Review

The prisoners of despair: right hemisphere deficiency and suicide

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Abstract

This paper presents an integrative approach to understanding of the inner experience of suicidal persons in terms of hemispheric asymmetry. The right hemisphere is involved in formation of polysemantic context. Polysemantic context is determined by multiple interconnections among its elements, while each concrete element bears the stamp of the whole context. Left hemisphere functioning leads to formation of monosemantic context. It is suggested that due to functional insufficiency of the right hemisphere the suicidal person demonstrates a compensatory shift to left hemisphere functioning. This shift manifests itself in reversed asymmetry of neurotransmitters, tendency to dissociation, alienated and negative perception of the body, lower sensitivity to pain, disintegration of self-representation, cognitive constriction, overly general nature of personal memories, difficulties in affect regulation as well as such personality traits as low openness to experience and personal constriction. This hypothesis raises a number of suggestions for future research.

Keywords: Suicide; Hemispheric asymmetry; Dissociation; Self-representation; Body perception; Affect regulation; Cognitive rigidity; Pain perception; Early development

Contents

1. The right and the left hemispheres: the problem of context .......................................... 800
2. Right hemisphere deficiency and suicide ......................................................................... 802
2.1. Right hemisphere: structural abnormalities ................................................................. 802
2.2. Neurotransmitters: reversed asymmetry ...................................................................... 802
2.3. EEG: right hemisphere dysfunction ............................................................................ 803
2.4. Dissociation .................................................................................................................. 803
2.5. Disintegration of self-representation ........................................................................... 803
2.6. Body perception .......................................................................................................... 804
2.7. Pain perception .......................................................................................................... 805
2.8. Affect regulation ......................................................................................................... 805
2.9. Cognitive style: constriction ........................................................................................ 806
2.10. Overly general memories of suicidal persons ............................................................ 806
2.11. Dead to the world: psychological suicide and low openness to experience .............. 807
3. The suicidal crisis ........................................................................................................... 807
4. Early development and etiology of suicidal tendencies ................................................ 809
5. Conclusions ..................................................................................................................... 810
Acknowledgements ........................................................................................................... 810
References .......................................................................................................................... 810

In this paper I will delineate a new holistic approach to understanding of the personal experience and dynamics of suicidal persons in light of various psychological and physiological findings. Suicide is defined as a deliberate, lethal self-injury with or without a conscious attempt to die [177]. Accordingly, suicide intent is defined as intent to commit suicide. Suicidal state of mind encompasses various aspects of personal experience of suicidal people, such as feelings, thoughts and attitudes, before making a suicidal act. The proposed approach offers a systematic,
integrative, and holistic understanding of this state of mind. It attempts to view the personal experience of suicidal individuals in terms of findings from various fields of research, and it is based on the convergence among these domains. I contend that suicidal state of mind cannot be understood without reference to various emotional, cognitive, neurochemical, and morphological aspects and processes that jointly generate it. The deadly interaction of these processes produces suicidal state of mind that can express itself in various forms of suicidal behavior: suicidal ideation, suicidal attempts or completed suicide. Some recent findings concerning the hemisphere asymmetry allow deeper understanding of these processes.

1. The right and the left hemispheres: the problem of context

Studies focusing on brain asymmetry have been increasing since the first investigations by Sperry, Gazzaniga and their associates [64,65,207]. The first theoretical conceptualizations suggested that the left and the right hemispheres process qualitatively different information [64,65,207]. In particular, the left hemisphere was thought to be involved in processing verbal material, signs, and symbols, whereas the right hemisphere was thought to be involved in handling non-verbal material, images, melodies, and spatial information.

However, other researchers refuted this point of view. In fact, in split brain subjects the right hemisphere is able to process verbal constructions, if they are not too complicated [49]. Electroencephalogram (EEG) activity in the right hemisphere predominates during reading stories, whereas EEG activity in the left hemisphere predominates during reading science textbooks [160]. Although all melodies are a type of non-verbal information, right ear (e.g. the left hemisphere) is superior to the left ear in perception of dichotically presented melodies if they differ only in rhythm [73]. Split-brain subjects are able to report their dreams [86], even though a dream is a visual experience. The left hemisphere is superior to the right hemisphere in perceiving faces with outstanding features (such as a very long nose [161]). Language signs for hearing impaired people are non-verbal. However, the ability to use signs is damaged by the left-hemisphere strokes [23].

According to another approach, human hemispheres differ in terms of information processing [73]. That is, the left hemisphere processes verbal and non-verbal sequential information. The function of the right hemisphere is single-stage, parallel processing of many elements of information as a single whole. However, that point of view cannot account for findings that the left hemisphere is also able to grasp a series of data simultaneously, and can do so as rapidly as the right hemisphere does [170].

According to yet another point of view [72,71], the left hemisphere is responsible for the maintenance of familiar forms of behavior, whereas the specialization of the right hemisphere includes detecting novel and unexpected events. However, even this approach cannot account for all existing data. It cannot explain the advantage of the left hemisphere in identification of strange faces, or the advantage of the right hemisphere in identification of normal faces with which the subject is familiar [161].

To explain the diversity of results in the field it was suggested [178,180,182,183] that the difference between the two fundamental and most important strategies of thinking (which are customarily associated with functions of the left and right hemispheres of the human brain) is reduced to the opposite modes of organizing the contextual connections among elements of information. Left hemispheric, or formal, logical thinking organizes any sign material (whether symbolic or iconic) so as to create a strictly ordered and unambiguously understood context. Its formation requires the active choice out of innumerable, real and potential connections between the multiform objects and phenomena, of few definite connections that would not create internal contradictions. The choice would be the one most appropriate for facilitation of a sequential analysis. This type of thinking makes it possible to build a pragmatically convenient, but simplified model of reality. This model is based on probabilistic prognosis [53] and a search for concrete cause-and-effect relations. In fact, probabilistic prognosis is a function of the left hemisphere [135]. It is precisely for this model that the vector-time orientation exists.

In contrast, the function of right hemispheric, or image, thinking is to simultaneously “capture” an infinite number of connections and through that capture to form an integral but ambiguous context [180]. In that context, the whole is not determined by its components, because all specific features of the whole are determined only by interconnections between the parts. Any concrete element of such a context bears an imprint of the whole. Perception of each concrete moment is brought in line with the entire past experience, with the already shaped picture of the world and with the impact of this capture on the status of thinking. Individual aspects of images interact on several planes simultaneously. Examples of such contextual connections are the connections between images in sleep dreams. In fact, dreaming is associated with increased activity of the right hemisphere [63]. The advantages of that strategy of thinking manifest themselves only when the information itself is complex, internally contradictory and basically irreducible to an unambiguous context. In that case, some existing connections, from the viewpoint of formal logic, can be perceived as mutually exclusive and, accordingly, many of them remain unrealized, forming the basis for intuition and creative realization.

This approach [180] states that only the right hemisphere functions according to the kaleidoscopic model and to the model of neural networks with parallel connections. Overlap and crosstalk are the main advantages of right
hemisphere thinking, which provide the creation of the polysemantic context and the combination of two or more concepts in a unitary pattern. The complicated interaction between concepts only exists for the linear monosemantic left-hemisphere system. That is especially true if all those concepts are encoded by the same units of the system and an overlap appears. For this reason, the encoding of information in a linear system is successive and not parallel. In contrast, the parallel system for the encoding of information represented simultaneously in many units is a mechanism of polysemantic context. The combination of different concepts, each represented in every unit of the holographic system, can be seen as illustrative of the proposition that the holographic system of the right hemisphere includes not the separate concept, but rather a holistic and mosaic picture of the world. Each separate concept is only a small component of that picture. Hence, every newly perceived component is integrated in the mosaic picture together with all the other components. The process, therefore, is one of integration and not of inference.

In contrast, left-hemisphere mechanisms bring about the distinguishing and structuring of some pragmatic monosemantic results extracted from the polysemantic mosaic. It is evident that the declared differences are most similar to the differences between the iconic and the symbolic systems of representation. The main distinction is that this approach emphasizes the arrangement of contextual relations rather than the consecutive or simultaneous nature of the synthesis [180,194].

Research provides increasingly abundant evidence that the ability to organize polysemantic context is a specific function of the right human hemisphere and need not be further amplified by the brainstem reticular formation. The ability of the right hemisphere to generate polysemantic contexts is associated with the pronounced alpha-activity in that hemisphere [182]. Particularly, in healthy subjects tested under normal conditions, the left hemisphere is always more active than the right, as revealed by the frequency and the amplitude of the alpha rhythm, or by the alpha-index. The intensity and uniqueness of daydream images show a positive correlation with the alpha-index [103]. Vivid mental visualization does not decrease EEG synchronization for persons who have well-developed image thinking [45]. In meditation, which corresponds to the right hemisphere pattern of thinking, alpha waves have high amplitude and become generalized [159]. People with high ability to generate polysemantic contexts display high alpha-activity over the right hemisphere. Conversely, people with low potential for formation of polysemantic contexts demonstrate desynchronized pattern of EEG in the right hemisphere [182].

The left hemisphere data-processing pattern, contrary to that of the right hemisphere, requires higher cerebral activity for the sole reason that it attempts to arrange the available information and distinguish the few relevant links in a multitude of irrelevant relations.

A number of studies supported the suggestion that the right hemisphere organizes information into polysemantic context, while the left hemisphere is involved in formation of monosemantic, strictly organized, and logical context. It has been found that while the left hemisphere activates only closely related information, the right hemisphere activates both closely and distantly associated information to the same degree [22]. In line with this, Coney and Evans [39] reported that the right hemisphere immediately and exhaustively activates various meanings associated with a word, while in the left hemisphere access is restricted to the dominant meaning. It seems plausible that for these reasons, only the right hemisphere is able to comprehend lexical metaphors [12]. Similarly, right hemisphere damage leads to decreased ability to understand metaphorical material [33,225].

Emotions are closely associated with the right hemisphere [68,92,93,94,95,98,115,180,183]. Emotional experience is essentially polysemantic and multidimensional. Words can name emotions, but they cannot convey the essence of emotional experience. Emotions continuously transform themselves into other emotions. That continuous transformation is the essence of personal experience. Only polysemantic context, formed by the right hemisphere, can sustain emotional experience in its uniqueness, inner complexity, and elusiveness. Studies demonstrated a close association between the right hemisphere functioning and emotions. Particularly, patients who suffer right-hemisphere damage are less facially expressive than patients who suffer left hemisphere damage [28] and have impaired recognition of facial expression of emotions [30]. Facial expressions are more intense on the left side of the face than on the right side [29]. The right hemisphere is faster and more accurate than the left hemisphere in discriminating between facial expressions of emotions [108,209] and is more efficient in processing emotional words [76]. Similarly, the cortical surface regions that best correlate with impaired recognition of emotion are the right inferior parietal cortex and the right mesial anterior infralcalcarine cortex [3]. What is important, the left-hemisphere lesions do not produce impairment in emotions recognition [3].

Western culture assumes that an activity should always have a purpose; a known goal should be accomplished. However, the activity of the right hemisphere in creation of the polysemantic context involves no statistical predictions and sets no cause-and-effect relations. The right hemisphere is responsible for predictions that extend beyond the actual statistics and thus come close to the experience brought about by insight. Its mechanism is yet to be identified. Right-hemisphere predictions may be kaleidoscopic in nature: many versions of the future exist simultaneously and are equally probable. As a result, the occurrence of any event, even if it is improbable from the perspective of past experience, has the same weight as a product of reasoning [180,181].

The development of the right hemisphere depends on the
quality of the relationship with the caregiver during the first years of the development [181,193]. If these interactions are mostly positive and mutual, they enable the infant to explore his or her emerging capacities in the safe environment created by affirming interaction. These interactions generate positive affects while negative affects are regulated by the caregiver as well as by the growing abilities of the infant. Mutual positive affects are accompanied by elevation in such substances as dopamine and norepinephrine that stimulate neural tissue growth, increase mutual connections between cortical cells and enable further maturation of the right cortex [192,193,194]. These enable the emergence of “the potential space” [226] — one of the most important abilities of the right hemisphere. However, severe traumata or repeated emotional stresses, which cannot be adaptively balanced by the emerging infant’s capacities, lead to predominance of unmanageable negative affects that elevate corticosteroids [194]. This increase in corticosteroids inhibits dendritic branching, reduces brain nucleic acid synthesis, and leads to axonal death [95,194]. Dopamine increases under stress [25] and induces neurotoxic inhibition of mitochondrial respiration and defective energy metabolism [24], which may lead to programmed cell death [124]. These stress-induced neurochemical changes lead to structural and functional alterations in the right hemisphere, which become the general, non-specific predisposing factor for psychopathology. In fact, the right hemisphere dysfunction is involved in various forms of psychopathology [41,58,181]. Early traumata experienced as the “psychic catastrophe” [27] lead to formation of functionally insufficient right hemisphere that cannot form polysemantic context and regulate affects.

The ability of the right hemisphere to generate polysemantic context makes possible perception of spatial information, pain, and music, representation of self- and body-image [96,179,180], processing of emotions and emotionally laden memories [183], and affect regulation [194]. From the perspective of this understanding of the functioning of the brain hemispheres, it can be proposed that suicidal persons demonstrate functional deficiency of the right hemisphere. Under the burden of mental pain, the right hemisphere collapses. Consequently, the person’s mode of experiencing and functioning is largely determined by the left hemisphere. Mental pain coupled with decreased right hemisphere functioning determines the suicidal state of mind. Below I will review some findings that support this understanding of the personal experience of suicidal people.

2. Right hemisphere deficiency and suicide

2.1. Right hemisphere: structural abnormalities

Suicidal persons demonstrate structural abnormalities in the right hemisphere, and right hemisphere injury may increase suicidal tendencies. In fact, Altshuler and colleagues [8] studied structural abnormalities in brains of 17 non-suicidal victims, 12 schizophrenics, and 10 psychiatric controls. The study demonstrated that, similarly to schizophrenics, suicidal persons displayed smaller area of the right parahippocampi than did the controls. Moreover, the shape of hippocampus and parahippocampus was smaller on the right side of brains of suicidal persons as compared to brains from two other groups. This study demonstrates an association between the abnormalities in the right hemisphere and suicidal tendencies. However, it does not clarify whether the relationship between the two is causal or purely correlative.

This question received a preliminary answer in a study by Persinger [167]. Persinger studied 50 patients who had sustained a traumatic injury. The patients were given a complete neuropsychological assessment. The results demonstrated that patient who suffered from the injury to the right hemisphere displayed a particular form of disintegration of self-sense of presence [166]. Sense of presence is defined as the feeling of some sensed “entity” — mystical or not. Sometimes the patient even actively searches for “the other person in the room”.

The relationship between the right hemisphere injuries and the “sense of presence” has been supported by the finding that electrical stimulation of the right amygdala elicits fear and a sense of someone standing nearby [69]. Similarly, rebound tempo-parietal stimulation following right temporal lobectomy evoked paroxysmal “feeling of somebody being nearby” [6]. Moreover, the right hemisphere injuries lead to sense of presence as well as to elevated suicidal tendencies. In fact, the occurrence of sense of presence is significantly correlated with suicidal ideation [167]. These findings demonstrate the close association between right hemisphere damage, disintegration of the self-representation, and suicidal tendencies. More importantly, right hemisphere damage precedes the increase in suicidality and may actually predispose to suicidal behavior. It would be important to verify this finding in the future studies.

2.2. Neurotransmitters: reversed asymmetry

A number of studies demonstrated that suicidal persons show a reversed hemispheric asymmetry of serotonin functioning. Particularly, Arato and colleagues [5] compared the imipamine binding — the measure of activity of serotonin autoreceptors — in the right and the left hemispheres of brains of 23 suicide victims and 23 controls. The findings were clear-cut: non-suicidal persons demonstrated increased binding in the right hemisphere as compared to the left hemisphere, whereas suicide victims showed elevated binding in the left hemisphere as compared to the right hemisphere. This asymmetry was more pronounced among violent suicides. This finding was supported in other studies ([44,210]; however, see Ref. [14] for negative findings). Another study [97] demonstrated that normal persons display increased noradrenergic activity in the right hemisphere, whereas the young schizophrenics who
committed suicide do not demonstrate such asymmetry. Taken together these results emphasize that non-suicidal persons show increased right hemisphere functioning and decreased left hemisphere functioning, whereas suicidal persons are characterized by the reversed hemispheric activity.

2.3. EEG: right hemisphere dysfunction

Another pioneer study pointed at right hemispheric dysfunction among suicidal persons. Graae and colleagues [75] compared EEG activity of 16 suicide attempters with matched 22 normal adolescents. It was found that normal subjects demonstrated greater alpha activity in the right hemisphere than in the left, whereas suicidal persons showed a trend in the opposite direction. Moreover, non-depressed attempters, but not depressed ones, displayed greater alpha activity in the left hemisphere than in the right one in the posterior regions. Alpha asymmetry over these regions was related to suicidal intent, but not to the depression severity. This study needs further replication. However, it clearly demonstrates decreased alpha-activity in the right hemisphere of non-depressed suicidal attempters. Since decreased alpha-activity is a concrete expression of decreased ability to form polysematic contexts [126,182], it may be concluded that suicidal persons have diminished ability to generate polysematic contexts. This difficulty affects personal experience of suicidal persons, their cognitive style, body and pain perception, contributes to disintegrated self-perception, and to inability to regulate one’s affects.

2.4. Dissociation

Dissociation is defined as a state of mind characterized by a break in the continuity of conscious experience. Dissociation manifests itself in such states as depersonalization, derealization, psychogenic amnesia, identity disturbances, as well as in detachment, loss of ability for self-monitoring, numbness, daydreaming, absorption, and emotional blunting [171]. Dissociation is related to deficiency in right hemisphere functioning. In fact, the functionally insufficient right hemisphere leads to difficulties in formation of polysematic contexts. This failure of organization may concretely express itself in dissociative reaction. The relation between dissociation and right hemisphere dysfunction has been supported in the study of brain activity of a person with multiple personality disorder (MPD). Since very high utilization of dissociation is implicated in the etiology of MPD [172], the study of people bearing such diagnosis makes possible understanding of the mechanism of dissociation as well. Mathew and colleagues [130] explored cerebral blood flow in a woman with three personalities. When she demonstrated one of the split-off personalities, she also displayed increased activity on the right parietal lobe. Similarly, Flor-Henry [59] reported that MPD is associated with the dysfunctional right hemisphere. These studies support the close relation between right hemisphere deficiency and dissociation.

The relation between dissociation and suicide has already been proposed by a number of authors. Orbach [150] hypothesized that early traumata that cannot be contained by the still developing capacities of the child lead to utilization of dissociation as an ultimate defense against mental pain. Later the person employs dissociation in face of every painful emotion: shame, guilt, humiliation, sadness, and anxiety. The over-employment of dissociation facilitates suicidal acting-out by dissociating body-image from the self-representation and, consequently, by appeasing fears of death.

A number of studies demonstrated that suicidal persons utilize dissociation to a higher degree than non-suicidal people [153,156]. Orbach and colleagues [153] compared 26 depressed suicidal persons to 19 depressed non-suicidal inpatients and 27 normal subjects with respect to suicidal tendencies and utilization of dissociation. As expected, suicidal persons displayed the highest suicidal tendencies as well as the highest levels of dissociation. Moreover, suicidal tendencies were highly connected with dissociative tendencies. Suicidal people displayed more affective dissociation feeling of changes in affective life, and more control dissociation feeling of changes in control. Another study [156] extended these findings and found that suicidal persons with such diagnoses as schizophrenia and personality disorders demonstrate increased utilization of dissociation. The relation between dissociation and suicidal tendencies has been further supported in other studies [50,84,154,157,158]. In conclusion, the relation between suicidal behavior and dissociation seems to be well established. This fact supports the relationship between suicidal behavior, dissociation, and right hemisphere dysfunction. It seems that right hemisphere dysfunction manifests itself in general failure of organization and failure to achieve adaptation by means of integration of various aspects of functioning and self-representation.

2.5. Disintegration of self-representation

Self-representation is defined as “the unconscious, preconscious, and conscious endopsychic representation of the bodily and mental self in the system ego” [208, p. 179–80]. The right hemisphere is the seat of the self-representation [95,179,180,193]. Particularly, only polysemantically organized context formed by the right hemisphere (which is characterized by multiplicity of interconnections among various self-representations as well as by multiple connections with personal and emotional experiences) allows representing polysematic and emotionally laden self-image [183]. However, when the right hemisphere functions deficiently, self-representation tends to disintegrate. In fact,
right hemisphere damage is associated with such manifesta-
ations of disintegration of self-representation as sense of
presence [166], as well as with a shift to egocentric frame
of reference [19]. Various degrees of self-representation
disintegration in suicidal persons may be arranged on the
following continuum:

1. In most general terms, suicidal people have non-cohesive
self-representation [18].

2. This tendency for self-disintegration is more pronounced
among people with narcissistic vulnerability. Specifi-
cally, the tendency for self-disintegration is the core of
narcissistic disorder [101]. Ultimately, people with
narcissistic vulnerability have an increased risk of suicide
[10, 177].

3. Even more pronounced tendency for self-disintegration
expresses itself in the fantasy of eternal self. Suicidal
persons often believe that they will continue to live in
some way (e.g. in heaven) after death [120].

4. Yet another manifestation of self-disintegration is
fantasy of the existence of a double, which is also asso-
ciated with suicidal tendencies [173].

5. At a higher degree of self-representation disintegration,
fantasy of the double attains hallucinatory quality of
fantasized companions [195]. These fantasized compa-
nions are usually perceived as real persons — enemies or
allies — with voices that emanate from them. The
appearance of imaginary companions can be usually
traced to the early childhood and to the dates of the
earliest narcissistic injuries [16]. The fantasized compa-
nions are associated with suicidal states and may even
command the person to commit suicide [195].

6. The most extreme degree of self-representation disinte-
gration manifests itself in MPD. Persons who suffer from
MPD have an increased risk of suicide [172].

To conclude: when — due to narcissistic vulnerability —
painful injury cannot be contained, processed or worked
through, the right hemisphere collapses, which leads to cata-
strophic disintegration of self-representation. This disinte-
gration may express itself in non-cohesive self-
representation, narcissistic vulnerability, fantasy of the
double, imaginary companions, as well as in MPD. Ulti-
mately, the right hemisphere deficiency that parallels disin-
tegration of the self-representation can lead to suicide.

2.6. Body perception

The right hemisphere contains one important aspect of
self-representation, namely, body-representation [96]. The
superiority of the right hemisphere in processing of all
forms of stimuli associated with one’s body — such as
somesthetic and tactile-spatial-positional information, has
been demonstrated in a number of studies (for review see
Ref. [96]). When the right hemisphere is damaged, patients
may experience peculiar disturbances that involve their
bodies
\[40, 66, 70, 85, 94, 99, 109, 140, 142, 184, 185, 188, 218, 219-\]
. These patients may fail to perceive stimuli applied to the
left side; wash, dress, and groom only the right side of the
body; confuse body-positional and spatial relationships;
misperceive left-sided stimulation as occurring on the
right; fail to realize that their extremities or other body
organs are in some manner compromised; and/or literally
deny that their left arm or leg is truly their own. When
confronted by their unused or paralyzed extremities, such
patients may claim that they belong to the doctor or a person
beside them or, conversely, seem indifferent to their condi-
tion.

Such reactions parallel the generally alienated and nega-
tive attitude of many suicidal persons to their bodies. Maltserger [119] describes the body experience of suicidal
persons in the following way:

For many suicidal patients...body...may be experi-
enced as a prison house in which one is helplessly
confined, escape from which is passionately desired.
It may be experienced as a crowded tenement where
others press in. It may be experienced as a frightening
place swarming with vermin, or an alien chamber into
which evil spirits or monsters penetrate and crowd out
the self. It may be experienced not as part of the self at
all, or, if it is, not experienced as essential self, but
disposable self-part, escape from which is not lethal,
at least to the essential self, which is mental (p. 149).

Maltserger [119] contends that rejection, abuse or lack
of acceptance during the first years of development lead to
the tendency towards dissociation of body-representation.
During the suicidal crisis the person identifies or confuses
the body or some its part with hostile and persecuting intro-
ject. During the suicidal act, the person revengefully attacks
the body that is experienced as an enemy or an alienated
self-part. Similarly, Furman [61] states that neglect, rejec-
tion and other negative bodily experiences in the process of
early development interfere with normal development of
body care. Consequently, the person develops negative atti-
dute towards the body, fails to attend to bodily needs and to
indulge in pleasant activities. Orbach [151] adds such
destructive processes, that shape body experience in suicidal
persons, as lack of moderating self-directed aggression, lack
of attunement to bodily needs, lack of representational
learning to care for the body, symbolized hate toward the
body, and dissociation of body-image. Negative attitude
toward the body, anhedonia, and alienation from the body
among suicidal persons have been observed by other authors
[104, 105].

This hypothesis has been supported by empirical studies.
Orbach, et al. [154] found that depressed suicidal persons, as
compared to depressed non-suicidal ones as well as to
normal subjects demonstrate a significantly more negative
attitude toward their body. Suicidal persons also demon-
strated a significantly higher discrepancy between the
ideal perception of the body and the actual one than the two control groups. Orbach and colleagues [156] extended these findings to suicidal patients with such diagnoses as schizophrenia and personality disorders (see, also Refs. [157,158] for further replication of the findings). Finally, Orbach and Mikulincer [155] reported that suicidal persons demonstrate decreased investment in their body in the form of: (a) more negative image, feelings, and attitude about the body; (b) less body care; (c) less body protection; and (d) less comfort from physical touch. Suicidal persons were found to display higher anhedonia. The association between anhedonia and suicidal behavior was further supported in other studies [52]. Taken together, these studies convincingly demonstrate the close association between suicidal tendencies and body perception. I suggest that right hemisphere dysfunction contributes to the negative and alienated attitude about their bodies in suicidal people.

2.7. Pain perception

Perception of pain is another function of the right hemisphere. In fact, abnormal activity in the right hemisphere can lead to sensations of pain. For example, Head and Holmes [79] reported a patient who suffered attacks of “electric shock-like” pain that radiated from his foot to the trunk. A glioma in the right hemisphere was subsequently discovered. McFie and Zangwill [133] reported an individual who began to experience intense, extreme pain in a phantom arm after a right stroke. That association has been supported in other instances [38,186,227].

If increased activity in the right hemisphere is associated with abnormal pain perception, then right hemisphere deficiency should be associated with decreased pain sensitivity. It is now widely recognized that suicidal people display distorted perception of pain. In fact, Furman [61] suggested that following painful rejection, harsh demands, or abuse during childhood, suicidal people develop disturbed perception of pain. Consistent with that conclusion, it has been found that suicidal persons demonstrate higher sensation and pain thresholds as well as higher pain tolerance than psychiatric inpatients and normal controls [156]. This finding is valid for such diagnoses as affective disorders, non-affective psychotic disorders, and personality disorders [100,156, 157,158,175,197]. It seems that there are two processes that lead to low sensitivity to pain among suicidal persons. First, right hemisphere deficiency manifests itself in general insensitivity to pain. Second, due to disintegration of self-representation, suicidal people fail to integrate painful stimuli in self-representation. Interestingly, pain threshold and pain tolerance are highly and negatively correlated with personal distress in suicidal persons [156,157,158]. That is, in non-suicidal persons intense mental pain is associated with high sensitivity to bodily pain. Conversely, among suicidal persons, intense mental anguish is associated with low sensitivity to bodily pain. This negative correlation between mental pain and sensitivity to bodily pain could be explained as following. During a suicidal crisis, the feeling of mental anguish is high. Consequently, due to the functional deficiency of the right hemisphere, functioning of the right hemisphere deteriorates. As a result, sensitivity to bodily pain decreases, too. Conversely, among non-suicidal people negative affect increases sensitivity to bodily pain [164].

2.8. Affect regulation

Affect regulation refers to the conscious and unconscious procedures people use to maximize pleasant and minimize unpleasant emotions [220]. Affect regulation is hypothesized to be the right hemisphere function [192]. In fact, the ability to generate polysemantic context enables one to work through and to contain painful affects. In addition, the right orbitofrontal cortex regulates autonomic aspects of emotional arousal [192]. Alternatively, deficient functioning of the right hemisphere compromises one’s ability to process affective experiences and leads to employment of inefficient strategies of affect regulation [193]. Ultimately, inability to regulate negative affects may lead to suicide. Maltzberger [118] contends that suicide stems from inability to regulate such negative affects as aloneness, self-contempt, and murderous rage. When important sources of self-regulation are lost or when inner turmoil is beyond the ability of the individual to soothe oneself, the person is flooded with emotional pain that exceeds one’s ability to tolerate, contain or endure it. In such a way the inability to regulate negative affect elevates suicidal tendencies. A very similar view has been formulated from the bio-social perspective. In particular, Linehan [114] states that parasuicides — acts of self-mutilation and non-fatal suicidal attempts — stem from inability to regulate one’s affects, behaviors, and cognitions. Importantly, an act of parasuicide enables one to regulate one’s affects, behaviors and cognitions. In line with these hypotheses, empirical studies supported the relationship between suicidal behaviors and low ability for affect regulation [221,228].

The immediate consequence of poor affect regulation is impulsive behaviors. In fact, studies demonstrate that suicidal persons are characterized by high impulsiveness [11]. More importantly, at more extreme levels this tendency forms a temperamental disposition. Persons who lack internal affect regulatory mechanisms — or self-soothing introjects that perform self-consoling and regulatory functions during emotional upheaval — suffer from borderline personality disorder [2]. These patients also have a very high risk of suicide [46,62,136,174,206].

In conclusion, it seems that right hemisphere dysfunction is associated with low ability to regulate affective experiences, high impulsiveness or borderline personality disorder that are also associated with suicidal behavior.
2.9. Cognitive style: constriction

The ability of the right hemisphere to generate polysemic context forms the basis for perception and tolerance of contradictions and paradoxes, and for ability to think creatively. Specifically, creative approach is based on divergent thinking — ability to use rare associations and unusual meaning in a productive way [78]. On the other hand, only the right hemisphere activates both dominant and sub-dominant meanings [39] as well as close and distant associations [22]. The left hemisphere activates only the dominant meaning and close associations [22,39]. In addition, in creative subjects creative activity is associated with increased alpha-activity in the right hemisphere [159,223]. Alternatively, among non-creative people the solution of creative problems is not accompanied by the intensification of the alpha-activity. Martindale [126] found that creative persons do not demonstrate additional activation of the right hemisphere during the solution of creative tasks. On the other hand, low creative subjects display increased activity — that is, decreased alpha-index — in the right hemisphere during the solution of the same tasks. These results were further supported in other studies [127,128,129].

However, when this ability to form polysemic contexts is impaired, the person’s approach to reality is determined mainly by monosemantic, logic context formed by the left hemisphere [181]. Left hemispheric approach is devoid of creative potential. It includes a set of over-learned responses, it lacks ability to see reality in a polysemic way, cannot tolerate ambiguity and is oriented towards search for clear-cut solutions. It seems that during suicidal states people demonstrate left-hemispheric approach to reality. In these persons, the functionally insufficient right hemisphere collapses under the burden of mounting emotional distress. The person remains without his/her right hemisphere capacities. Consequently, the mode of experiencing and functioning is determined almost exclusively by the left hemisphere and the creative ability is seriously compromised.

This state of mind accounts for inflexible, constricted, and non-creative thinking of suicidal individuals. Suicidal individuals demonstrate a disposition to think in a somewhat rigid manner [26,35,48,139,199,204]. The rigidity of thinking manifests itself in cognitive constriction, “tunnel thinking” or difficulty to develop new, alternative solutions to existing problems [201]. The person with tunnel thinking lives in a continuously narrowing world with fewer and fewer options available for solution. The rigidity traps the person in the unbearable situation that is perceived and experienced as inescapable. The person desperately clings to what he or she has and rejects any new possibility. In fact, Neuringer [144] demonstrated that suicidal persons are more socially rigid and inflexible as well as incapacitated in ability to shift problem-solving strategies than non-suicidal patients. They cannot shift from one previously successful but inappropriate problem-solving strategy to another plan. That result has been replicated in another study [111]. Levenson [110] found that suicidal persons experience difficulties in finding alternate uses of common objects — the common test of creative thinking. In addition, suicidal persons have a restricted perceptual range — they do not perceive objects on the periphery of the visual field [110].

Cognitive rigidity manifests itself in dichotomous thinking. Inflexible thinking restricts suicidal persons to the narrow world with only two options available. The ability to bear uncertainty and ambiguity and to perceive paradox is seriously compromised. Consequently, everything is polarized: feelings, thoughts and perceptions of solutions and of possible outcomes. A number of studies showed that suicidal persons display polarized thinking [143,145,146]. Suicidal people live in the world of “all”, “none”, “always”, etc. It is known that depressed persons also tend to think in rigid dichotomies. However, suicidal individuals demonstrate this thinking pattern to a more pronounced degree [147].

It seems that due to right hemisphere insufficiency suicidal persons demonstrate low ability to think creatively, to perceive ambiguity and paradox and to resolve contradictions. Consequently, they display rigid, inflexible, and dichotomous thinking that traps them in unsolvable conditions.

2.10. Overly general memories of suicidal persons

The ability of the right hemisphere to form polysemic context allows the representation of personal experience in a multidimensional way, with all inner complexities, paradoxes and affective nuances. More importantly, polysemic context formed by the right hemisphere is a necessary condition for encoding, storage, and retrieval of personal, emotional, and episodic memories [183]. In fact, the right prefrontal cortex is involved in retrieval of episodic memories [56,83,214], while right hemisphere damage is associated with inability to retrieve memories of autobiographical episodes (for review, see Ref. [125]). Similarly, remembering one’s past and free associating to one’s memories is accompanied by the right hemisphere activation [13]. Therefore, the involvement of the right hemisphere in retrieval of episodic memories seems to be well documented.

However, when the right hemisphere fails to form polysemic contexts personal experiences are represented monodimensionally. The memories of such experiences are prosaic, emotionally flat, and devoid of any specificity. If suicidal persons are conjectured to have deficiently functioning right hemisphere, then their memories should be impersonal and non-specific. This is exactly what has been found.

Williams and Broadbent [224] studied characteristics of memories among 25 suicide attempters, 25 inpatients and 25 normal subjects. The subjects were asked to recall events associated with cue words (such as happy, sad, sorry, hurt).
It has been found that suicide attempters tended to retrieve less affective memories. Moreover, the recalled memories were over-general, such as “when I am in bed” or “the first few years of my marriage”. This tendency was not a result of the subjects’ not having understood the instructions. These findings were further replicated in another study [51].

The overly general nature of memories of suicidal individuals sheds the light on the personal experience of these persons. It seems that due to the right hemisphere dysfunction suicidal people live in a flat, monodimensional and simplified world determined by the left hemisphere functioning.

2.11. Dead to the world: psychological suicide and low openness to experience

Yet another painful consequence of the inability to use the right hemisphere is a particular trait of suicidal persons, namely, lack of openness to experience. Openness to experience [134] is defined as need to move beyond existent cognitive or behavioral concepts. Openness to experience is closely related to right hemisphere functioning [183]. The right hemisphere is “open” to real-life occurrences as opposed to the openness of the left hemisphere to constructing logical structures that are shut-off from the outside world [180]. The relationship between openness to experience and right hemisphere functioning has been empirically verified [121]. Similarly, other authors suggested that the right hemisphere specializes in perception of novelty [72,71]. Only the right hemisphere enables one to sustain experiences in their complexity and in interactive and mutually enriching connections between their various components. Furthermore, this ability to represent the experiences in a multidimensional way generates need for new experiences in order to further enrich, deepen, and organize them. However, when the right hemisphere cannot sustain the polysemic context, the person withdraws into the shut-off world of the left hemisphere.

In fact, suicide victims demonstrate very low openness to experience [47]. They prefer the familiar to the novel, follow routine and avoid challenges. They are uninterested in open discussions and philosophical arguments. Consequently, they are closed to any new event or experience, they are not open to feelings and find them unimportant.

Another process that characterizes suicidal persons refers to personality constriction. Some clinical observations go in line with that conception. A number of authors [81,139,200] contended that long before the actual suicidal act, suicidal persons commit psychological suicide, while Firestone [57] described this characteristic of suicidal people as inwardness of their existence. They distance from every expression of their inner being, from spontaneity, and liveliness. They are alienated from inner experiences and life occurrences charged with emotional and personal meaning. Consequently, they live in a routine world, devoid of “spontaneous gestures” [226]. The person is “dead to the world” [81].

This state of mind is characterized by a marked diminution or near-cessation of affect involving both hemispheres of concern, the inner and the outer world. Here it is if the person’s primal springs of vitality had dried up, as if he were empty or hollow at the very core of his being. There is a striking absence of anything but the most perfunctory and superficial social interactions; output as well as intake is at a minimum. The person is a non-conductor. To him the human species is wholly uninviting and unlovable, a monotonous round of unnecessary duplicates; and since everything he sees and every alternative opportunity for action seems equally valueless and meaningless, he has no basis for any choice ([81] p. 317)

I contend that psychological suicide reflects inability to use the right hemisphere capacities and an almost exclusive reliance on left hemispheric functioning. This over-reliance on left hemisphere functioning culminates in the suicidal state of mind and, ultimately, leads to suicide.

3. The suicidal crisis

The suicidal person feels unbearable mental pain—psychache [201,202,203]. Psychache is the pain of frustrated important psychological needs. It is experienced as the pain of guilt, shame, humiliation, loneliness, or fear. When psychache becomes unbearable, the person is in danger of suicide. The stronger is the pain, the higher is the suicidal risk. Studies demonstrate that, as compared with non-suicidal people, suicidal persons experience to a stronger degree such negative affects as guilt [141], shame [32], depression [169], anxiety [149,169], hopelessness [21], and loneliness [87].

Unlike normally experienced negative affective states, the mental pain of suicidal persons is experienced during a particular state of mind that is determined exclusively by the left hemisphere functioning. I contend that intolerable anguish, felt by the suicidal person, cannot be understood without taking into account that particular state of mind. Due to right hemisphere insufficiency, mental anguish leads to further exacerbation of the right hemisphere dysfunction.

Since suicidal persons have a functional deficiency of the right hemisphere, their right hemisphere functioning is particularly sensitive to negative affects. In fact, the baseline right hemisphere activation (decreased alpha-activity) — a measure of the right hemisphere deficiency — predicts more intense negative affect following negatively toned clips. The intensity of negative affect is predicted by the right hemisphere activation, but not by the baseline negative affect [212,222]. The induction of negative affects interferes with performance of tasks involving the right hemisphere.
in people with low alpha-activity over the right hemisphere [17,213]. Similarly, the deterioration in right hemisphere functioning following negative affects is specific for people who demonstrate decreased alpha-activity over the right hemisphere during the baseline [212,122,222]. The functional deficiency of the right hemisphere makes it more reactive to negative experiences and makes its activity more labile. Consistent with this, the variability of right hemisphere activity as well as high activity over it during remission is associated with a history of depression [43,82]. In addition, children who display low alpha-activity over the right hemisphere cry more following separation from their mothers than children with high alpha-activity over the right hemisphere [42]. These findings demonstrate that functionally deficient right hemisphere manifests itself in greater reactivity to negatively toned events, in difficulty in affect regulation, and in further deterioration of the right hemisphere functioning during such negative experiences. Importantly, such deterioration escalates and generates a vicious self-destructive circle of negative affects that decreases the right hemisphere functioning, which in turn further exacerbates mental pain.

The functionally deficient right hemisphere of suicidal people makes them vulnerable to negative affects. When they experience negative affects, the functioning of their right hemisphere decreases, leaving them without the right hemisphere capacities. Consequently, the functioning and the mode of experience of the suicidal person are determined solely by the left hemisphere. Due to right hemisphere dysfunction, the person remains without cognitive flexibility and affect-regulation strategies needed for processing of mental pain and effective coping. In fact, during a suicidal crisis people demonstrate increased impulsiveness [163] and more rigid thinking [165]. The low ability for affect regulation, coupled with high levels of negative affects is particularly destructive. Moreover, the shift to left-hemispheric mode of experience leads to unusual thinking. The low ability for affect regulation, and in further deterioration of the right hemisphere function during such negative experiences. Importantly, such deterioration escalates and generates a vicious self-destructive circle of negative affects that decreases the right hemisphere functioning, which in turn further exacerbates mental pain.

These processes have been described in the literature. Alvarez [9] called suicidal state of mind “the closed world of suicide”. He described it as follows:

First and most important, suicide is a closed world with its own irresistible logic... The logic of suicide is not rational... The logic of suicide is different. It is like the unanswered logic of a nightmare or like the science-fiction fantasy of being projected suddenly into another dimension: everything makes sense and follows its own strict rules. Yet, at the same time everything is also different, perverted, upside down. Once a man decides to take his own life he enters a shut-off, impregnable but wholly convincing world where every detail fits and each incident reinforces his decision (p. 120–21)

Similarly, other authors described the trance quality of the pre-suicidal state, during which the person is increasingly driven towards self-destruction [57,80].

This logic of suicide is the logic of the left hemisphere. When the right hemisphere collapses, the person lives in the self-sufficient, detached world of the left hemisphere. This mode of experience is determined by narrow-mindedness and search for new evidences supporting existent beliefs coupled with inability to verify them critically and reject them following contradicting feedback. In this world, every detail falls on its place to support some preexisting conclusion or state of mind. This logic perfectly fits the logic of delusions: in fact, delusions are generated by the left hemisphere [181]. Delusional persons do not reject the delusional belief when confronted with contradicting information. On the contrary, they integrate the new information in their delusional system and employ that information to support the delusional belief. Alvarez points at a similar process among suicidal people: they utilize every new event — whether positive or negative — every interpersonal encounter, or every new experience to confirm and expand the suicidal state of mind.

The relationship between the delusional states and the suicidal ones has already been emphasized in the clinical literature [4]. However, the suicidal state and the delusional system are different in one important point: while delusions refer to a particular belief, the suicidal crisis is associated with a particular state of mind that is much more general than a given belief.

Baumeister [20] calls this state of mind “cognitive deconstruction”. During this state of mind the personal meaning of event is destroyed in order to avoid unbearable mental anguish. In addition, the person focuses on the immediate goals and avoids long-range projects. The person lives in the present without the future and the past. I contend that those processes ultimately reflect right hemisphere dysfunction. More specifically, under the burden of mental pain the right hemisphere collapses and fails to maintain the personal experience. Without the right hemisphere the person cannot sustain the personal meaning of events, cannot integrate the personal aspects of future and present in the experience of time, and, consequently, refers to the immediate goals. The price the person pays is high: he or she lives in an ever-constricting world that lacks flexibility of the right hemispheric thinking and ability to regulate affects, and to sustain cohesiveness of the self-representation.
4. Early development and etiology of suicidal tendencies

I believe that early negative emotional experiences are implicated in the development of the functionally deficient right hemisphere, which contributes, ultimately, to elevated suicidal tendencies. In fact, disturbed family environment, early emotional experiences and negative life events during childhood are implicated in etiology of suicidal tendencies. In particular, parental restrictiveness [168], neglectful and overprotective parenting [205], low family cohesiveness [15,102], poor communication [217], and low family organization, expressiveness, and independence [138] have been related to suicidal behavior. Families of suicidal adolescents are less cohesive and the suicidal adolescent usually has poor communication with parents (for review see Ref. [217]). Parental psychopathology, such as affective disorder, personality disorders, alcohol and substance abuse, are also associated with suicidal behavior (for review see Ref. [217]). Lack of empathy and parental unavailability predict suicidal behavior. In fact, in a prospective study that assessed parent–child relationship by a researcher rating (rather than by self-report data), lower maternal responsiveness and harsher paternal demands were predictive of suicide attempt [54]. Suicidal adolescents usually perceive their parents as less warm [216]. In addition, neglect, sexual, physical or emotional abuse are strongly associated with suicidal behavior [31,77,116,198]. Losses due to death, separations, divorce of parents or suicide are associated with suicidal behavior. Moreover, losses during early years interact with more recent losses and elevate the suicidal risk (for review see Ref. [1]).

The peculiarities of the right hemisphere development make it more vulnerable to pathogenic influences of such negative experiences during the early development. First, the right hemisphere matures later than the left one. In fact, the myelination of the right hemisphere is completed later than that of the left hemisphere [96]. Similarly, while alpha-phase in the left hemisphere attains 80% of adult values by the age of 6 years, alpha-phase in the right hemisphere does not reach 90% of adult value until approximately 10 years of age [211]. While verbal ability — a concrete measure of left hemisphere functioning — is not related to the rate of maturation, the spatial ability — a measure of right hemisphere functioning — is [215]. Second, as measured by the EEG activity, the right hemisphere is more active during the first four years of life [37]. The right hemisphere dominance during the first years of development was further supported neuroanatomically [36,162] and by functions attributed to it [67,106,107].

These factors make development of the right hemisphere dependent on the affective quality of relationship with the caregiver. In fact, early negative experiences interfere with development of the functionally sufficient right hemisphere. A number of factors exert a chronic influence on the development of right hemisphere deficiency. Particularly, depression of mother impairs the development of the right hemisphere. In fact, children of depressed mothers display decreased alpha-index in the right frontal region [55,89]. This pattern of cerebral activity arises as early as at one month of age [91] and is still consistently displayed by the age of 3 years [90]. Emotional unavailability of mother is another process that hampers the development of the functionally sufficient right hemisphere. In particular, withdrawn style of mothering was found to be associated with decreased alpha-index over the right frontal region in the infants [90]. Emotional unavailability, lack of empathy and of affective resonance with infant emotional state, as well as disturbed family environment, do not allow elevation of dopamine that normally modulates dendritic branching and cortical development in response to emotional experiences [192]. It was found that low maternal care does not allow the normal elevation of synaptophysin and NMDA receptor expression and, in that manner, interferes with synaptogenesis in developing hippocampus [117]. In these ways, all these factors lead to undeveloped neuropil and, ultimately, to the functionally deficient right hemisphere.

Other factors contribute to development of the functionally deficient right hemisphere by means of destruction of neurons or interneuronal connections. In particular, emotional trauma and other stressful events elevate levels of corticosteroids, which destroy the hippocampal cells [189,190,191] that are particularly sensitive to this substance [74]. While the atrophy of hippocampal neurons is reversible if the stress is short-lived, a long-lasting stress can lead to irreversible destruction of hippocampal neurons [132]. Due to a longer process of the right hemisphere maturation and its high activity during the first years, such destruction of hippocampal cells is more pronounced in the right hemisphere. In fact, abused children display decreased ability to identify emotional expressions [34]. Similarly, PTSD patients show reversed hippocampal laterality [196]. Consistent with these evidences, suicidal persons demonstrate destruction of the right hippocampus [8].

In addition, prenatal stress impedes the development of the right hemisphere and leads to reversal of dopamine asymmetry in cerebral hemispheres [60]. This finding is further supported by the fact that depletion of brain amines follows the right, but not the left, hemisphere damage [131,176]. Interestingly, these results parallel the reversed asymmetry of brain amines among suicide victims. The damage to the right hemisphere could point at the potential mechanism that relates prenatal stress to the increased rates of suicide. In particular, it has been found that adolescents committing suicide experienced more prenatal stress and more birth complications, as compared with non-suicidal controls [187].

The studies reviewed above suggest that early negative experiences interfere with normal development of the right hemisphere. In this way, they could contribute to development of suicidal tendencies. While this hypothesis could integrate the findings in the field, it needs empirical...
5. Conclusions

The studies reviewed above support the hypothesis that suicidal dynamics are associated with right hemisphere dysfunction. The proposed hypothesis describes how early traumata lead to right hemisphere insufficiency and suicidal behaviors. Due to early traumata — severe or cumulative — the right hemisphere fails to develop. Functional insufficiency of the right hemisphere manifests itself in difficulties in generation and maintenance of polysemantic context. Right hemisphere deficiency forms the general diathesis factor for development of suicidal states. Right hemisphere deficiency is expressed in non-cohesive self-representation, tendency toward dissociation, decreased sensitivity to pain, body alienation, anhedonia, failure to attend to body needs and care about the body. Acute anguish coupled with right hemisphere deficiency further increases right-hemisphere dysfunction. Self-representation disintegrates, affective regulation fails and the person is flooded with painful feelings of injury, rejection, shame, guilt, sadness, and anxiety. The failure to regulate affects increases impulsiveness. The shift to left hemisphere functioning manifests itself in cognitive constriction and inflexible approach to problems. The person enters into desperate imprisonment in the closed world determined by left hemisphere functioning. Unbearable mental pain coupled with right hemisphere dysfunction culminates in the suicidal act, which is perceived as the sole escape from the intolerable anguish.

It can be still hypothesized, that the relationship between right hemisphere deficiency and suicide could be explained by the association of depression with suicide [112,169], which is also connected with right hemisphere dysfunction [58,183]. However, the reviewed studies demonstrated right hemisphere abnormalities among suicidal persons with such diagnoses as schizophrenia, conduct or personality disorders. Therefore, the relationship between the right hemisphere dysfunction and suicidal behavior is valid beyond any specific nosological category.

The hypothesis developed in this paper refers to psychophysiological aspects of suicidal crises. It describes how various psychological as well as physiological variables generate suicidal state of mind. However, the proposed hypothesis does not distinguish among various personality types of suicide. In fact, it has been repeatedly emphasized that different personality types are associated with different risk factors as well as with different dynamics of suicide [122]. Recently, Orbach [152] proposed a taxonomy of risk factors that divides them into three clusters. Each cluster is associated with a particular personality type: perfectionist — depressive, impulsive, and disintegrative. It would be interesting to verify whether the right hemisphere deficiency is related to all personality types as opposed to some of them. Specifically, the right hemisphere deficiency can form a general and non-specific vulnerability factor for development of suicidal tendencies among all personality types as opposed to only some of them. Similarly, it is not clear whether some manifestations of the right hemisphere deficiency (e.g. affect dysregulation, cognitive constrictions, etc), as opposed to other manifestations of it, are specific for a particular personality type.

In addition, the proposed approach does not differentiate between various subgroups of suicidal behaviors, such as suicidal ideation, attempts or completed suicide. The importance of differentiation of those forms of suicidal behavior has been repeatedly emphasized in the theoretical literature [148] and empirical literature [123], whereas Shneidman [201] described phenomenological distinctions between suicide attempters and completers. Linehan [113], following an extensive literature review, differentiated suicidal persons into two groups: completed suicides and parasuicides (non-fatal suicidal attempts and deliberate self-harm). Arensman and Kerkhof [7], after reviewing studies in the field, further distinguished mild suicide attempts from severe suicide attempts. The explanation of those differences in terms of the proposed approach needs additional theoretical and empirical effort.

The proposed hypothesis should be verified empirically. It points at new directions of research. In fact, it opens an avenue for research of such functions of the right hemisphere of suicidal persons as interpersonal perception, affect regulation, perception of humor, metaphors, and ambiguous contexts as well as interrelationships among various psychological and physiological variables.

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