A GROUNDED COGNITION PERSPECTIVE ON IRRATIONAL BELIEFS IN RATIONAL EMOTIVE BEHAVIOR THERAPY

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Abstract
Knowledge has been the subject of different controversial theories in psychology; recently the idea that knowledge is grounded in the modal systems of the brain has gained considerable evidence. This paper discusses applications of the grounded cognition theory to irrational beliefs, a main concept of Rational Emotive Behavior Therapy (REBT), proposed as core cognitive vulnerabilities for emotional disorders. Irrational beliefs, as grounded maladaptive emotional knowledge structures are considered the result of interactions between linguistic representations and simulations in motivational and emotional brain processing circuits. It is proposed that irrational beliefs (e.g., demandingness) are represented by distorted simulations in motivational and emotional brain processing circuits that bias the online processing of activating events. This biased emotional processing generates emotional disturbance. A three-level model of irrational beliefs is presented. The impact of irrational beliefs on emotions can be analyzed at the verbal or linguistic symbols level, at the simulations and modal symbols level and at the level of relations between verbal symbols and modal symbols. Maladaptive mechanisms and proposed corrective cognitive interventions are analyzed at each level. We conclude that a grounded perspective on irrational beliefs increases the explanatory power of the REBT theory of emotions.

Keywords: grounded cognition, irrational beliefs, Rational Emotive Behavior Therapy, cognitive restructuring

Knowledge is essential for the existence of all living beings; it gives them past and future, the chance of intelligent behavior and coordinated responses to the environment. Various models and perspectives have been developed regarding

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the role of knowledge in determining human responses. Moreover, knowledge is profoundly involved in human psychological dysfunctions. The field of cognitive clinical sciences is focused on types of knowledge and knowledge processes that promote psychological disturbance. Various psychological therapies, such as cognitive oriented therapies, have been developed around the idea of modifying specific types of knowledge and cognitive processes or cognitive vulnerabilities that promote psychological disturbance.

The oldest form of cognitive behavior therapy (CBT), Rational Emotive Behavior Therapy (REBT) assumes that specific types of maladaptive knowledge (i.e., irrational beliefs) are the core cognitive vulnerably for emotional disorders. There are four types of irrational beliefs, as described in REBT (Ellis, 1994): demandingness (DEM), awfulizing/catastrophizing (AWF), low frustration tolerance (LFT) and global evaluation of human worth or self-downing (SD). The cornerstone of REBT is the “ABCDE” model (Ellis, 1994). According to the “ABCDE” model, people experience adversities (A), about which they have rational and irrational beliefs (B). These beliefs lead to emotional, behavioral and cognitive consequences (C). Rational beliefs (RBs) lead to functional consequences, while irrational beliefs (IBs) lead to dysfunctional consequences. Clients are encouraged to actively dispute (D) their IBs and to assimilate more efficient (E), adaptive and rational beliefs, with a positive impact on their emotional, cognitive, and behavioral responses (Ellis, 1994).

Recently theory and research in REBT addressed the organization of irrational beliefs, mainly in terms of propositions (Ellis, 1994; Dryden, 1984; Wessler & Wessler, 1980) or in terms of schemata (DiGiuseppe, 1996; Nielsen, 2003; Szentagotai, Schnur, DiGiuseppe, Macavei, Kallay, & David, 2005). Schemata and propositions are essential concepts of the symbolic approach in cognitive psychology (Eysenk & Keane, 2000). The propositional and schematic views of irrational beliefs are both based on the assumption of irrational beliefs as amodal symbolic representations. According to this view, information in the physical world produces neural states in the perceptual system. A transduction process takes these states as input and produces descriptions of them in a completely different representational language (Barsalou, Simmons, Barbey, & Wilson, 2003). Cognition is viewed as computations on amodal symbols, independent of modal representations. This idea is consistent with the mainstream view of cognitive psychology regarding semantic memory and with traditional theories of knowledge.

Considerable evidence has amounted lately supporting the idea that knowledge is grounded in brain modal simulations, embodiments, and situations (e.g., Allport, 1985; Barsalou, 1999; 2008; Damasio, 1989; Thompson-Schill, 2003). Grounded cognition theories maintain that perceptual states are not translated into a completely different representational language. Instead, subsets of perceptual states are extracted to function symbolically and support higher cognitive functions. Once in the memory, these extractions function symbolically,
standing for referents in the world and entering into all forms of symbolic computation (Barsalou et al., 2003). The basic idea of the Perceptual System Theory, one of the best articulated grounded cognition theories, is that modal states are captured during perception, action and introspection and that these states are later simulated to represent knowledge (Barsalou, Santos, Simmons, & Wilson, 2008). For example, during an emotional experience of fear when seeing snakes, modal states in the visual, auditory, somato-sensory, motivational and emotional systems are captured about what snakes look like, sound like and feel like. On future occasions, when representing snake-related experiences, the brain attempts to reactivate these multi-modal states, but typically only partially succeeds. The resultant simulation of the brain states associated with experiencing fear of snakes is later used when encountering snake-related stimuli to generate emotional reactions. The grounded cognition view also maintains that humans use a powerful external symbolic system, in the form of language, to transmit, transform and generate knowledge. Thus, knowledge is considered a result of the interaction between linguistic and modal symbolic activity that informs behavior (Barsalou et al., 2008). Both language and simulations in modal brain states are essential in generating knowledge. In recent years, the grounded cognition perspective has focused on types of knowledge important for emotional reactions such as emotional knowledge (Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). A solid background on emotional knowledge is important for both theory and practice, for developing theories of psychological dysfunctions and interventions that change dysfunctional knowledge leading to psychological disturbance.

<table>
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<tr>
<th>Basic ideas of grounded cognition theories with implications for emotional knowledge</th>
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<td>• The distinction between two major levels of knowledge: linguistic knowledge, in the brain’s language systems, on one hand, and situated simulations in the brain’s modal systems on the other hand.</td>
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<td>• Linguistic symbols and situated simulations that interact continuously in varying mixtures to produce conceptual processing or meaning (Barsalou et al., 2008).</td>
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<td>• Verbal symbols have two functions in relation to perceptual symbols: a) they label or describe activated perceptual symbols/situated simulations; and b) they affect the structure and function of perceptual symbols (Barsalou et al., 2008).</td>
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<td>• Emotional knowledge is represented by simulations (i.e., partial activations) in the emotional processing circuits of the brain;</td>
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<td>• Specific states of emotional processing circuits, in the form of modal symbols (i.e., simulators), are captured and later used in new emotional encounters (Barsalou et al., 2008; Niedenthal et al., 2005).</td>
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An emotional simulator is a distributed collection of modal memories captured across emotional instances. When a specific emotion is activated on a given occasion, only a small subset of this information becomes active – not the entire simulator. The active subset is then run as a simulation that functions as one of many conceptualizations for the emotional experience.

Verbal knowledge (e.g., verbal statements such as I need to be loved) gains meaning/believability only by coordinated simulations in corresponding brain processing circuits (e.g., partial activations in the motivational and emotional circuits involved in the processing of experiences related to being rejected by an attachment person).

Verbal knowledge structurally affect the simulations in different brain processing circuits depending on their specific verbal content, by activating corresponding simulators.

Simulations directed by verbal beliefs influence ongoing activation of emotional processing circuits and emotional reactions during emotional encounters.

This article analyzes the implications of applying the modal representation perspective to dysfunctional knowledge such as irrational beliefs. We argue that irrational beliefs (i.e., demandingness) may be represented as modal symbols and their effect on emotions result from the interaction between modal and linguistic symbols. The ABC model of emotions in REBT is presented from a modal perspective of irrational beliefs.

The modal perspective of the REBT cognitive model

The B in the ABCDE model stands for beliefs or cognitions. Beliefs mediate the effect of external situations (As) on emotions and behavior (Cs). Maladaptive beliefs or cognitions mediate the relation between A and emotional disturbance. Different forms of cognitions or knowledge are important in mediating the effect of A on C, such as descriptions, inferences and evaluations. REBT focuses on maladaptive evaluative beliefs in the form of irrational beliefs as core cognitive vulnerabilities to emotional disturbance (e.g., Ellis, 1994). For example, according to the classical ABC model, descriptions are cognitive structures that can be verbally expressed and reflect external stimuli in the cognitive system, in the form of propositions. This means that representations in different modal systems such as the visual, auditory and proprioceptive systems are translated into propositional representations. Inferences are propositional cognitive structures about abstract situations. Evaluations are propositional cognitive structures reflecting the value of external situations (e.g., David, 2006). Cognitions are stored in a semantic memory system, are later activated by external stimuli and influence emotional and behavioral responses. When cognitions are distorted they lead to emotional disturbance. This model has gained preeminence in the REBT literature, even though the original model of irrational
beliefs proposed by Ellis asserted that beliefs, feelings and actions are different ways of conceptualizing the same phenomenon (Ellis, 1962), which is consistent to a modal perspective of irrational beliefs.

The Grounded cognition perspective maintains that the cognitive system uses one multimodal representational system (Barsalou, 1999). Perceiving an emotional stimulus involves seeing, hearing and feeling intense emotions. Populations of neurons in modality-specific sensory, motor, motivational and affective systems are activated. These populations of neurons are highly interconnected and their activation involves a multimodal experience of that emotional stimulus (Niedenthal et al., 2005). Different multimodal states of brain functioning are captured in form of simulators that are used as symbols for later interpreting a similar experience. When activated, simulators lead to the partial re-instantiation of modal states in the visual, auditory, motor, motivational and emotional systems (Barsalou, 2008). States of modal systems are not translated into different representations, but rather simulated to represent knowledge (Barsalou, 1999).

The simulation mechanism makes the difference between types of knowledge such as descriptions, interpretations and evaluations to reside in simulations of activity in distinct brain processing circuits. Knowledge about objects requires simulations of states in different sensory modalities involved in perceiving that object; knowledge about the value of personal goals involves simulations in the motivational processing systems; knowledge about emotions involves simulations of states in emotional processing circuits, knowledge about action involves simulations in motor processing circuits (Barsalou, 2008). Complex types of knowledge, such as negative beliefs (e.g., negative schemata, irrational beliefs) involve simulations of multimodal states in different modal systems, as different sensory systems, motivational, emotional and motor systems, dependent of the context (i.e., verbal or external sensory stimuli) of simulation (Barsalou, 1999). When the context leads to processing focused on perceptual or motor modalities, cognitive products are cold cognitions (i.e., descriptions and inferences). When the focus is on the personal relevance or emotions, cognitive products appear in form of hot cognitions (i.e., evaluative beliefs). In other words, we propose that cold cognition is represented by partial activations in sensory-motor processing circuits, while hot cognition is represented by partial activation in different limbic processing circuits. In short, cold cognition is partially activated perception while hot cognition is partially activated emotion. For example, Grabenhorst and Rolls (2008) found that when subjects were verbally instructed to remember and rate the pleasantness of a taste, activations were greater in the medial orbitofrontal and pregenual cingulate cortex than when subjects were instructed to remember and rate the intensity of the taste (Grabenhorst & Rolls, 2008). When subjects were instructed to remember and rate the intensity, activations were greater in the insular cortex. These findings show that when attention is directed to affective value of a stimulus (e.g., taste),
the brain systems engaged in representing the sensory stimulus are different from
those engaged when attention is directed to the physical its properties, such as its
intensity (Grabenhorst & Rolls, 2008).

The simulations that are active when someone encounters an emotional
situation can direct the activation of brain modal systems involved in processing
that experience and the resultant emotional reactions (Niedenthal et al., 2005). For
instance, if a person has experienced repeated and powerful emotional
experiences related to physical abuse by the parents, this type of emotional
processing is captured in memory. Later, in similar situations (e.g., separation) the
individual re-instantiates the same emotional processing pattern (i.e., emotional
simulations) which directs the processing of the new encounter and promotes
powerful emotional reactions.

Moreover, grounded cognition theory maintains that the human cognitive
system not only uses internal symbols (i.e., modal or brain symbols) to interpret
experience, but it also uses a complex external symbolic system in the form of
language. Both types of symbols interact to produce knowledge (Barsalou et al.,
2008).

We will shortly describe this interaction in the case of maladaptive
beliefs. Usually, distorted cognitions are reflected in their linguistic expressions.
The verbal expression of a maladaptive belief gains meaning by generating partial
simulations corresponding to the verbal content. These simulations bias the online
processing of various stimuli. Thus, we propose that the use of verbal labels or
statements related to emotional experiences may drive the functioning of the
motivational and emotional systems in an adaptive or maladaptive way. When
seeing a snake, a person that interprets the situation as a “deadly experience”
generates simulations (i.e., partial activations associated with this statement.
These simulations will trigger brain responses corresponding to previously
experienced “deadly” situations, leading to disturbed emotions. Negative
interpretations activate situational simulators that are associated with other
emotional simulators as a response to new or ambiguous situations.

We suggest that negative verbal interpretations influence emotional
processing indirectly, by activating perceptual simulators that are associated with
emotional simulators. In turn, these emotional simulators generate emotional
simulations biasing current emotional processing. On the other hand, we propose
that evaluative verbal beliefs directly influence motivational and emotional
processing by activating their associated emotional simulators which direct
activity in emotional processing circuits.

In the “seeing a snake” example, if a person thinks of this experience as
being “awful”, the awfulizing leads to partial activations in emotional systems
that re-instate the processing of the previously encountered most dangerous
experience. This activation bias can lead to the overactivation of bottom-up
affective processing and to powerful emotions. If the person is telling
himself/herself “I should not be bitten by the snake, I can’t stand this”, their
motivational processing in terms of avoidance will be biased by partial simulations corresponding to the negative beliefs. These negative beliefs, in the form of verbal statements, may lead to the over-activation of motivational and emotional processing brain circuits. This over-activation may result from a combination of simulations supporting the high reactivity of bottom-up emotional processing and of deficient top-down inhibitory circuits. Changing the negative statements and replacing them with adaptive ones (i.e., rational beliefs), most likely generates different simulations to bias emotional brain processing. When these simulations direct emotional processing in the sense of diminished reactivity or increased inhibition the output is an adaptive emotional response. This is consistent with the view of irrational beliefs as proximal cognitive vulnerabilities to emotional disturbance (e.g., Ellis, 1994).

The grounded cognition perspective considers the interaction between the external linguistic symbols system and the internal perceptual/modal symbols system as fundamental in generating knowledge (Barsalou, 1999). Therefore, from a grounded view of cognition, maladaptive knowledge processes can be described at three levels (see Figure 1), factors at each level being targeted by attempts to restructure maladaptive beliefs:

a) at the level of linguistic symbols several types of maladaptive knowledge processes can be described: excessive use of distorted verbal beliefs, detrimental use of adaptive verbal beliefs and maladaptive learning processes that maintain the use of maladaptive verbal symbols and impair the use of adaptive verbal symbols;

b) at the level of simulations and modal symbols maladaptive knowledge resides in maladaptive emotional modal symbols that direct motivational and emotional processing in a distorted or dysregulated way;

c) at the level of the interaction between external (i.e., linguistic) and internal (i.e., modal /brain) symbols, maladaptive knowledge resides in the high strength between maladaptive verbal and modal symbols and the low strength between adaptive verbal and modal symbols.

Different factors lead to maladaptive processes at each level. For example, verbal irrational beliefs are the result of learning during negative emotional experiences or of observing ones parents make irrational evaluations. REBT argues that whatever the situations in the past that led to irrational beliefs, people are actively using these philosophies to disturb themselves (Ellis, 1962). This other “insight” of REBT emphasizes that irrational evaluation is an active behavior controlled by an agent. Different behavioral learning mechanisms control the manifestation of irrational self statements in response to adversities. Most REBT interventions target the verbal level of irrational beliefs (for a detailed description of these interventions see Ellis & Dryden, 1997).
At the level of simulations and modal symbols, we propose that irrational beliefs are the result of different factors, such as intense, repeated or dysregulated emotional experiences, biological state and trait deficiencies, and the repeated use of maladaptive verbal symbols. Intense emotional experiences promote learning of a dysfunctional emotional brain processing (captured in a form of a motivational or emotional simulator) that when re-enacted bias emotional processing in a similar way leading to disturbed emotions. For example, repeated strong emotional experiences could lead to emotional processing biased toward the lack of recruitment of inhibitory control during these experiences. Moreover, sensitization processes (i.e., repeated use of a reward/aversive stimulus to produce pleasure/fear) lead to abnormal responses of the incentive salience processing system to the particular stimulus category. The processing pattern in limbic circuits is captured by cross-modal neurons in the ventromedial prefrontal cortex that function as an emotional convergence zone (Damasio, 1994; Simmons & Barsalou, 2003). When reactivated by a specific stimulus (e.g., visual cue) it generates partial activations (i.e., simulations) in the limbic processing circuits that bias ongoing limbic processing or generate output programs.

**Fig. 1. Levels of maladaptive processes in irrational grounded beliefs**

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<th>Verbal symbols level</th>
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<tr>
<td>excessive use of irrational verbal beliefs</td>
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<td>detrimental use of rational verbal beliefs</td>
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<td>maladaptive learning processes that maintain the use of irrational verbal beliefs</td>
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<td>maladaptive learning processes that impair the use of rational verbal beliefs</td>
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<th>Modal symbols level</th>
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<tr>
<td>highly activated maladaptive emotional modal symbols</td>
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<th>Interaction level</th>
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<tr>
<td>high strength between maladaptive verbal and modal symbols</td>
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<td>low strength between adaptive verbal and modal symbols</td>
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As mentioned above, in order to gain meaning, verbal irrational beliefs have to be simulated in brain motivational and emotional circuits. From a grounded cognition perspective, we can distinguish between two sources of meaning of irrational beliefs suggested by simulation mechanism: a) a learning/cognitive-derived meaning, and b) a brain-derived meaning. When simulations are guided by simulator activation and are partial reactivations of original processing experiences, a process of learning-derived meaning unfolds. On the other hand, abnormalities in the function and structure of motivational and emotional processing circuits may alter the simulations and thus generate a brain-derived meaning of irrational beliefs.

At the level of interactions between verbal and modal symbols, maladaptive processes refer to different cognitive and biological factors that maintain a strong link between verbal irrational statements and modal simulations or a weak link between verbal rational statements and corresponding simulations. For example, implicit metabeliefs such as “The fact that I feel negative about something, makes it a negative thing” or “The fact that I have this belief, means that it is real” may maintain a strong interaction between verbal irrational beliefs and corresponding simulators. Changes in these beliefs lead to changes in interaction between verbal and modal symbols. Acceptance and commitment therapy (ACT) provides suggestions for interventions that change these implicit metabeliefs (e.g., defusion techniques) and loosen the interaction between verbal and modal symbols. At level of interactions, factors that impair the connection between verbal rational beliefs and corresponding simulators may also be integrated in the same conceptualization. These factors can be identified as metabeliefs, experience or response expectancies, deficiencies in the attentional mechanisms that implement these interactions and so forth.

Changing irrational beliefs from a grounded cognition perspective involves changes in maladaptive factors and mechanisms at the level of verbal symbols, at the level of modal symbols and simulations and at the level of interactions between external (i.e., verbal) and internal (i.e., modal) symbols. Cognitive restructuring of “grounded” irrational beliefs integrates interventions at each level into a common conceptualization.

The following part of the article analyzes this three-level model of conceptualizing irrational beliefs in relation to the cognitive restructuring process.

In the belief evaluation phase, the therapist can assess if the problems appear mainly or differentially at the verbal symbols level, modal symbols level or at the level of their interaction. Once an irrational belief is identified, the client may be socialized with this three-level conceptualization of beliefs effect on emotions, as in the following example: “Maria, we both agree that these irrational beliefs are the ones generating your distress, and in order for you to experience a healthy negative reaction, such as sadness, when confronted with disagreements, we have to change these beliefs. Before we start changing them it is important to know that these beliefs are complex and affect you by three
pathways: one is what you say to yourself, second is the emotional memories that your brain is activating when you are saying these things to yourself, (in the course of your development your brain learned to respond to these situations with very powerful emotions so now it is using the same responses) and third is the interaction between them what you say to yourself and emotional memories. To change these dysfunctional beliefs and the way they affect you, we have to change what you are saying to yourself, you disturbed emotional memories and factors that keep them tied”.

The conceptualization of problematic beliefs as different mechanisms that maintain emotional problems suggests that a client’s irrationality (e.g., demandingness) can be reflected as verbal statements that label the motivational simulator activation during encounters or as verbal statements that direct the activation of specific modal brain circuits. If verbal irrational beliefs have a predominant labeling function, the focus of intervention should be on the simulation/modal symbol level to support the use of adaptive simulators (e.g., preferences) during future emotional encounters. This is the case when clients have difficulties in verbalizing their demands but they have dysfunctional emotional reactions. A different situation is when verbal irrational beliefs have a predominant function of directing activated motivational simulators. In this case, the verbal use of irrational beliefs is the main mechanism for maintaining emotional problems, and therapy should focus on changing verbal symbols by empirical, logical or pragmatic disputations, by behavioral interventions that aim to reduce the use of irrational beliefs, and by promoting the use of rational evaluations during emotional encounters (Ellis & Dryden, 1997).

The interactions level of the intervention aims to modify factors that affect the interaction between verbal symbols and distorted simulations. At this level, cognitive defusion techniques as described by ACT may be integrated into a common conceptualization with classical cognitive restructuring interventions. Defusion techniques are cognitive interventions that target implicit metacognitions such as events-though fusion metacognitive beliefs (i.e., thoughts and beliefs are real events). The change of these beliefs alters the relation between verbal and modal symbols and results in the loss of the emotional impact of verbal beliefs. After the assimilation of new implicit metacognitions, the relation between verbal beliefs and emotions will be guided by adaptive metacognitive knowledge (i.e., thoughts are not realities; they are just thoughts, independent of negative events), weakening the maladaptive regulatory control of negative thoughts on emotions. Exposure to verbal demandingness in a relaxed state can also provide an exercise of using different simulators in response to a verbal belief, thus reducing the control of beliefs over future activating events. It is important to note that not all three levels should be addressed in changing target negative cognitions, but the one which contributes most to maintenance of emotional problems.
After changing verbal symbolic manifestations of irrational beliefs (e.g., demandigness) or dysfunctional factors at the interaction level, the next phase is to change dysregulated motivational symbols and simulations (i.e., the level of modal simulations) and to support the use adaptive ones in response to activating events. This may be done by imagery techniques (e.g., rational emotive imagery), behavioral experiments, exposure, guided experience, mindfulness techniques, reprocessing of emotional memories associated with irrational simulators and real-life practice of new simulators. Also, when adaptive emotional simulators are identified as responses to other activating events, analogical transfer can be used to help the client adopt these simulators in response to target activating events. It is important to help clients explore adaptive simulators in other emotional situations, to make this change easier in the target situation. Most of these interventions overlap with interventions used to achieve “long-term change” or a deep change in irrational beliefs. The grounded cognition view of irrational beliefs is different from the amodal view of irrational beliefs by assuming that medication (e.g., benzodiazepines, d-cycloserine) or transient neurohormonal states (e.g., hormonal changes during ovulation, sleep deprivation effects) directly modify the manifestation of irrational beliefs and alter the cognitive restructuring process. The effect depends on whether medication affects the functioning of emotional brain circuits involved in the simulation of emotional experiences during the process of irrational beliefs activation.

In sum, conceptualizing irrational beliefs as grounded cognition leads to three levels to be targeted during cognitive restructuring. Maladaptive processes may be identified at one, two or all three levels and change should be directed where these processes are manifested.

Conclusions

The grounded cognition perspective offers a complex conceptualization of irrational beliefs as a maladaptive knowledge structures grounded in emotional and motivational processing brain circuits. This perspective integrates research lines from affective neuroscience with core concepts in cognitive clinical science. Irrational beliefs are viewed as core cognitive vulnerabilities for emotional disorders, manifestations of dysregulated emotional/motivational brain processing circuits in response to adversities. Moreover, the grounded cognition perspective suggests that these dysregulated processing styles can be captured in a memory form (i.e., motivational simulators) that bias motivational and emotional processing in new situations.

A three-level model of analyzing irrational beliefs was presented in this paper. This model offers a common conceptualization involving classical, language-based cognitive restructuring interventions (i.e., verbal level), acceptance and commitment therapy interventions (i.e., interaction level), and factors affecting brain functioning (e.g., medication, state hormonal changes etc.).
Grounding irrational beliefs in the brain’s motivational and emotional processing systems also offers new possibilities in designing interventions for changing irrational beliefs and for integrating different research perspectives such as clinical cognitive science, affective neuroscience and psychotherapy.

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