

A Three-Dimensional Model of Thoughts: Insight into Depression

Martin Desseilles^{a, b, d} Trina Chang^b Camille Piguet^d Gilles Bertschy^c
Alexandre G. Dayer^{d, e}

^aCyclotron Research Centre, University of Liège, Liège, Belgium; ^bDepression Clinical and Research Program, Massachusetts General Hospital, Harvard Medical School, Boston, Mass., USA; ^cDepartment of Psychiatry, University of Strasbourg and University Hospital of Strasbourg, INSERM (Unit 666), Strasbourg, France; ^dDepartment of Basic Neurosciences, University Medical Center, and ^eDepartment of Mental Health and Psychiatry, Geneva University Hospital, Geneva, Switzerland

Key Words

Thoughts · Cognition · Mood · Depression · Creativity

Abstract

Thought processing and mood regulation are closely linked, but existing classifications of mood disorders fail to recognize the complex interplay between these two clinical dimensions. Furthermore, existing classifications fail to account for the possibility that depression might be associated with an increased frequency of self-referential thoughts that could in some circumstances be related to creativity processes. Based on recent evidence from clinical phenomenology, experimental psychology and affective neuroscience, we propose a novel comprehensive theoretical framework that incorporates thought processing and emotional valence. This new taxonomy provides insights into the clinical understanding of the spectrum of mood disorders and accounts for the possibility of increased creativity in altered mood states.

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In everyday life, it is commonly assumed that the content of thought is as important as – if not more important than – the process. However, research suggests that vari-

ous aspects of thought process may be extremely important in determining mood. For example, if someone is ruminating with a narrow focus and a constrained and limited associative thought pattern, he/she might feel depressed [1]. However, if someone has also a low variability of thought and if thought speed is fast, he/she might feel more anxious as well as depressed [2]. These examples illustrate that it is important to consider both thought content and thought process in order to have a better phenomenological understanding of mental states, which in turn could promote insight into the pathophysiology of psychiatric disorders and help tailor specific psychotherapeutic interventions.

These examples also illustrate several key dimensions of thought: thought speed, thought variability, thought content and associations. In this article, we will first review the current models of thought processing in the context of mood disorders [1, 2]. Then we will propose that in some circumstances altered affective states might elicit creativity and that existing theoretical models of thought processing fail to fully integrate this dimension. Based on clinical phenomenology, experimental psychology and affective neuroscience, we put forward a new theoretical framework that includes thought processing and emotional valence and that accounts for the possibility of increased creativity in altered mood states.

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Martin Desseilles, MD, PhD
Cyclotron Research Centre, University of Liège B30
8, allée du 6 Août
BE-4000 Liège (Belgium)
Tel. +32 4 366 3687, E-Mail m.desseilles@ulg.ac.be

Thought Processing in Relationship to Mood Regulation: Current Models and Limitations

As proposed by Pronin and Jacobs [2], there are several elements that constitute the concept of mental motion. First, mental motion can be described in terms of thought speed: how many thoughts per unit of time are present. During slow thinking, there are few thoughts in mind, while during fast thinking, there are many thoughts in mind. While fast thinking is generally associated with positive affect and even manic elation with racing thoughts, slow thinking is generally associated with a negative tone and eventually elicits depressive feelings [2]. Second, mental motion can be described in terms of thought variability: the proportion of thoughts that are the same (i.e., repetitive) or not (i.e., variable). This element is hypothesized to be correlated with thought speed in that repetitive thought leads to decreased thought speed and can elicit feelings of anxiety or depression. By contrast, variable thought leads to increased thought speed and can elicit states of daydreaming, elation or even mania [2]. In addition, Pronin and Jacobs [2] proposed two key principles that regulate mental motion. One of them, the combination principle, postulates that fast, varied thinking leads to elevated mood, while slow, repetitive thinking results in depressed mood. The other principle, the content independence principle, holds that the specific nature of thought content is independent of the effects of both thought speed and variability. In other words, thought speed and variability affect mood separately from the content of thought [2].

Pronin and Jacobs [2] have used this concept of mental motion to reconceptualize depression and other mood states. By experimentally manipulating one of their variables, they have been able to induce specific mood states in their subjects. For example, Pronin and Wegner [3] used several methods in order to accelerate thought in healthy subjects (i.e., instructions to brainstorm freely, exposure to multiple ideas, encouragement to plagiarize others' ideas, performance of easy cognitive tasks, narration of a silent video in fast-forward, and experimentally controlled reading speed). They observed that increased thought speed was accompanied by positive affect [3]. In addition, they suggested that effects of thought speed on mood are partially due to the subjective experience of thought speed and that these effects can be attributed to a positive effect of fast thinking (i.e., 'joy-enhancing' effects of fast thinking) rather than to the diminution of a negative effect of slow thinking (i.e., the 'joy-killing' effects of slow thinking) [4]. Together, these studies suggest

that thought sequences that have more 'motion' (i.e., occurring fast and varying widely) usually lead to more positive affect than do sequences that have little 'motion' (i.e., occurring slowly and repetitively) [2]. However, in certain circumstances, speed and variability can oppose each other. This gives rise in this model to various psychopathological patterns such as fast and repetitive thinking, which can induce more anxiety than depression. As Pronin and Jacobs [2] have noted, fast thoughts that go 'nowhere' may feel more 'frustrating and anxiety-provoking than joyous and exhilarating'.

Other ways to conceptualize mental motion and its relationship to mood have been studied. For example, Bar [1] has proposed associative processing as key to depression. Associative processing can be described as cortical activation of associations between thoughts. Bar [1] pointed out a reciprocal association between mood regulation and level of associative processing, whereby positive mood promotes associative processing and vice versa. Bar [1] hypothesized that an evolutionary pressure for learning and predicting could have led to a reciprocal interaction between the cortical activation of associations and mood regulation. He further suggested that mood could be a reward mechanism that induces people to use their brains in the most productive manner. According to this hypothesis, associative patterns might underpin creative processes in certain circumstances; for example, during hypomanic and manic states among artists suffering from bipolar disorders.

However, these models do not explain certain clinical phenomena, such as increased creativity in depression or the presence of crowded thoughts in certain depressive and mixed states [5]. Examples abound of artists who produced immensely creative work while in a depressed state, such as T.S. Eliot, Virginia Woolf and Sylvia Plath.

While we might consider that these last centuries' artists had a depression (disorder) from the perspective of contemporary nosography, we recognize that the integration of the psychopathology of these artists in today's diagnostic schemes is reductive. More complex and nuanced mental states such as grief, sorrow, reaction to loss, discouragement, or depressive mood (state) might be more accurate to depict the rich diversity of subjective experiences in comparison with depression as a disorder.

The psychoanalytic theory of mourning was articulated by Freud [6] in 'Mourning and melancholia' and since then the theory of mourning has undergone many additions and shifts in emphasis [7]. Many authors consider mourning to be a critical factor in creativity (for a

review, see Ornstein [7]). For Ogden, 'successful mourning centrally involves a demand that we make on ourselves to create something – whether it be a memory, a dream, a story, a poem, a response to a poem – that begins to meet, to be equal to, the full complexity of our relationship to what has been lost and to the experience of loss itself' [8, p. 65]. More recently, Verhaeghen et al. [9] found that students with a history of depression also reported greater creativity, a relationship that appeared mediated entirely by self-reflective rumination. In other research, negative tone was shown to increase cognitive perseverance (i.e., the number of ideas within a particular cognitive category) and to lead to creative fluency and originality [10]. Depressive rumination was also shown to reflect a trait associated with more stability (goal maintenance) than flexibility (goal shifting), leading to both beneficial effects (fewer errors on a goal maintenance task) as well as detrimental ones (more errors on a goal-shifting task) [11]. These examples suggest that sad mood might be linked to increased associations coupled with creative associations (fig. 1).

In the same vein, mixed states are not fully explained by the variables described by Pronin and Jacobs [2] or by Bar [1]. Mixed states include fast thinking and increased thought quantity, which according to the models above should be associated with positive mood. However, by definition, mixed states include a depressive component. They could be likened to a traffic jam in which there are many cars entering a highway, speeding and not exiting the roadway. This clinical state illustrates that fast thoughts do not always induce positive mood.

A New Framework to Explore the Link between Thought Processing and Emotional Regulation in the Context of Mood Disorders

Since neither Bar's hypothesis [1] nor Pronin's model [2] accounts for creative depressed individuals or individuals in mixed states, we propose a new framework to explain these phenomena. Specifically, we propose three distinct dimensions: (a) thought associative pattern, (b) quantity of thoughts and (c) emotional valence – as well as an additional principle, the thought continuum principle – in order to account for the rich phenomenology of mood disorders and the interplay between thoughts and mood from normal to pathologic states.

The thought associative pattern reflects a combination of the speed, variability and fluidity of thought. Previous models have shown that thought variability or as-

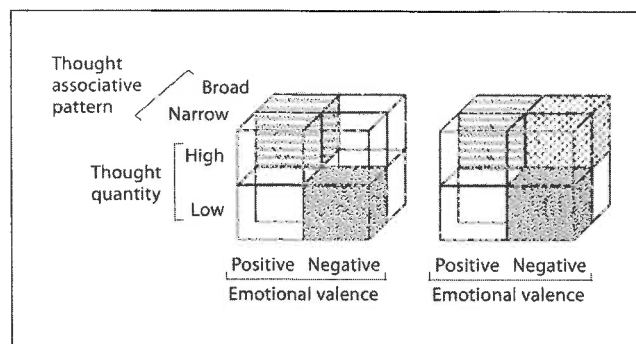


Fig. 1. Three-dimensional model with emotional valence, thought quantity and thought associative pattern. The left cube presents the two situations proposed by Bar [1]: positive emotional valence with broad associative pattern and high quantity, or negative emotional valence with narrow associative pattern and low thought quantity (i.e. ruminations). The right cube presents an additional condition with negative emotional valence, broad associative pattern and high thought quantity, which is supposed to lead to creativity during depression.

sociative processes are partly linked to thought speed [1, 2]. The thought associative pattern reflects the sequence that relates to thoughts produced around a theme (i.e., broad or narrow). For instance, during depression, the central mechanism might be the difficulty of letting go to current thoughts and the need to brood on them more and more. Most of the time, this condition is associated with decreased thought quantity and narrow associative pattern, and it leads to slow speed and a very limited number of thoughts, a typical state of depressive rumination. But sometimes the difficulty of letting go of current thoughts, in combination with depressed mood, might be associated with increased thought production as a result of cognitive excitation. This could lead to a specific type of 'tachypsychia' [from the Greek words *tachos* (swiftness) and *psuchè* (mind); it translates loosely as 'rapid mind' or 'fast psyche'] [12]: there are many new thoughts, unable to leave the mind and probably going at high speed (psychic agitation), thus resulting in crowded thoughts with a narrow associative pattern rather than linear racing thoughts with a broad associative pattern as in hypomania. This specific situation could occur when the depressed mood is associated with cognitive excitation, as in a predominantly depressive mixed state [5, 13].

Below, we propose that in various circumstances a broad associative process is not necessarily associated with a positive tone of thought content. Such broad nega-

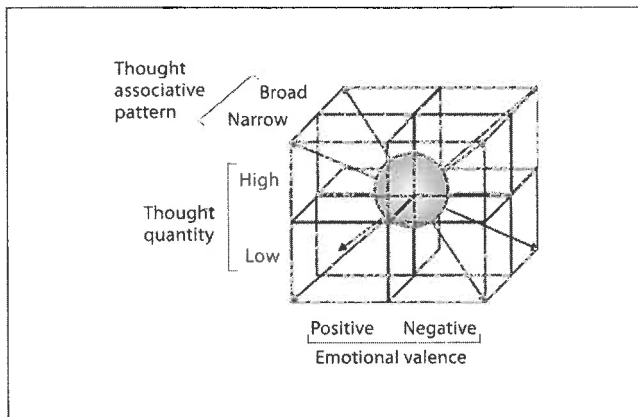


Fig. 2. Schematic representation of the variability of thought content and processes. Our framework proposes a dimensional approach of thought content and process and postulates that healthy thought processes borrow some attributes from each category according to the internal and external environment.

tive associations contrast with the narrowed associative process seen in ruminative depressed subjects and support the need for a more detailed analysis of thought processes in depressed patients [5].

Based upon clinical phenomenology, experimental psychology and affective neuroscience, we propose a second axis: thought quantity. This axis reflects the amount of thoughts regardless of the underlying causes. Modifications in thought quantity can depend on changes in the production of new thoughts or changes in the survival rate of thoughts [5]. Thought quantity is supposed to be partly linked to thought associative pattern and thought speed, whereby high thought quantity accompanied by broad associations may lead to hypomanic mood in some circumstances and low thought quantity accompanied by narrowed associations may lead to dejection, in accordance with Bar's and Pronin's models [1, 2].

Another major axis is emotional valence of the content of thought. The Velten procedure constitutes strong evidence that the emotional valence of thought content is one determinant of affect/mood. The Velten procedure consists of a series of statements that become increasingly elated or depressed, depending on the condition [14]. These statements are explicitly designed to induce a depressed or elevated mood by reading them. Researchers can thus reliably induce depressed or elated mood by using this well-established Velten effect [15, 16]. In psychiatry, emotional valence is an important clinical characteristic that may define or distinguish between different

clinical conditions. One major distinction made in mood states is the dichotomous division between positive and negative mood. For instance, mood during pure or non-mixed hypomania or mania is frequently positive or irritable, as opposed to mood during depression, melancholia, grief, mourning or mixed states, in which mood has a negative tone [17]. Similarly, the same opposition can be seen with affective tone during dreams (happy dreams, neutral dreams or nightmares) [18], 'trips' in substance use (good or bad trip) [19], or hypnotic induction [20].

In order to account for the interplay between thoughts and mood from normal to pathologic states, we propose a thought continuum principle (fig. 2). According to this continuum, broad versus narrow thought association patterns, high versus low thought quantity and positive versus negative emotional valence are not pathological symptoms per se. Rather, the concern should be whether thought processing and emotional valence are appropriate in a given situation and whether these processes are transient and not fixed. For example, fast, associative, positive thinking that appears only in a brainstorming situation and is not sustained (as would be seen in mania) can be considered as an adaptive brain response. Another example would be intrusive thoughts: while anyone may experience intrusive thoughts, not everyone will experience them as repetitive and permanent as they might be experienced in depressive ruminations. A third example is provided by self-reflective thoughts. They are an essential human feature and can lead to creativity, planning, and correction of errors, all of which are positive consequences. However, if self-reflective thoughts increase, they can lead to depressive rumination. In addition, this continuum can be seen with meditation. Mindfulness meditation training teaches being in the present moment where there is no cause or effect, thus leading to a decrease in associations, retrieval of memories, and rumination. At the extreme, however, this meditative state might lead to a drift from reality, potentially leading to impaired social interactions in the absence of feedback from and impact on the external environment. Thus, well-determined patterns of thoughts (e.g. self-reflection, metacognitive awareness) present sometimes an invasive state of mind that can be difficult to regulate or may even be counterproductive, such as in the case of the thought suppression paradox (in which trying not to think about a thought paradoxically increases the intrusiveness of the thought) [21].

In summary, several elements and principles have been described in previous models of thought processing:

(a) thought speed, (b) variability of thought patterns or associations, (c) combination of thought speed and variability of thought modulating affect, and (d) independence of thought content [1, 2]. Based on these previous data, we introduce a three-dimensional model that includes thought associative patterns, quantity of thoughts and emotional valence. Figure 2 is a schematic representation of the normal variability of thought processing and emotional regulation. As addressed in the following sections, this model allows us to take into account the possibility that in some instances altered affective states such as depression can trigger creativity.

How Different Clinical Dimensions of Affective States Can Be Explained by This New Theoretical Framework

The combination of three distinct dimensions (thought associations, thought quantity and emotional valence) leads to the theoretical existence of 8 potential different states. In this section, we will review how different clinical dimensions of affective states fall into these 8 potential dimensions. Since a major limitation of existing models that focused on thought processing and emotional regulation is that they fail to recognize the possibility that depression can trigger creativity, we will address this specific question.

Depressive Creativity

Negative mood is traditionally associated with lower creativity [22]. Current models propose a direct reciprocal relation between the cortical activation of association [1] or thought speed or variability [2] and mood regulation, whereby positive mood promotes associative processing [1] and creativity [2]. Based on several observations derived from experimental psychology, affective neuroscience, and artistic creativity, we extend this view and propose that depression in some cases could provide key insights associated with broad creative associations with a negative valence.

Artistic Creativity

Creativity refers to the experience whereby something new (e.g. for an individual, for a society or in a particular field) is created which has some kind of value. Throughout the last decades, many definitions of creativity have been proposed. Guilford [23] proposed that creativity is composed of the unstructured inventiveness and the constructive-ordering abilities which can manifest

through the actions on the object. For Guilford [23], inventiveness is displayed in activities in which discovering, designing, and inventing are the main characteristics. Both abilities should come together in a balanced relationship. For Matussek [24], 'Words that go with creativity are originality, inventiveness, flexibility, discovery, the extraordinary, and the novel'. For him, creative potential is not the attribute of the exceptionally talented. It is present in almost everyone and can be activated in every situation.

Similarly, Arieti [25] differentiates between 'great creativity', which is reserved for exceptional individuals, and 'ordinary creativity', an ability which almost everyone has. More recently, Mihalyi Csikszentmihalyi [26] identified a distinctive characteristic of creative people: the capacity to experience what he called 'flow', whose definition is the timeless and total involvement of individuals in the activity in which they are engaged. According to this author, in flow, the concentration is focused on what we do, here and now. 'One-pointedness of mind is required by the close match between challenge and skills, and it is made possible by the clarity of goals and the constant availability of feedback' (p. 112). Achieving a flow state is linked with optimal performance in the fields of artistic creativity [27]. In this review, creativity refers to the experience whereby something new (e.g. for an individual, for the society or in a particular field) is created which has some kind of value. On the basis of previous literature, we will focus on thought processes and expend the description of Csikszentmihalyi regarding the 'flow'.

'Human kind cannot bear very much reality', wrote the famous poet T.S. Eliot [28] after suffering from intense bouts of depression. The link between sadness and creativity through poetry [29], writing [30], painting and music suggests the possibility of making rich semantic and aesthetic associations that could be qualified as 'broad' associations (see Box 1). It is likely that in certain circumstances, and depending on each individual's previous abilities, a depressive mood enables the unique experience of a painful reality that stimulates the generation of powerful insights into what constitutes the human condition. An extensive review of all artists who produced some creative work during depression goes beyond the scope of this paper. However, we present through a sample of artists the idea that thought processes associated with depression could lead to broad associations with a negative valence, in a state that is considered creative.

Box 1. Examples of the link between sadness and creativity through poetry, writing, painting and music

Thomas Stearns Eliot (1888–1965) is one of the dominant figures in poetry and literary criticism in the English-speaking world and was honored with the Nobel Prize in Literature in 1948. He published *The Waste Land* in 1922 after a period of enormous pain and depression. This highly complex poem which reflects the fragmented experience of the 20th-century sensibility of modern life is considered the single most influential poetic work of the twentieth century. This melancholic poem is viewed as the expression of the horror of a sterile world in which human beings search for some signs of promise or redemption. Many of its phrases entered the common idiom: ‘April is the cruelest month’, ‘I will show you fear in a handful of dust’.

Gérard de Nerval (1808–1855), one of the most essential Romantic French poets, suffered from a manic-depressive disorder and committed suicide in 1855, hanging himself from a window grating. In addition to all his production, he left a brief note to his aunt: ‘Ne m’attend pas ce soir, la nuit sera noire ou blanche’ (‘Do not wait up for me this evening, for the night will be black or white.’). Thus, in this last poem, de Nerval made broad associations and perhaps a joke since, intriguingly, Emile Blanche was the name of his physician in 1855.

Sarah Kane, a British playwright (1971–1999), wrote a play (‘4.48 Psychosis’) from the point of view of someone with severe clinical depression and intense suicidal ideation, a condition from which she suffered, and killed herself after writing the play and before it was performed. This play reveals an increased thought production and intense creativity subtended by broad associations even if the hyperactive and distant associations illustrate also the psychotic component of her depression.

Samuel Taylor Coleridge (1772–1834) was an English poet, Romantic, literary critic and philosopher who was one of the founders of the Romantic Movement in England and one of the Lake Poets. Throughout his adult life, Coleridge suffered from crippling bouts of anxiety and depression, and it has been speculated that Coleridge was affected by bipolar disorder, a mental disorder that was unknown during his life. Coleridge chose to treat these episodes with opium, becoming an addict in the process. Nevertheless, during depression he wrote ‘Dejection: An Ode’ that inspired the great wail of melancholic Romantics. The reading suggests that the experience of suffering enriches existence if it is moderate [30]. Coleridge was capable of making his negative emotions poetically workable [50].

Stéphane Mallarmé (1842–1898) was a major French symbolist poet and critic, and his work anticipated and inspired several revolutionary artistic schools of the early 20th century, such as Dadaism, Surrealism, and Futurism. He is suspected to have suffered from seasonal depression, and one severe depressive episode inspired his tragedy ‘Hérodiade’.

Théodore Géricault (1791–1824) was a French painter whose entire life story is one of changes and innovations. Nothing is more novel than his portraits of the insane he painted for his psychiatrist, Doctor Georget. Each of these paintings was in fact a kind of occupational therapy prescribed by Georget for one of Géricault’s frequent bouts of depression. The uniqueness of the works lies in the fact that they were among the first to depict an abnormal mental state as illness, rather than a laughing matter.

Robert Schumann (1810–1856), a German composer and influential music critic, was one of the most famous and important Romantic composers of the 19th century. Suffering from manic-depressive disorder, he began to work on a number of compositions, including *Genoveva*, during his depressions.

Clinical Phenomenology

Apart from severe depressive episodes of long duration, which constitute the majority of episodes of inpatients with depression, we propose that a sad mood with a negative valence occurring during physiological experience (as during mourning, emotional breakdown, separation, pain of losing a loved one) and sometimes leading to clinical depression can be related to broad associations with a negative/melancholic tone. These associations can be related to an increased fluidity/speed of thoughts. This state could lead to artistic production depending on each individual's abilities. In addition and more generally, sad mood with a negative valence can lead to an increased need to speak about and share some feelings, which suggests that a psychic pain with a negative valence, if not long enough to constitute a full-blown and deep depressive episode, could be a powerful means to strengthen social bonds, stimulate empathy from others and provoke rich evocations, great memories and nostalgia. Many examples of these behaviors are provided through displayed manifestations of empathy following terrorist attacks (e.g. September 11), natural catastrophes (e.g. a tsunami) or the death of a celebrity or a political or spiritual leader as well as following the death of a loved one, losses and an emotional breakdown. These examples contrast with the co-existing behavior through which people observe a period of grieving, marked by withdrawal from social events and quiet respectful behavior. But even in these cases, certain religious traditions provide occasions of social exchange giving place to broad associations in case of the loss of a loved one. Active thought associations, both qualitatively and quantitatively, could be a condition to revisit the many, at times contradictory, facets of the links with the lost object, a condition to integrate a certain level of ambivalence, a necessary step for the mourning process. Mourning and depression share several characteristics such as the loss of interest in the outside world and the loss of the capacity to love. At a certain level, sad mood constitutes a narcissistic withdrawal and makes it possible to organize the world on the basis of internal, subjective perceptions ('in-sight') and not on the basis of external perceptions. This particular state of enhanced self-referential focus and of creative process establishes the possibility of creating broad associations with negative valence, related sometimes to the expression of the creative process, depending on personal preexisting abilities.

Experimental Psychology

Several psychological experiments suggest that self-reflective rumination and negative tone lead to creativity

in particular concerning insight problems. An early study suggested that the association between depression and creativity was the result of self-reflective rumination [9]. Congruent with this study, negative tone was shown to increase cognitive perseverance (i.e., the number of ideas within a particular cognitive category) and to lead to creative fluency (i.e., the number of nonredundant ideas, insights, problem solutions, or products that are being generated) and originality (i.e., the uncommonness or infrequency of the ideas, insights, problem solutions, or products that are being generated) [10]. Even more recently, depressive rumination was shown to reflect a trait associated with more stability (goal maintenance) than flexibility (goal shifting) leading to both beneficial (fewer errors on a goal maintenance task) and detrimental effects (more errors on a goal-shifting task) [11], as discussed earlier. Creativity is a multifaceted construct, and negative mood could differentially influence several facets of creative thinking. For instance, negative mood significantly facilitated creative problem-solving performance, but no significant effect was shown with an analytic reasoning task [31]. Overall, intense negative emotion can lead to prevailing self-reflective thoughts and perseverance and then lead to enhanced creativity. These observations seem to run counter to evidence from previous models [1, 4].

Affective Neuroscience

Different observations derived from affective neuroscience reveal that depression and self-referential thoughts have biological substrates and can lead in some circumstances to enhanced creativity underpinned by broad associations of negative valence. For example, increased creativity was linked to a hormonal predisposition towards negative affect in a recent study by Akinola and Mendes [32]. Their findings suggested that an individual's biological vulnerability to negative affect (i.e., low baseline levels of an adrenal steroid, dehydroepiandrosterone sulfate, which have been linked to depression) interacts with exposure to situational intense negative emotions (i.e., social rejection) to increase artistic creativity. This suggests that situational triggers of negative affect influence creativity as well as biological vulnerability to negative affect. Another aspect of creativity and a crucial human feature is the ability to think beyond the present experience and reflect upon the past (i.e., autobiographical memory, self-referential thoughts), the future (i.e., prospecting), and the minds of others (i.e., 'theory of mind' ability). These three cognitive processes have been associated with the pattern of activity of cerebral regions

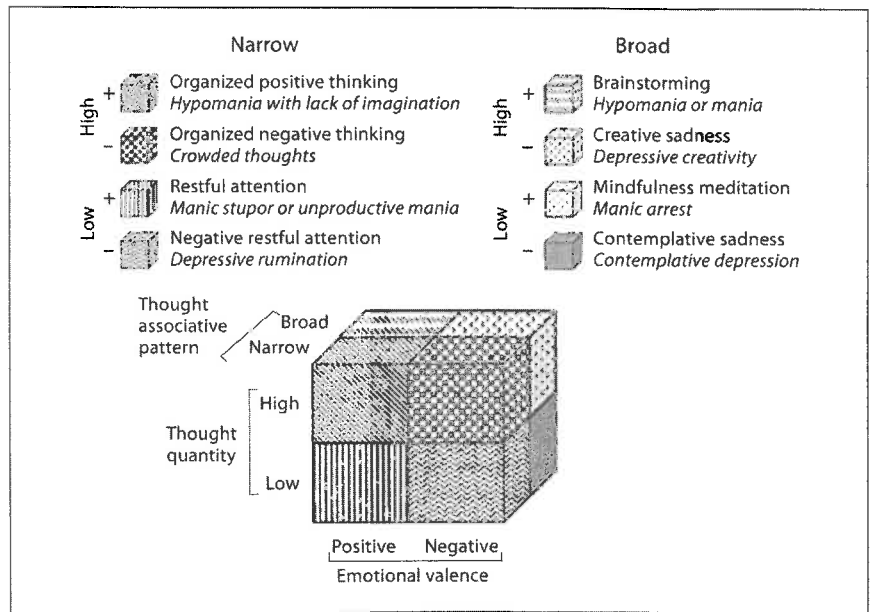


Fig. 3. Three-dimensional model with emotional valence, thought quantity and thought associative pattern. We describe for each potential category along the three dimensions a normal and a pathological state (in italics). Narrow or broad = Narrow or broad associative pattern; low or high = low or high thought quantity; + or - = positive or negative emotional valence.

that is typically observed at 'rest', called the default mode network, which includes midline cortical areas as well as the ventromedial prefrontal cortex [33]. In addition, patients with depressive symptoms show increased activity in the medial prefrontal cortex as compared to healthy subjects [34]. Recently, a study showed that depressed patients had increased neural filtering of irrelevant visual information in a low attentional load condition as compared to healthy subjects [35]. These results have been interpreted as an indication that depressed patients engage important cognitive resources even in a simple pop-out task, which consequently restricts the processing of peripheral distractions and might reduce the spatial spanning of attention. An alternative and complementary interpretation could be that the reduced spatial spanning of attention restricts the possibility of being distracted by irrelevant visual information, leading to an apparent better control of 'noise filtering', while greater allocation of attentional resources to self-referential thoughts could lead to better insight, producing associations with a negative valence that could be creative at times and could become the trap of depressive ruminations at other times.

While considering the medial prefrontal cortex as a whole, its increased activation in this region seen in depressed patients and linked with self-focused thought [36] might lead to various patterns of thought content and process.

Other Manic-Depressive States

We have shown that data from experimental psychology, affective neuroscience, and artistic creativity suggest that depressive states might be accompanied by an increase in self-referential thoughts that could be related to the process of creativity. Now, we would like to further illustrate three core points derived from this paradigmatic clinical state of creative depression. The first one is that creative processes might be preferentially related to broad associations. Consequently, our models would identify several mood disorder entities linked to broad association and creativity. The second one is that while we focus on clear-cut clinical entities at the extremities of each dimension, more adapted entities could be described between these extremities. Consequently, we describe for each potential category along the three dimensions a normal and a pathological state. A third point is that the states we describe could be combined and are likely to alternate and to change across time, maybe even during the same clinical episode.

The creative process is habitually described as involving a free processing style of atypical associations among ideas [2, 37, 38]. It has been conceptualized as involving the generation of a high quantity of varied original ideas in a short period of time [2, 38]. Pronin and Jacobs [2] reviewed that positive mood may promote creativity by enhancing loose cognitive associations [39, 40]. The reverse causal direction might also be possible, i.e., diver-

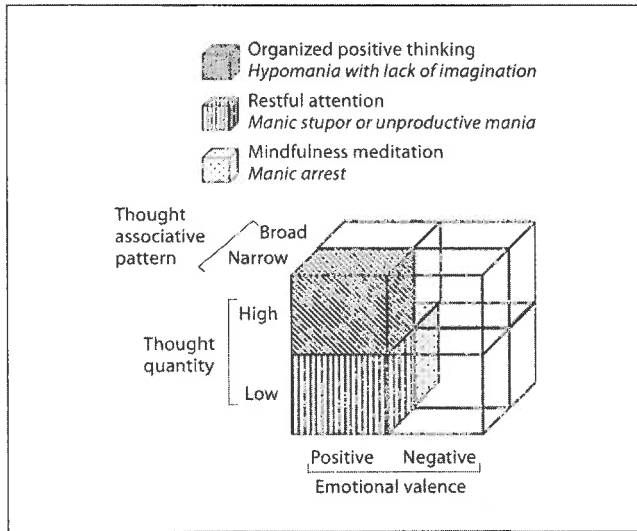


Fig. 4. Schematic representation of concentration, mindfulness meditation and restful attention. We describe for each potential category along the three dimensions a normal and a pathological state (in italics).

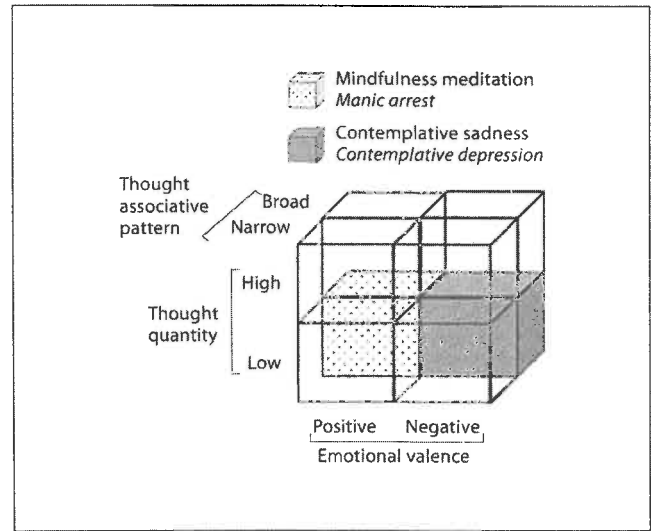


Fig. 5. Schematic representation of mindfulness meditation and contemplative sadness. We describe for each potential category along the three dimensions a normal and a pathological state (in italics).

gent thinking might contribute to positive affect. Pronin and Jacobs [2] suggest that mental blocks that happen in creative individuals such as writers or painters and that are characterized by nonstop fixed thoughts that fail to take a new direction might contribute to the unpleasantness of those experiences. Here we suggest that broad associations among ideas might be constructed around negative themes and that negative mood may be associated with creativity even when these broad associations are present.

Incorporating the preceding remarks and the three dimensions previously retained, we would like to propose the following categorization/distribution also illustrated by figure 3.

(1) *Low quantity of thoughts, narrow associations, positive valence*

Normal: positive restful attention (fig. 3, 4): the subject is positively open to the processing of internal and external stimuli. This might be encountered when a person presents positive reactivity to stimuli without being associated with a creative output.

Pathological: manic stupor [41]: state of rapturous emotion (fig. 3, 4). The stupor inhibits thought processing and is accompanied by poverty of ideas and thus no creative output. In unproductive mania [41], the situation is similar but with an increase in motility or activity.

(2) *Low quantity of thoughts, broad associations, positive valence*

Normal: daydreaming, mindfulness, states that can lead to creative insights. Experience of an encounter with God in believers, or transcendental experience in meditators (fig. 3–5). Mindfulness meditation involves being aware, by focusing attention, of all experiences happening in the present moment either internally (e.g. feelings) or externally (e.g. subjects or objects seen, smelt, heard), in a nonjudgmental fashion [42].

Pathological: manic arrest [41] or ecstatic mania (fig. 3–5): the intense ecstasy inhibits thought quantity but leads to broad associations that can have the character of mystic revelations about the world. Writings of some mystic saints.

(3) *High quantity of thoughts, broad associations, positive valence*

Normal: creative brainstorming, imaginative problem-solving (fig. 3).

Pathological: typical hypomania or mania [41] accompanied by racing thoughts that might potentially lead to creative thoughts or projects (fig. 3).

(4) *High quantity of thoughts, narrow associations, positive valence*

Normal: organized positive efficient thinking but lacking novelty or imagination (fig. 3, 4).

Pathological: between unproductive mania and hypomania, hypomanic organized racing thoughts in this state lack novelty or imagination (fig. 3, 4). Patients do not surprise us with the quality or originality of their hypomanic-manic state.

(5) *Low quantity of thoughts, narrow associations, negative valence*

Normal: negative restful attention: the subject is negatively open to the processing of internal/external stimuli (fig. 1, 3). Negative reactivity to stimuli, but no creative output.

Pathological: depressive rumination (fig. 1, 3), where thoughts and ideas tend to be circumscribed to a few morbid items [43].

(6) *Low quantity of thoughts, broad associations, negative valence*

Normal: contemplative state of sadness that can be associated with creative insights (fig. 3, 5). Romantic poems written after a romantic disaster.

Pathological: contemplative depression that can lead to creativity (fig. 3, 5).

(7) *High quantity of thoughts, broad associations, negative valence*

Normal: sadness with creative imagination (fig. 1, 3). State of mourning where memories of the lost loved one trigger broad and rich associations.

Pathological: creative depression (fig. 1, 3). Enduring state of mourning associated with creativity.

(8) *High quantity of thoughts, narrow associations, negative valence*

Normal: organized thinking with negative valence and lacking novelty or imagination (fig. 3).

Pathological: crowded thoughts lacking novelty or imagination (fig. 3). Depressed patients with racing thoughts often describe that 'their head is full of thoughts that they cannot stop' [5]. The appellation 'crowded thoughts' has consequently been proposed to better describe these racing thoughts in the context of depression or mixed depression [43], forming a type of mixed state characterized by a full depressive syndrome and a few hypomanic symptoms [44]. No strong creative output.

Discussion

While creativity was clearly present in certain exceptional individuals who suffered from a depressed mood, it has not been conceptualized in such terms for 'nonexceptional' people who are grieved, sad or even depressed. However, according to previous literature, achieving a

'flow' state is linked with optimal performance in the fields of artistic creativity. This suggests that creativity processes are not the prerogative of exceptionally creative individuals. Here we extend this suggestion and propose that creativity might occur in 'nonexceptional' people at various levels and act as a therapeutic process that does not necessarily give rise to exceptional artistic outcomes.

Overall we have developed/explicated the theory that depression might be associated with creativity processes through higher frequency of self-referential but broad associative thoughts. The activation of these broad associations might allow the depressed subject to gain insights into the human nature/condition and help him/her to develop metacognitive awareness of the depressive experience. The construction of metacognitions or metarepresentations as exemplified in works of art but possibly also existing in nonhuman species [45] might prevent stereotypical ruminations and act through similar pathways as cognitive therapy and mindfulness-based cognitive therapy [46]. If this is confirmed by further experimental testing, it remains to be established why depressive states can generate broad and creative associations in certain individuals and not in others. A first possibility might reside in the fact that for professional artists, as well as for amateur artists who represent a large fraction of the general population, the production of works of art is a lifelong quest responding to an 'inner necessity', as described by the painter W. Kandinsky in his theoretical writings [47]. This artistic goal-oriented drive usually predates the depressive episode and could persist during the experience of depression. It is thus possible that the persistence during depression of this reward-related artistic drive could activate part of the broad associative network described by Bar [1]. Another nonexclusive possibility is that negative mood per se promotes broad associations in some individuals independently of their artistic drive and that the triggering key factor is an increased level of thought quantity, similar to what is reported in hypomanic states. We have to remind ourselves of the association between creativity and vulnerability to bipolar disorder as demonstrated in family studies of bipolar patients (more creative people than in the family of controls) or in clinical studies of creative people such as writers (high prevalence of bipolar disorders) [48]. Perhaps bipolar vulnerability facilitates the occurrence of a dissociation between the field of mood/emotions, cognitive activity and drive/energy according to the classical Kraepelinian distinction: depressed mood (inhibition) could be associated with an

increase or at least preservation of thought quantity and associative process. During mourning, a similar process could be activated at least during the initial phase of mourning, allowing empathy, emotional sharing and the strengthening of social bonds. This process could represent transient hypomanic activation to counterbalance grief and pain (evoking a classical intuition of psychoanalysts that hypomania could sometimes function as a defense against depression). Because most people cannot sustain such an energy-consuming activated mode of adaptation, this would be transient in most cases. The only exception might be people with a bipolar diathesis. But even if transient, this temporary activation of thought quantity and associative processing could be effective to help individuals begin to adapt to the loss. Some individuals will not and, perhaps because of vulnerability to depression, may be at risk of becoming depressed [49].

In short, we propose that a broad associative process is not necessarily associated with a positive tone of thought content, and we have provided an illustration with creative production in depression as clinical paradigm. Such broad negative associations contrast with the narrowed associative process seen in ruminating depressed subjects and argue for a detailed analysis of the thought processes and content in depressed patients [5].

Conclusion

In conclusion, we propose a three-dimensional model of thoughts with emotional valence (e.g. positive, negative), thought quantity (e.g. high or low) and thought associative pattern (e.g. broad or narrow) as the main axes (fig. 3). Our framework postulates that thought processes can vary along each of these dimensions depending on the situation, becoming pathological only at the extremes. In this view, variations along these three axis are non-pathological if they occur transiently and constitute an appropriate adaptation to internal/external challenges. 'Abnormal' states might be represented by excessive and/or inappropriate use of one strategy, as illustrated in figure 3. An abnormal state could occur when a mismatch occurs between the internal stimulus (i.e., beliefs and goals) and the external requirements – for example, a mindfulness meditation state during an important interview or a contemplative state of sadness while efficient administrative work needs to be done.

Our model presents the advantage of not requiring an answer to the question of the dynamic causality between

dimensions (thought associative pattern, thought quantity, and emotional valence). Indeed, it helps to refine our understanding of some conditions and to integrate everyday life experiences and pathological conditions along a continuum. Thought content both influences and depends on thought processes, and in the end, the subprocesses cannot be separated, since they are likely to overlap and influence each other mutually. In that view, we recognize that a model with orthogonal dimensions, such as the model we propose, is unlikely to reflect the reality. Nevertheless, in this paper, we presented several clinical applications in order to illustrate that a phenomenological point of view could lead to a new taxonomy of thought processes that impact on diagnosis. Further multidimensional models might help to create a better representation of the complexity of thought processes and psychiatric disorders.

This review should stimulate the necessary research to validate or reject the model being proposed.

Finally, existing therapeutic approaches aiming at developing metacognitive awareness of the depressive experience, such as mindfulness therapy, might be reframed along the proposed model. Additionally, a novel therapeutic approach acting on thought dimensions and promoting creativity might also be derived from the present model.

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