presence of constant and unnecessary neural responses to environmental and internal salient stimuli, leading to the over-activation of the VAN [100] and the subsequent recruitment of the DAN to stimuli that have no ecological salience, having been incorrectly attributed salience by the dysfunctional attention system [101]. Furthermore, schizophrenia has recently been associated with a decrease in synaptic density within the anterior insula cortex [102], along with decreased gray matter in the temporal cortical regions associated with the processing of auditory information [103–105]. As such, hallucinations in schizophrenia, which are predominantly auditory in nature, may reflect an inability to appropriately orient attention through the DAN to salient phenomena, thus leading to the inappropriate interpretation of poorly attended auditory signals as being externally created [96].

Thus, attentional deficits may be responsible for both positive (e.g., hallucinations) and negative (e.g., social withdrawal) symptoms in schizophrenia. For this reason, we contend that schizophrenia should be placed at the low end of the attentional axis of the psycho-periodic cube.

An example of placement and scoring of the three axes

We propose that schizophrenia has an externalization score of 0 out of 5, because they have difficulties in their connections with others and with themselves and there is no balance between novelty seeking and harm avoidance. Drive score is 0 out of 5, because people with schizophrenia use immature defense mechanisms, they can't engage in seeking a target, their ability to assess reality is distorted, they have social skill deficits, and they have emotional intelligence problems. Attention score is 0 out of 5, because the insight and outsight are problematic and there are difficulties in sustaining and shifting attention.

Conclusion

In this paper, we proposed a new three-dimensional classification system for psychiatric disorders. The reader may refer to the website

http://www.psychocube.com for a three-dimensional journey into the corridors of the psycho-periodic cube. When we considered the disadvantages of current categorical and dimensional diagnostic classification systems in psychiatry, as discussed in the introduction of this paper, we found there was a need to develop a new system. The main issue was to decide which axis to use. Among the many possibilities, we selected externalization, drive, and attention to represent the three-dimensional explanation for mental health, i.e., well-being in social, motivational, and cognitive areas, respectively. We have explained the meaning of each of the three axes, although the definitions presented herein are broader than those associated with the classical understandings of the terms. We have also compared our model with a categorical diagnostic system and with Cloninger' psychobiological approach, which represents the dimensional system. Our purpose was to add a deeper and different approach to the current classification systems in psychiatry, albeit, our hypothesis is only theoretical at this time. Accordingly, empirical evidence is needed before this hypothetic approach may be applied to everyday clinical practice.

Conflicts of interest

There are no conflicts of interest to declare.

Role of the funding source

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