Psychological Topics 19 (2010), 2, 221-234

Original scientific paper - UDC - 615.851
159.953.2

Examining the Scope and Concept of Schema: Should We Look Beyond Cognitive Structures?

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Abstract

Traditionally, cognitive therapy and the cognitive-behavior therapies have focused on three levels of cognitive phenomenon: automatic thoughts, cognitive distortion, and underlying assumptions. Underlying assumptions constitute the general notion of what is referred to as "schema." Schemas have traditionally served as sort of a template for the way in which an individual views him/herself, the world, and others. In addition, a proposed model has also appeared in the professional literature that includes memory structures and multimodal representations of stored information that serve to explain the concept of schema in general. Recently, some controversial research has raised the question as to whether separate memory cell networks in the body may play an additional role beyond cognitive structures.

This article reviews some of the research on the role of neuropeptides in the process of memory and emotions and raises the question of whether or not an expansion of the concept of schema should be considered. The article also discusses what scientific support exists at this time and whether we can draw any clinical implications from such a theory. The article also discusses the impact of this theory on the view of schema resistance and the role of cognitive therapy, particularly as it relates to conditions involving trauma.

Keywords: schema, memory structures, memory cell networks, peptides, multisensory effects of schema, trauma

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> *"The Mind and the Body are one and the same thing, which is conceived now under the attribute of Thought, now under the attribute of Extension. The result is that the order, or connection, of things is one, whether nature is conceived under this attribute or that; hence the order of actions and passions of our Body is, by nature, at one with the order of actions and passions of the Mind."*
>
> (Spinoza, 2001)

Traditionally, cognitive therapy and the cognitive-behavior therapies have focused on three levels of cognitive phenomena: automatic thoughts, cognitive distortions, and underlying assumptions (Beck, Rush, Shaw, & Emery, 1979; Young, 1990). Underlying assumptions, or schemas, are considered the deepest and most fundamental level of cognition and are viewed as the basis for screening, differentiating, and coding stimuli that individuals encounter during the course of their lifetimes (Beck et al., 1979, p. 13). Beck originally defined the notion of schema in his 1967 work, *Depression: Clinical Experimental and Theoretical Aspects*, as the following:

"A structure for screening, coding, and evaluating the stimuli that impinges on the organism. On the basis of the matrix of schemas, the individual is able to orient himself in relation to time and space, and to categorize and interpret experiences in a meaningful way" (p. 283).

Although Beck's definition of schema was the first, and became one of the more popular definitions among the cognitive therapies, the basic concept of schema is certainly not a new one. The term "schema" originates from the Greek root word ΣΧΗΜΑΤΑ (scheen), which is defined as "to have or to shape." Other definitions include: "to plot or to make a detailed plan or outline". It is for this reason that future definitions incorporated the term "template" in their descriptions (Young, 1990).

Segal (1988) went on to define schema as: "Organized elements of past reactions and experiences that form a relatively cohesive and persistent body of knowledge capable of guiding subsequent perception and appraisals" (p. 147). Arias and Beech (1987) also expanded on Beck's original definition and suggested that schemas are: "A set of rules held by an individual that guides his or her attention to particular stimuli in the environment and shapes the types of inferences the person makes from an unobserved characteristic" (p. 110). Young (1990) further amplified the original conceptualization, referring to schemata as "Extremely stable and enduring themes that develop during childhood and are elaborated upon throughout an individual's lifetime." Young believes that schemas serve as "templates for the processing of later experience" (p. 9).

In all of the aforementioned definitions, the main theme appears to center on the representation of highly generalized superordinate-level cognitions that are

resistant to change and exert a powerful influence over thought, affect, behavior, and even physiologic processes. Beck further emphasized that individuals with chronic or recurring problems often coexisting with personality disorder have established early maladaptive schemas in childhood. These schemas direct attention to an increased recall of information consistent with the schema. For example, depressive schemas focus on loss, deprivation, and failure; anxious schemas focus on threat, such as danger to valued aspects of self (Beck, Emery, & Greenberg, 1985). Personality schemas are general themes of interpersonal and self-functioning, which correspond to vulnerabilities that may be activated by current life events. Beck has always underscored the operation of cognitive schemas as being the most fundamental factor in his theory of emotional disorders, playing a principal role in the maintenance of psychological disorders, as well as in the recurrence and relapse of episodes (Beck, 1967, 1976). However, it is interesting that Beck chose to use the term "organism" in his 1967 definition of schema. This term alone implies that there might be more levels in defining the concept than to only cognitive processes.

The concept of schemas has played a major role in the mental health field, deriving from cognitive psychology, cognitive development, and self-psychology, as well as attachment theory. Within the cognitive therapy literature alone, the term "cognitive schema" has had multiple meanings, which vary according to the extent to which they are accessible or inaccessible cognitive structures (James, Southam, & Blackburn, 2004; Segal, 1988; Young, Klosko, & Weishaar, 2003). It appears that the vast majority of these definitions maintain that schemas have a powerful influence over cognition and affect and are often resistant to change. It is further believed by cognitive-behavior therapists that schemas exert their influence through conscious information processing rather than through unconscious motivation or instinctual drive as proposed by psychodynamic theorists. Interestingly, many theories posit that emotions operate in the same manner as cognitions, viewing them as a primary nonconscious mental process that create a readiness for action, disposing individuals to behave in a particular way (Siegel, 1999).

Memory Structures

Recently, some authors have suggested a need to revise and expand the concept of schema as used by cognitive-behavior theorists, reconnecting its links with the memory literature and the manner in which information about life experiences is stored (James, 2001, 2003; James, Reichelt, Freeston, & Barton, 2007). There are two central aspects under consideration. The first aspect involves the diathesis-stress model, in which schemas are viewed as memory structures in general. This model builds on the notion that there are features that have been encoded in one’s past that are stored cognitively and will be activated at some

future date by the presence of an appropriate cue. The cue may be cognitive, emotional, or physiological. The second aspect of the revised perspective is derived from clinical observation, indicating that once an individual has experienced depression, future episodes are likely to share many characteristics with that initial experience. Thus, there will be characteristics of cognitive themes, behavioral strategies, sensitivities relating to noise and sounds, and even smells or other visceral sensations that are replicated later. Consequently, multi-sensory information relating to an individual's depression is stored as some form of unitary concept, and it is this multimodal representation that is reactivated during subsequent episodes of depression. It is the contention of several recent authors that the view of multimodal representation should be used to define the concept of schema (James, et al., 2007). This broader view differentiates between the concept of schema and core beliefs, suggesting that a core belief is merely one component of schema (i.e., the cognitive feature). From the authors' perspective, schema are viewed as representations of previous experiences (i.e., memories) that are stored multimodally, containing details about emotional, kinesthetic, olfactory, sensory, physiological, neural, and cognitive processes. Therefore, an individual who has previously suffered from depression or anxiety will have stored representations of what it is like to be anxious or depressed. The more episodes of anxiety or depression that one experiences, the more familiar one becomes with the state of being depressed and/or anxious. An important concept emerges from this discussion of memory as to whether or not such components may house stored material in areas other than in cognitive structures. In turn, this raises the question of whether or not schemas involve a complex system of multiple layered component parts that are activated at various times, depending on stimulus cues. In other words, do the multimodal aspects that involve emotion and other sensory stimuli, such as physiological, neural, and olfactory, consequently expand what we currently accept as that definition of cognitive structure to an interrelated network that involves myriad domains that are not limited to only thought processes? This may be particularly salient with regard to disorders that involve physical illness, injury, or trauma.

Recent research has proposed the idea that emotion and cognition strongly interact and are only minimally decomposable in the brain, and that the neural basis of emotion and cognition should be viewed as more strongly non-modular than once thought. While some evidence has also linked emotions to the body and its affect on consciousness (Damasio, 1999; McIntosh, 2000; Mesulam, 1998), there has been other evidence that suggests that the opposite may be true (Pessoa, 2008).

Memory Cell Structures

Some research has suggested that memory cell structures may be transported through organic chemicals in the body known as peptides. This concept was originally proposed by Candace Pert, a NIMH researcher and formerly a professor of cell physiology and biophysics at Georgetown University School of Medicine and later expanded by Ekman and Davidson (1994). Pert, who is an expert in peptide pharmacology, believes that the mind and body are in constant communication with each other through organic chemicals known as "peptides." Peptides, which are substances in the body, formed from the linking of amino acids and present in the brain, as well as in other major organs of the body. Pert hypothesizes that memory can be accessed anywhere in the peptide preceptor network, ranging from the brain and pathways through internal organs, including the very surface of our skin. These research findings indicate that neuropeptides and their receptors form an information network within the body that affects cognition and emotion (Pert, 1986, 2002). The first component of the molecules of emotion is the molecule found on the surface of cells in the body and brain and is known as the opiate receptor. In the early 1970s, Pert's discovery of the opiate receptor launched her career as a bench scientist. Pert identified a mechanism by which to measure opiate receptors and, thereby, substantiate their existence (Pert, 1997; Pert, Ruff, Weber, & Herkenham, 1985).

Receptors in molecules are comprised of proteins, tiny amino acids strung together in crumpled chains that appear almost like beaded necklaces that have folded in on themselves. If one were to assign a different color to each of the receptors that has been identified, the average cell surface would appear like a multicolored mosaic of at least 70 different hues, 50.000 of one type of receptor, 10.000 of another, 100.000 of a third, and so on. A typical neuron, or nerve cell, may possess millions of receptors on its surface. Molecular biologists are now able to isolate these receptors, determine their molecular weight, and eventually decipher their chemical structure, which means identifying the exact sequence of amino acids that make up the receptor molecule.

Receptors function as sensory molecules, similar to electronic scanners. Just as one's eyes, ears, nose, tongue, fingers, and skin act as sense organs, so do these receptor molecules. The only difference is that these receptors function on the cellular level; that is, they hover in the membranes of one's cells, vibrating and waiting to detect messages carried by other vibrating structures that are made up of amino acids. Many of these amino acids cruise along, diffusing themselves through the fluids surrounding each cell. All receptors consist of proteins and cluster in a cellular membrane, waiting for the right chemical keys to connect with them through intercellular fluids. This process is known as "binding".

Much in the same way that receptors are constructed, peptides are comprised

of strings of amino acids. Peptides are not limited to the brain, but can be found in every part of the organism. Although peptide structures are deceptively simple, the responses they elicit can be extremely complex. This complexity has led to their classification under a wide variety of categories, including hormones, neurotransmitters, neuromodulators, growth factors, gut peptides, interleukins, cytokines, chemokines, and growth inhibiting factors. These terms all come under the rubric of what may commonly be referred to as "informational substances" because they point to the common function as a messenger, distributing information throughout the organism.

Pert's controversial work proposes that peptides exist in all parts of the body. Until 1984, it was firmly believed that emotions clearly originated in the brain and that emotion and cognition were separate entities (Pessoa, 2008). It is now accepted that cognition and emotion involve complex interactions in the brain, strongly blurring the distinction between the two (Cohen, 2005; Drevets & Raichle, 1998; Pessoa, 2008). It is Pert's proposal that peptides and other ligands should also be considered "biochemicals of emotions" and exist in other parts of the body, as well as the brain (Pert et al., 1986).

Reciprocal Influences of Physiology, Cognition, and Emotion

In 1984, Schmitt introduced the term, "information substances", to describe a variety of transmitters, peptides, hormones, factors, and protein ligands responsible for transmitting information. Alongside the conventional model of synaptic neuronal circuitry, Schmitt proposed a parasynaptic or secondary parallel system where chemical information substances travel with the extracellular fluids circulating throughout the body to reach their specific target cell receptors. Neuropeptides have been discovered not only in the rows of nerve ganglia on either side of the spine, but in the end of various organs themselves (Pert et al., 1986). These discoveries opened the way to the notion that peptides and other informational substances are the biochemicals of emotion and that their distribution in the body's nerves has all types of significance. In this respect, the body becomes the nonconscious mind, so to speak. It was hypothesized that repressed traumas caused by overwhelming emotion are able to be stored in body parts, affecting one's ability to feel the part or even move it. The new work suggests that there are infinite pathways for the conscious mind to access and modify the unconscious mind and the body, and provides an explanation for a number of phenomena that the emotional theorists have been considering (LeDoux, 1996; Siegel, 1999).

In this respect, every change in physiological state is accompanied by an appropriate change in the mental/emotional state, conscious or unconscious, and conversely, every change in the mental/emotional state, conscious or unconscious,

is accompanied by an appropriate change in the physiological state. In essence, mental and physiological states are a two-way street. This hypothesis has led to another insight into the meaning of the discoveries with regard to peptides and their receptors and about the theories regarding molecules and emotions (Pert et al., 1985).

Pert and colleagues (1997) believe that, as a result, we can no longer consider the emotional brain to be confined solely to the classical locations of the amygdala, hippocampus, and hypothalamus. Other anatomical locations have been identified where high concentrations of almost every neural peptide receptor exist; locations such as the dorsal horn or backside of the spinal cord, which is the first synapse within the nervous system where all synaptic sensory information is processed (Pert, 1997). This raises many complex questions about what becomes a thought rising to consciousness and what remains as thought pattern lodged in a deeper level of the body and mediated by various physiological receptors. The fact that memory is incurred or stored at the receptor level might suggest that memory processes could be emotion-driven and not always a part of conscious awareness. This theory is in sharp contrast with other theories that contend that emotions are directly involved in conscious (or unconscious) evaluation of events (Arnold, 1960). While some strong evidence links emotions to the body (Damasio, 1994), other research suggests that emotional states or moods are produced by the various neural peptide ligands (small molecules that specifically bind to a cellular receptor that then conveys informational messages to the cell) (Ekman & Davidson, 1994). This research suggests that what we experience as an emotion or feeling is also a mechanism for activating a particular neuronal circuit, simultaneously throughout the brain and body, which generates a behavior involving the entire system with all of the necessary physiological changes that behavior would require. Ekman and Davidson (1994) developed a formulation that each emotion is experienced not only through the brain, but throughout the organism as well.

Cellular Memory

Subsequent findings support the concept of the direct effect of endogenous neuropeptides on cognition as well (Azmi, Norman, Spicer, & Bennett, 2006). These results lead to speculation about how much memory is actually stored in the cellular units of the body in addition to the cognitive centers of the brain. While such a concept clearly raises skepticism for a variety of reasons, if it were accurate, it may certainly explain, in part, why some schemas are so resistant to change, particularly those involving medical illness or physical injury.

Additional research has begun to address the issue linking neural function, cellular physiology, and molecular genetics to cognitive and emotional processes (Taylor & Liberzon, 2007). Further studies, now in progress, examine how cellular

structures store memory on interaction and trauma and the manner in which it is communicated through the body's system. A recently published study by Issabelle Mansuy and colleagues at the University of Zurich found that the enzyme calcineurin and the gene regulation factor Zif268 can decisively determine the intensity of emotional memories (Baumgärtel et al., 2008). The researchers in this study addressed the effects of calcineurin on the amygdala by conditioning mice to associate a sugar solution with nausea. Mice were used as a model system because their learning processes are very similar to those in humans and have established behavioral tests in the past. The results showed reduced activity in the conditioned mice compared to the mice in which no association with nausea had been generated. The results indicated that this association persisted for months afterwards and the mice, in response, avoided the sugar solution during clinical trials. Because calcineurin is a negative regulator of learning and memory, its activity needed to be reduced to enable strong memorization. The researchers selectively activated and deactivated the enzyme in nerve cells of the brain of transgenic mice, indicating that their selective activation and inactivation in nerve cells was important due to the fact that calcineurin was an enzyme that occurred in a number of different cells throughout the body. The researchers hypothesized in their study that inactivating calcineurin strengthened the memory of the association between sugar solution and nausea, whereas the memory was weakened by increased calcineurin activity. The results further suggest the connection that the period of time needed to suppress the negative memory by purely positive memory could be prolonged or shortened respectively by this intervention.

The outcome of this study suggests that negative memories do not necessarily disappear, but merely descend in a manner of priority and are outweighed by newly learned positive memories. Further, while some material regarding traumatic events may vanish from memory, extreme cases of emotional recollection may remain stored in these cells for a lifetime. This is analogous to overwriting material on one's computer, wherein some material may be erased, but other content may remain embedded on the hard drive permanently. Active intervention is, therefore, necessary to reduce the priority level of these negative memories, some of which may be invoked by cognitive restructuring or mediational techniques. However, other content may remain very resistant to change.

Case Example

Let us consider an example of how all of this might work. In the case of traumatic injuries, such as physical or posttraumatic stress disorder, an individual might be affected by a trauma on multiple levels (i.e., thoughts, olfactory, auditory, or various other sensations) (Dattilio & Castaldo, 2001, 2006). When

there is traumatic physical abuse wherein an individual is exposed to environments in which he or she sustains considerable physical trauma, the memory of such abuse might be stored on a number of levels (Dattilio & Castaldo, 2001, 2006). Consider the case of Sara, whose father was a heavy consumer of alcohol and would often come home intoxicated and physically abuse her and other family members. Sara's abuse occurred repeatedly over the course of a number of years. Consequently, she developed the basic schema that "alcohol makes people violent and dangerous." Because Sara sustained many physical injuries from her father's abusive behaviors, she was exposed to stimuli on multiple levels (i.e., auditory, her father shouting; olfactory, the smell of alcohol and perspiration on her father; and tactile, the pounding of his fist or the sting of his belt). The effect of this repeated trauma also set off a number of internal reactions, such as urinary excitation, which included loss of bladder control when her father would yell at her; nausea, as a result of increased stomach acid when she became tense and anxious; and myriad other physiological responses. All of these bodily sensations certainly serve as cognitive memory triggers as proposed by James et al. (2007). However, if we also consider the theory of the existence of separate memory cell networks that are housed in the individual organs themselves, and store information regarding trauma and other events, this might very easily apply to Sara's case, whose cognitive processes were also affected by way of cellular communication, as well as the psychological effects of the trauma. Even though this sequencing is arduous to measure; nonetheless, we must ask ourselves whether or not schemas remain limited to memory structures in the brain, or do these memory structures also extend beyond cognitive processes? Sara's general schema that alcohol is "poison and it makes people crazy and dangerous" obviously affects her on multiple levels. For example, she may feel the need to avoid certain friends and loved ones who drink, even in moderation, because she experiences nausea or a general tenseness in her body when she smells the alcohol. Because of the multisensory impact that the trauma has on her body's entire system, she may not be consciously aware or in control of how extensively the trauma affects her whole being and the choices she makes. Perhaps this suggests that in Sara's case, and others, cognitive-behavior therapists may need to look beyond the scope of cognitive processes and restructuring to take into account the full multisensory perspective. We may be more limited than once thought to other sensory systems or body anchoring that contributes to a resistance to change. When Sara says that she has a bad "gut feeling" upon smelling alcohol, it has a particular meaning on a multisensory level that may not always respond to cognitive mediational strategies or behavioral exposure and desensitization. Excitement and anger have long been known to increase gut motility. All of these sensations may need to be considered and addressed in some way during the course of treatment in order for Sara to fully rehabilitate. As an example, during the course of treatment, particular attention may need to be paid to the visceral

reaction that Sara experiences to the trauma and, thus, acknowledging these sensations as visceral and not only attempting to hammer away relentlessly at restructuring her thinking, but to consider additional interventions.

Another classic example of this dynamic is veterans of war who experience shell shock because of their exposure to battle. Such conditions involve visceral reactions in addition to cognitive interplay, sometimes lasting for decades after the initial trauma, despite years of psychological and pharmacological treatment. Desensitizing individuals to such a reaction can prove quite challenging, even with repeated exposure.

Individuals such as George Engel, who hypothesized that his biopsychosocial model of conceptualization may provide a more comprehensive way of viewing mental illness (Engel, 1977), raised such considerations decades ago. In Engel's attempt to integrate psychosocial issues into medical practice, he emphasized the biological system, which included anatomical, structural, and molecular substrates of the human system and its influence on a person's overall functioning. Engel urged practitioners to maintain a comprehensive perspective on all illnesses in the interest of obtaining effective results and recommended that it become a regular part of mental health assessment (Campbell & Rohrbaugh, 2006; Dattilio, 2005). Unfortunately, Engel only suggested that various levels of functioning interact and did not expand on the mechanics of how they interact. Therefore, more evidence to support such scientific theory is needed.

Clinical Implications

If the notion of stored memory in body cells or peptide networks were to prove accurate, then it may raise a very important consideration with regard to how these body chemicals communicate with the brain and how this process affects what we currently regard as "cognitive memory." If this information is indeed communicated subtly through other channels, then the question remains to what extent does it influence conscious thought and memory? This area of inquiry has major implications with regard to the limitations of our work in restructuring schemas. This is especially true as it applies to stored memory regarding trauma. When addressing the effects that external events may have on our bodies and our psyche, we may need to reconsider the concept that some of the stored memory may be unreachable with the repertoire of contemporary therapeutic techniques that we have at our disposal. Additional exploration and research in the use of innovative interventions may be necessary in order to affect change.

Since the immune system, like the central nervous system, has memory and the capacity to learn, we might hypothesize that a form of storage for information is located not only in the brain, but also in cells that are distributed throughout the entire body. If the mind is defined by brain-cell connection, as it has been in

contemporary science, then this model of the mind can be viewed as extending to the entire body since neuropeptides and their receptors are intricately entrenched in the body's system as well. The brain is undeniably well integrated with the rest of the body at a molecular level. This is one of the reasons why therapeutic cloning would not likely be successful for serious mental illnesses (Dattilio, 2002). As a result, it is a reasonable conclusion that the mind is also in the body in the same sense that the mind is in the brain and that schema is likely to encompass both, albeit at different levels.

DISCUSSION

This paper raises interesting food-for-thought - namely, whether the concept of schema extends beyond cognitive structures to the role of neuropeptides in cellular memory.

The aim of this paper is not to propose a well-grounded theory of cellular memory and emotions. If anything, the scientific support is in its early stages and is far from offering any solid basis for consideration. However, it is enough to raise awareness about the potential for memory to extend beyond what we know to be cognitive structures. Thinking about such expansion would serve the interest of science in several ways. If we become too complacent in our beliefs about the potential limits of cognitive structure, then we inhibit our growth toward advancement of new ideas. Even if these proposed theories lack the rigorous scientific evidence to fully support them, they may still be worth contemplating and exploring further in order to keep an open mind about the potential limits involved.

One of the obvious limitations of this theory is the difficulty in accessing and measuring the stored memory cells throughout the body. As mentioned previously, this also has implications as to what interventions would be effective in addressing such memories and facilitating change.

Clearly, it behooves us to look beyond our basic understanding of cognition and memory structures in the best interest of science and in the endeavor to develop a comprehensive conceptualization of schema. Although we may not yet be able to effectively address memories stored in body cells, we may be able to incorporate this knowledge into a greater understanding of the broad concept of schema, as well as the resistance that accompanies certain schema content. This is particularly important as we seek to understand our limitations and possibilities as clinicians.

Acknowledgements

The author wishes to acknowledge Professor Candace Pert of Georgetown University School of Medicine for her input regarding the clinical literature, as well as Amanda Carr of Lehigh University for her assistance with the literature review.

Portions of this article were presented at the 6th International Congress of Cognitive Therapy in Rome, Italy, in June 2008.

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Received: December 2, 2010