A Neural Network Model for Transference and Repetition Compulsion Based on Pattern Completion

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*If the only tool you have is a hammer, every problem begins to resemble a nail.*

Abraham Maslow

Abstract: In recent years because of the fascinating growth of the body of neuroscientific knowledge, psychoanalytic scientists have worked on models for the neurological substrates of key psychoanalytic concepts. Transference is an important example. In this article, the psychological process of transference is described, employing the neurological function of pattern completion in hippocampal and thalamo–cortical pathways. Similarly, repetition compulsion is seen as another type of such neurological function; however, it is understood as an attempt for mastery of the unknown, rather than simply for mastery of past experiences and perceptions. Based on this suggested model of neurological function, the myth of the psychoanalyst as blank screen is seen as impossible and ineffective, based on neurofunctional understandings of neuropsychological process. The mutative effect of psychoanalytic therapy, correcting patterns of pathological relatedness, is described briefly from conscious and unconscious perspectives. While cognitive understanding (insight) helps to modify transferentially restored, maladaptive patterns of relatedness, the development of more adaptive patterns is also contingent upon an affective experience (working through), which alters the neurological substrates of unconscious, pathological affective patterns and their neurological functional correlates.

Freud would be impressed if he knew of the growing number of current psychoanalytic–neuroscience studies. While he abandoned this endeavor because of the then limited knowledge of neuroscience, we have an effective bridge between these two disciplines: neuropsychoanalysis. Since transference and its analysis are core concepts in all psychoanalytic theories and therapies, an understanding of their neural bases is important. The complexity of transference and countertransference was
noted by William James when he stated, “Whenever two people meet, there are really six people present. There is each man as he sees himself, each man as the other person sees him, and each man as he really is.”

In the case of Dora, Freud (1905/1961a, p. 116) elaborated: “What are transferences? They are new editions or facsimiles of the impulses and phantasies which are aroused and made conscious during the progress of the analysis; but they have this peculiarity, which is characteristic for their species, that they replace some earlier person by the person of the physician.” However, if a patient repeats repressed material in the hereand–now, then transference will be a key to uncovering the unconscious processes which originated from the past (Hobson & Kapur, 2005). Gabbard (2006) relates transference to the unconscious process of implicit memory. While he relates the automatic, unconscious, stereotyped behaviors and defenses to implicit procedural memory, he suggests implicit declarative memory is a basis for more conscious expectations, fantasies, and fears transferred to the therapist. In this article, we conjecture a model for both transference and for repetition compulsion, facilitated by an automatic neurological function of pattern completion in cortical, thalamic, and hippocampal areas.

PATTERN COMPLETION, A NEUROPSYCHOLOGICAL MEANS OF ORGANIZING VAGUE STIMULI

Pattern completion is a neurological function involved in memory retrieval. It facilitates the retrieval of a complete pattern from a perceived, incomplete pattern (Samura & Hattori, 2005). When the mind encounters a vague and incomplete visual, or auditory, stimulus, it refers to its previously memorized visual or auditory patterns to match the new stimulus with the one complete pattern most closely correlated with it. Then that pattern is “locked,” and the person will perceive the vague pattern as the originally “locked,” complete pattern.

Autoassociative neural networks are a subgroup of connectionist, functional neural systems. As a broader group, they can be trained to generate a range of target patterns in response to a range of inputs (O’Brien & Opie, 2006). After training, these networks are able to synthesize an output based on the resemblance of newer inputs with stored patterns, assimilated during the training phase. In other words, “a connectionist network constitutes a system of representing vehicles whose relations sustain a resemblance with respect to the task domain over which the network has been trained” (O’Brien & Opie, 2006, p. 36). Pattern completion is then accomplished by autoassociative neural networks that feedback to themselves. This feedback enables the autoassociative neural networks to “correct” the vague patterns presented to them.
Such autoassociative neural networks can be trained by repeated presentation of complete patterns (Peláez, 1997). When a vague pattern is presented to such a trained neural network, it is broken (or analyzed) into its principal components. These components are then reconstituted and completed in a new synthesis with the elements of the completed pattern, especially when there is ambiguity in the principal components of the vague pattern (Diamantaras & Kung 1996). Effectively, the network eliminates irrelevant components as distracting noises.

Once an autoassociative network is trained, a “noisy,” damaged, vague, or incomplete testing pattern can be input to the trained network. The network will output a noise–free complete pattern. During this testing phase, the autoassociative network outputs an idealized version of the testing input pattern. This idealized output is a synthesis of the testing pattern with the principal components. These principle components are extracted by means of a hidden layer of the network. In this blend, irrelevant data are extinguished, and the output is then considered an idealized version of the input. Peláez proposed that since the thalamus has the same structure of an autoassociative neural network, it is able to complete noisy or damaged patterns, using principal components extracted from its reticular layer (Peláez & Simões, 1999).

Pritchard (1961) describes the case of visual pattern completion. If an image is stabilized on the retina by a projector placed on the cornea so that relative movements between the retina and the image cannot take place, a remarkable phenomenon happens. The image soon fades and disappears. After a while, fragments of the image appear again. For example, a monogram formed of the letters H and B breaks into recognizable letters and numbers that come successively into view.

In other words, a distorted figure is transformed into a more rounded one! Leopold and colleagues (2002) and Maier and colleagues (2003) have suggested that “the neural expression of a state of perceptual organization may have an inherent storage capacity that promotes the reestablishment of the same state during the subsequent dynamic processing of visual information” (p. 1076).

Pattern completion in the thalamus is the key concept used by Peláez to explain some cognitive disorders involving hallucinations of several kinds: visual hallucinations of the Charles Bonnet syndrome; somatic hallucinations of phantom limbs; hallucinations of schizophrenia; psychedelic drug–related hallucinations; and those intermittently associated with dissociative identity disorders (Peláez, 2000). He states that

Being (that) prefrontal and temporal areas (are) devoted to cognitive functions, fragmented or uncompleted cognitive patterns should be reconstructed at the thalamus. Because the neural architecture is essentially the
same all over the thalamus it would not be reasonable to imagine a pattern completion task being performed in thalamic sensorial areas and not in thalamic areas receiving inputs from prefrontal or temporal cortices. (Peláez, 2003, p. 1161)

In other words, he proposes the resulting cognitive hallucinations to be vague inputs from the prefrontal and temporal areas, resulting in the delusions, hallucinations, and loose thinking of schizophrenic patients. His hypothesis of defective, prefrontal or temporal inputs to the thalamus in schizophrenic patients has been confirmed by some studies (Bunny & Bunny, 2000; Jones, 1997).

Pattern completion, in concert with conceptual sensory ambiguity (as a result of impaired sensory gating), may be a cause of hallucinations in such psychotic disorders as schizophrenia, bipolar disorder, and post traumatic stress disorder (Javanbakht, 2006). Conceptual sensory depri-
vation, caused by a sensory gating deficit, fosters compensatory pattern completion to restore the most appropriate and repeated patterns of memory related to the affective state of the person. As a result, a patient with posttraumatic stress disorder, for example, may reexperience affects of the traumatic event as a result of the sensory overload caused by a sensory gating deficit. The pattern completion which follows from the vague trigger stimulus leaves the amygdala in a state of firing that arouses anxiety, an affective memory of the originally trained or locked template. Similarly, a schizophrenic patient with oedipal conflicts might hear voices ordering him/her to kill his/her father, having such oedipal conflicts as the originally trained or locked (fixated/cathected) complete pattern.

As mentioned earlier, although pattern completion is mostly studied in sensory modalities, because of the similar global structure of the thalamus as an autoassociative neural network, pattern completion may occur with conceptual and affective patterns of relatedness that are also vague to the person. Pattern completion may be an explanation for the consolidation of delusional systems of thought, as well as transference. While some authors focus on thalamo–cortical pattern completion, especially for visual perception, others have worked on hippocampal pattern completion, because hippocampal structure also resembles an autoassociative neural network (Maloney, Dal Martello, Sahm, & Spillmann, 2005; Nakazawa et al., 2002; Samuri & Hattori, 2005). In the hippocampus, some axons return from hippocampal CA3 region back to itself, resembling the structure of an autoassociative neural network’s feedback loop. This feedback loop facilitates hippocampal pattern completion, mirroring the previously stabilized memory patterns. However, the patterns that are perceived repeatedly enough are also corticalized and fixated in cortex (Eichenbaum, 2003).

MIRROR NEURON SYSTEMS AND ACTION RECOGNITION

The studies on mirror neuron systems were first done on Macaque monkeys. Maletti and his colleagues (Maletti, Luppino, & Rizzolatti, 1985) found that during the observation of an action, the same motor neurons which are needed for performance of that action are activated in the area F5 of the cortex of monkeys. These neurons were called mirror neurons. It was suggested that “the activation of the same substrates during action observation would allow the observer, through an observation–execution matching mechanism, to understand what the actor is doing” (Buccino, Binkofski, & Riggio, 2004, p. 370). The presence of a mirror neuron system in humans is supported by electrophysiological, behavioral, and imaging studies (Brass et al., 2000; Buccino et al., 2001,
2004; Strafella & Paus, 2000). In these studies, motor evoked potential and PET scan results supported the premise of the activation of a common brain pathway during action observation and action execution.

Interestingly, when humans are asked to observe the mouth actions of conspecifics, such as monkeys, mirror neurons are activated (Buccino et al., 2001). However, this activation is not as substantial as the activation seen during observation of human mouth movements. Furthermore, during the observation of mouth actions of a nonconspecific (a dog barking), mirror neurons are not activated (Buccino et al., 2001). Although most of the studies on mirror neuron systems have been in the fields of hand and mouth movements, some authors have suggested that frontoparietal and frontotemporal mirror neurons function as a bridge between the self and others (Uddin, Iacoboni, Lange, & Keenan, 2007). In other words, the mirror neuron system is proposed to be a substrate for empathy and recognition of other people’s affects and imminent intentions (Gallese, 2003).

Thus, the mirror neuron system has importance as a mechanism for understanding others’ intentions and behaviors. There, as yet, appear to be no studies relating the mirror neuron system and pattern completion as two interrelated mechanisms. However, it is possible that the mirror neuron system serves to process especially clear inputs of physical and kinesthetic behaviors, while pattern completion serves as a system for processing perceptions of ambiguous, vague sensory and conceptual inputs, perhaps having more of a relational quality. In other words, if an action or intention cannot activate a specific mirror neuron system, its ambiguous, vague aspects must be processed through pattern completion. Such an idea might imply a hierarchy of perceptual processing priorities, similar to the concepts of series or parallel circuits in electrical wiring models. However, this suggestion awaits confirmation by subsequent neurological studies.

**TRANSFERENCE AS A CONCEPTUAL AND AFFECTIVE PATTERN COMPLETION**

As described above, during visual pattern completion a perceived image is compared with the previously memorized images, especially with the ones most often repeated. If the perceived image has “lost parts” (part–objects?), or vague elements, it will be locked with the template of the most relevant memorized image (object representation). From an object relational point of view, one infers that memorized objects and their patterns of relatedness can be used for pattern completion with ambiguous perceptions and situations. One such particularly ambiguous and vague relational situation is the relationship with the analyst who, if not
simply neutral, might attempt to be in an almost inert position without the expression of emotions. Furthermore, this person might then easily represent a parental figure during the process of psychodynamic therapy.

Therefore, what happens in the therapeutic relationship is similar to the case of an incomplete, or blurred, visual image presented to the visual cortex. In such a situation, there is a potential space for pattern completion to help the analysand organize an understanding, as much as is possible, of the analyst with whom he or she participates in an affectively charged relationship. While the analyst is mostly vague and unknown, and while an environment of ambiguity is intensified during the free-association process, autoassociative, pattern completing, neural networks complete the unknown characteristics of the analyst, superimposing such ambiguous components onto an archaic template. Since the analyst is usually in the position of a parental figure, unknown parts of his or her character and behavior will be generally and specifically completed by those of the parents, especially by the experiential representations that were frequently repeated, and by those which significantly affected the analysand. In other words, the analyst/therapist, as an incompletely perceived object, is completed, as an object representation, by the most relevant, archaic, parental patterns, encoded on the autoassociational neural network template. These patterns have been frequently repeated, and they generally have been activated with an affective significance (i.e., affective cathexis of a self-object relational unit).

If the patient has had distorted and limited object relationships in his or her past, he or she has limited access to memorized patterns (templates) of healthy objects and object relatedness. Most of these were maladaptive, thereby locking in with the ambiguous input of the analyst, and distorting the therapeutic relationship along those maladaptive, transferential lines. So the maladaptive, pattern completion sets up the transferential possibility of revising the template, or of a working through in analytic space. A pattern repeatedly presented is consolidated in the hippocampus and the cortex (Eichenbaum, 2003). Through such training of the autoassociative networks, repeated patterns presented become templates for future pattern completion. This repetitious training during infancy and childhood, when patterns of relatedness and of temperamental fit to a caregiver are experienced, provides the experiential foundation for these archaic templates.

High expressed-emotion stimuli presented to the cortical-hippocampal-amygdala circuitry may more likely become the repressed memories of a posttraumatic stress disorder with all of their developmentally biased distortions that create pathological templates.
from which locked-in negative therapeutic reactions may arise. Physical or behavioral characteristics of the analyst may shape the pattern completion toward alternative patterns. This could explain in part the varied core transferences experienced with different analysts, perhaps offering another perspective on the idea of parallel circuitry. Some transference-type experiences in relationships outside the therapy are not experienced in the therapeutic relationship, and might be further considered by the therapist, perhaps being mislabeled as resistances or a flight into healths, or as an aspect of a splitting process.

Object pattern completion might occur both for the affective state and the conceptual context of the therapeutic relationship. For example, if a patient is anxious and he or she is in a vague therapeutic relationship, limbic system templates most relevant to patterns of relatedness of the anxious affective state will be accessed for pattern completion. This may kindle a transference in which the patient perceives the analyst as a punishing angry father figure. However, it might also be inverted: the patient being locked-in with a self-concept as punishing and angry (a complementary transference paired with a concordant countertransference). A male patient might even relate in an inverted sense to a therapist whose physical or behavioral characteristics are somehow similar to a punishing aunt, leaving a pattern completion lock reviving an unconscious identification with that aunt (a cross-gender transference). This might lock the pattern of this transference–countertransference relationship with memories of the aunt, activating cortico–limbic patterned templates. Again, anxiety might arise in an affective pattern completion, having an inverted, conceptual context.

To summarize, in the psychoanalytic therapeutic relationship, the therapist as an object has partially ambiguous characteristics, perceived by the patient. This ambiguity is intensified in proportion to the perceived neutrality of the therapist. In other words, if in schizophrenia there is lack of clarity of the sensory input because of the anatomical defects in relaying networks, for transference pattern completion, the input itself is vague and incomplete. On the other hand, one might conjecture a developmental continuum on one side of which there is benign transferential pattern completion characteristic of neurotic relatedness, and on the other extreme, a highly distorted, delusional pattern completion characteristic of psychotic relatedness. Both free associational process and primary process seem particularly well-suited to activate, or specifically kindle, the autoassociational pattern completion circuitry most relevant to imprinted, or repeated, object related, affective, and conceptual experiences (templates).
The perceptual resemblance to archaic patterns may be due to the following: the physical and behavioral characteristics of the therapist that are similar to certain archaic self–and–object experiences; the conceptual position of the therapist as a parental figure; the affective state of the patient, especially during transference neurosis–like occasions; the neuropsychological availability of the archaic self–and–object patterns; the affective significance (cathexis) of the imprinted objects (or object relationships); or even, perhaps, the repetition rate (especially during certain developmental windows of neural consolidation) of the archaic patterns. As a synergy of the noted factors, pattern completing networks lock the most relevant pattern onto the perceptual experience of the therapist in the form of transference. On the other hand, as noted above, when an autoassociative network completes a pattern, it not only attaches or links the missing components, but it also deletes, or de–links, the irrelevant parts as noises. This de–linking process could explain the patient’s apparent need to perceive the therapist as a facsimile of past persons, genetic representations, if you will, despite the therapist’s variant attributes and behavioral cues that confirm this difference in reality. In other words, those aspects of the therapist that do not match the locked pattern are eliminated from patient’s conscious awareness, especially at the height of the transference neurosis.

Considering the mirror neuron system, the clear, undistorted, patterns of behavior are probably first processed, and their meaning comprehended through its functioning. The comprehension of vague or ambiguous patterns, or of the higher level intentions of actions in relational–conceptual contexts, may be subject to pattern completion. For example, if the therapist extends his hand to reach for his pen, a mirror neuron system detects his action and his intention to be picking up the pen. However, there are ambiguities in his higher order intentions. Is he picking up his pen to prescribe medication? Is he picking it up to play with it because what the patient is saying is unimportant to him? Or is he planning to write something embarrassing about the patient in his notes? Such conceptual pattern completions can happen at any time and for various levels of hierarchical intentions. For example, if the therapist writes the medication with his pen, is he doing this to tell the patient that the session is over, or is he worried about the patient and wants to help more by giving medication?

As another example, if the therapist smiles, the mirror neuron system through visual and motor cortices registers the behavior as simply smiling. In a motor neuron system language or registry, if the patient smiles similarly when he or she wants to look down on others, he or she will
perceive (project) the same intention in the therapist’s act. However, based on the previous experiences with significant others’ smiling, and based on the conceptual, emotional, and contextual significance of these others, through pattern completion this patient might perceive different motivations for the smile (happiness, kindness, misery, feeling pity, embarrassment, etc.). On another level, even if the patient perceives this smile as a sign of happiness, the intentional pattern might be completed (based on transference) as happiness for the patient’s progress, or for the ending of the therapeutic relationship, because the patient is a boring person.

The same model can be applied to countertransference. However, because the therapist has been analyzed and can be more aware of his/her pathologic patterns of relatedness, or may have even resolved them, he or she can recognize these distorted patterns when they lock onto a patient’s outputs. In other words, higher cortical executive ego functioning may revise archaic completed patterns (internal self–and–object representations) that may distort an empathic view of the patient. Before excessive pruning weakens the cortex, the cortex can similarly correct the wrongly completed patterns (Javanbakht, 2006). This early cortical skill might explain how people who later develop schizophrenia do not experience delusions and perceptual distortions before adolescence, when excessive pruning takes place.

Furthermore, with professional training, the therapist has consciously stored more contextual understanding of various experiential patterns through formal education. This learning also happens on an unconscious level. Based on experiences with different patients and with their various patterns of object relationships, the therapist has an unconscious storage of several patterns, both concordant and complementary to those of various patients. As a result, he or she has a higher chance of locking empathically attuned patterns onto the patient, when the therapist experiences countertransference. For example, a therapist well–experienced in the psychotherapeutic work with borderline patients carries a rich store of varied object relationships with such people in general. So, when he or she encounters a new borderline patient without knowing the diagnosis, he or she has more chance to lock restored, and “repaired,” patterns, similar to, and different from, the behavioral, cognitive, and affective patterns of the new patient. Gabbard’s theory of relating transference to implicit memory processes could be complemented then by the concept of pattern completion, here regarded as the neuropsychological mechanism by which such implicit memory enables the transferential experience.
PATTERN COMPLETION, REPETITION COMPULSION, AND PROJECTIVE/INTROJECTIVE IDENTIFICATION

Although he initially alluded to repetition compulsion in 1914, Freud’s (1920/1961b) main discussion of the concept was in his work “Beyond the Pleasure Principle.” He wrote that the patient “is obliged to repeat the repressed material as contemporary experience instead of . . . remembering it as something belonging to the past” (p. 12). Although tentative about the idea, he suggested repetition compulsion served to achieve mastery and control over past trauma (Freud, 1920). He extrapolated from there to the concept of the death instinct, or thanatos. This referred to the tendency of an organism to revert to an inanimate state. This aspect of the repetition compulsion is not addressed in the present article.

If one is to understand the relation between pattern completion as transference and pattern completion as repetition compulsion, one needs to understand the neuropsychology of projective and introjective identification, as it has direct bearing on the affect regulation and cognitive–behavioral aspects of memory retrieval (Schore, 2003). Functional MRI studies of the left orbitofrontal areas of the cerebral cortex, that have been often associated with the left verbal–linguistic hemisphere, are also “specifically involved in ‘semantic implicit retrieval that does not depend upon intentional recollection’” (Ragan, 2006, p. 640; Schore, 2003). Areas of the right orbitofrontal cortex (ventromedial prefrontal cortex) are associated in imaging studies with “critical human functions, such as social adjustment and the control of mood, drive and responsibility, traits that are crucial in defining the ‘personality’ of an individual” (Cavada & Schulz, 2000, p. 205). More specifically, Schore (2003) notes, “Current neuroimaging studies demonstrate that the processing of self (Keenan et al., 2000) and self–regulation (Levine et al., 1998; 1999) occurs within right prefrontal cortices, and that the self–concept is represented in right frontal areas” (Craik et al., 1999).

Executive functions associated with this right prefrontal system include: attention and data–gating (right dorsolateral prefrontal cortex; Barkley, 2006), attachment, “processing of visual and auditory information associated with emotionally expressive faces and voices, the self–regulation of bodily states, and the correction of emotional responses (i.e., affect regulation)” (Schore, 2003, p. 105). Rotenberg (1995) notes that right cortical image thinking is particularly adaptive when information is “complex, internally contradictory, and basically irreducible to an unambiguous context” (p. 243), circumstances that form the essentials of both pattern completion and projective/introjective identifi-
cation. Schore (2003) has elaborated a theory of projective identification which develops neuropsychologically from the aforementioned prefrontal cortical systems that lay at the “hierarchical apex of the limbic system” (amygdala, hippocampus, thalamus, and temporal regions) and that utilize unconscious right hemispheric bilateral communication between infant and mother, and evolves, dependent upon the degree of “ambient trauma,” throughout life. This right prefrontal cortical network, Schore maintains, based on functional MRI studies of Hariri, Bookheimer, and Mazziotta (2000), “modulates and attenuates emotional responses at the most basic levels of the brain.” They note further that such modulating processes are “fundamental to most modern psychotherapeutic methods,” and that the modulation occurs “through interpreting and labeling emotional expressions” Hariri, Bookheimer, & Mazziotta, 2000).

Citing the basic mechanisms of projective identification for the early development of primitive empathy, as well as for defensive security and attachment functions, Schore (2003) further notes, linking the concepts of neuroplasticity and top–down (Ragan, 2006) influence on neuropsychological adaptation and revision, that the working through processes implicit in the repetition compulsion have a forerunner ontologically in the maternal “containing” (Bion, 1970) and “holding” (Winnicott, 1956, 1960) functions involved in the differentiation of self from object. Seligman’s (1999) infant observational studies on projective identification empirically corroborate (Ragan, 1999) the clinical veracity of Schore’s (2003) following remarks:

The operations of the early–maturing (right) hemisphere mediate the empathic perception of the emotional states of other humans. It is important to note that the right hemisphere cycles back into growth phases throughout the lifespan (Schore, 2001; Thatcher, 1994) and that the orbitofrontal cortex retains a capacity for plasticity in later life (Barbas, 1995), thereby allowing for the continuing experience–dependent maturation of the right frontal regulatory system within the growth–facilitating environment of an affect–regulating therapeutic relationship. This structural organization, in turn, is reflected in a progression in the complexity of the patient’s coping mechanisms—specifically, a developmental advance in the form of a mature personality organization that accesses adaptive over defensive projective identification. A deeper apprehension of the developmental and therapeutic changes in this right–brain system that is centrally involved in the regulation of emotional states is therefore directly relevant to Klein’s (1946) pioneering explorations that are fundamentally concerned with the “regulation of feelings.”
Thus, projective identification and introjective identification form the primitive, or trauma–based, and maturing psychological “imprints,” or templates, for the phenomena of transference and countertransference, each resting on the neuropsychological systems found in the bilateral orbitofrontal cortices, whose linkages with the limbic system are mediated by the concept of pattern completion as described above. Schore (2003) presciently notes, concerning trauma–based projective identification and dissociation,

Experiences of early relational trauma (Schore, 2001) restrain the manner in which coping responses occur at later points of stress: “The experience is then structurebound, the present situation or certain aspects of it evoking only an already formed experience pattern with a fixed unchangeable repetitive structure.” . . . These representations, a primary source generator of Freud’s repetition compulsion, are stored in the early–developing, “holistic” (Bever, 1975) right hemisphere (Schore, 1994).”

As working through and experiential learning found in psychoanalytic therapy, or in psychoanalysis, are based on a form of revision of the repetition compulsion, while using its ubiquity as the common mutative vehicle, one could easily infer that pattern completion in its therapeutic nuances is the neuropsychological foundation of the repetition compulsion, of working through, of the maturation of projective and introjective identificative mechanisms, of empathy, of transference and countertransference, of neuropsychological development, and of maturational movement into the experience of intrapsychic conflict (Brenner, 1980, 1982).

Others have given different psychological explanations for the repetition compulsion. They have related repetition compulsion to: repetition of the trauma in order to process it (Horowitz, 1976); reliving it as a way to master it (Janet, 1919/1925); and a curative motive, searching, by reliving the traumatic pain, for a healing opportunity (Russell, 1990). Shapiro (1985) has opined that it serves the function of reducing anxiety associated with early fears of abandonment. Orlandini (2004) suggests that it is a mixture of a painful, impossible desire with a familiar kind of relief–analgesia induced by revictimization. Levy’s (2000) view of repetition compulsion also has two dimensions: the continual reexperiencing and repeating of past thoughts and feelings; and the compulsive repetition of rigidified defenses. There have also been biological models proposed for the phenomenon including: a compulsion to seek a perceptual identity between the present objects and the past ones (Modell, 1990); an arousal–related automatic revival of past memories (Van der Kolk, 1996); and an involvement of the opioid system in
addiction and habituation to repeated traumata (Erschak, 1984; Starr, 1978), among others.

Repetition compulsion can also, however, be explained by pattern completion. At the inception of every significant relationship, many aspects of the other person are vague to the perceiver. Subsequently, the mind, through the neuropsychological mechanism of pattern completion, attempts to relate these vague aspects to an archaic template, presumably to give anticipatory, meaningful context for relating. The perceived person’s behaviors, emotions, facial expressions, tone of voice, and even words with their rhythm and cadence, generally evoke various meanings within the perceiver, contingent upon the degree of influence of his/her past significant relationships. He or she will complete those patterns of relatedness based on his/her reservoir of templates of past experiences, especially those with most significant emotional relevance to the percepts received. Maslow once said “when the only tool you have is a hammer, every problem begins to resemble a nail.”

As an example, a patient with a repetitive, imprinted pattern of relatedness with an abusive father completes her pattern of perceptions of most men based on her experience with father. She perceives them as abusive people, and so she repeats the perceptions, and their corresponding behaviors, that for so long she has adapted to interact with the experience of an abusive father. Recall that when a trained autoassociative network receives ambiguous inputs, it not only completes the incomplete, or vague, parts of those inputs, but it also eliminates irrelevant parts as noise. So, even if the perception of the other person is at variance with the archaic templates of stored patterns of relatedness with father, the variances are omitted as irrelevant noises. This excision of noise phenomenon might explain how the perceiver appears to “ignore” those realistic differences (variances) in the therapeutic setting or an affectively charged relationship. This might be one type of “blind spot” essential for the experience of transference.

The reaction of the perceived person to the perceiver’s patterned behavior, resulting from her pattern completion, might be different. The other person (the perceived one) might not be abusive at all. So he (the perceived person) may not consciously resonate with the perceiver’s completed patterns. He does not accept them and cannot be easily evoked as a proxy (“hooked”). If the perceived one is not a therapist, he doesn’t easily comprehend how the perceiver’s behaviors and ideas developed. As a result, the perceiver may feel unfamiliarity with the relationship and with the other person (the perceived one). This unfamiliarity occurs with the other person (the perceived one) as well. They may not continue the relationship and separate.
On the other hand, the other person (the perceived one) might be insulted by the defensive, abuse-averse behavior of the perceiver, and react the same way that she (the perceiver) expects him to behave. In other words, through the perceiver’s projective identification and the perceived one’s introjective identification, the perceived one recruits templates of his own (patterns of abusiveness), matching his perceptions of her, as a reaction to (and acceptance of) the perceiver’s predefined (via archaic templates) perceptions with their corresponding behaviors. This reciprocal projective and introjective identification enables the perceiver to consolidate and synthesize her conceptions about an abusive partner, and to then complete other associated patterns about the proxy partner’s abusiveness. These concordant and complementary processes magnify the importance of a detailed analysis of the relationship in couple therapy, emphasizing the reactive behaviors of the perceived person (“absent” in the perceiver’s individual therapy sessions) to behaviors resulting from the perceiver’s archaic, completed patterns. If partner B is abusive, this might be a reaction to her (partner A’s) repeated projective identification of her archaic, templated role relationship—patterns with an abusive parent into him by partner A, and not be the core organizing templated behavior of the partner B.

Partner A might seek pattern completion with archaic templates and evoke abusive patterns of relatedness in order to limit expenditure of energy. The automatic use of pattern completion might also limit the experience of the insecurity of unknown, novel, or even excessively ambiguous, inputs. Her need for such security, a type of rigidified hypervigilance, enables her resistance to change of those templates. It serves a compelling neuropsychological function: limiting the reception of an overwhelming volume and/or quality of inputs to a relatively less plastic and developmentally more primitive neuropsychological system. Effectively the perceiver appears to prefer bearing the pain of repetition, rather than the insecurity and neuropsychological work of making sensible a data-rich, ambiguous input. In essence, a type of gating system is effectively employed for neuropsychological security functions.

As an autoassociative network, the thalamus is able to generate a set of coordinate axes for representing each sensorial pattern, so that each pattern is represented over a limited and finite set of axes (Peláez, 2003). These axes are adjusted during childhood (as patterns of relatedness are more prone to change) when plasticity in thalamic circuits is greater. The generation of coordinate axes by the thalamus for representing sensorial patterns is a way of performing dimensionality reduction. Although this dimensionality reduction can give rise to some perceptual errors, it is also a way of reducing the overall energy necessary for imprinting perceptual tasks.
Conversely, by maturity the synaptic connections in the thalamus have a more enduring repertoire of axes. Therefore, representation of conceptual and sensorial ideas is performed using this more limited repertoire of coordinate axes. Thus, memorizing new patterns of relatedness requires more adaptive energy and conscious resources. This neuropsychological investment, an induction of plasticity with new imprinting, is the difficult essence of learning during the working through process in psychotherapy. However, during the emotional turmoil, say of the transference neurosis, patients have more limited resources for conscious data processing. They are more prone to learning by unconscious processes, including pattern completion, instead of conscious evidence–based analysis of the relationship.

In a third situation, when the partner A completes patterns using the templates of an abusive partner, the partner B might have as a core template an imprinted abusive experience. He then could also have archaic patterns of relatedness to a victim. His patterns are easily locked onto the sensorial input data displayed by a prone–to–victimization individual. Such a neuropsychological template fit offers abeyance of the insecurity of the unknown potential in favor of the quick–templated, and therefore less demanding, complementarity of easily accessible pattern completion. The neuropsychological use of neuroplasticity and energy expense are thereby minimized. However, in order to minimize the conscious experience of anxiety and pain of completing archaic patterns of relatedness, repression is employed to keep unconscious the autoassociative templating process for both partners. This repression process keeps neuropsychological linking distant from fronto–cortical linkages, leaving the process relatively sequestered in the thalamo–hippocampal–amygdalar circuits. The complementary template–fitted relationship will be consolidated and synergized by both partners unconsciously, matching then the exact case of a repetition compulsion.

To summarize, early in a relationship, in order to protect the partners from fear of ambiguity or novelty, more primitive, rigidified neuropsychological structures serve the functions of pattern completion, or templating, relatively unknown or ambiguous inputs. The unfamiliar aspects of the behavior and character of the other person (which are not few) are comprehended through the imprinted, archaic memory patterns of relatedness, using substitution for and excision of those data–rich inputs. This complementary fitting of neuropsychologies will evoke responsive patterns of behavior from each person, especially if he or she is familiar with these behavioral, sensorial, and contextual patterns based on his/her past relationship experiences. The responses will confirm the assumed, completed pattern and synergistically consolidate a relationship similar to those of the past. The partner thus needs not to
learn new patterns of relatedness. He or she is thereby free of the anxiety and insecurity of ambiguity and of unknown potentialities. In essence then, psychotherapy is the accessing of those neuropsychological structures where unlearning must coordinate with new evidence-based learning.

In an example, Levy says,

Another man who had not worked through his parent’s rejection of him became flooded with rage, hurt, and disappointment when a friend failed to return a phone call. He understood this as proof that he was not cared about and in an angry tirade told off his friend. This led to his friend withdrawing from him, which was a reenactment of his relationship with his parents. (Levy, 1998, p. 231)

The behavior of the friend in failing to return the phone call could have many reasons including forgetfulness, being too busy, or temporary inaccessibility. The closest reactive pattern, however, to the friend’s failure to return the phone call that was most often repeated, imprinting deep emotions and memories, was the pattern of being rejected. Finally, instead of mastery over the past, repetition compulsion may alternatively be an attempted mastery over the unknown in present. The partner escapes the unknown by completion of the unknown with the imprinted patterns of relatedness to significant others. Although this process may make a patient suffer more familiar pain, mastery (even if not ego–adaptive) over the unknown overrides the pleasure principle!

**IMPLICATIONS AND OVERVIEW**

Since transference is the core concept in psychoanalysis, knowing its neural basis is an important aspect of neuropsychoanalytic research. In the theory proposed here, transference is suggested to be based on pattern completion through which the unknown aspects of the therapist’s behavior and character are completed with the memories of important past relationships. This theory suggests autoassociative neural networks (especially thalamo–cortical and amygdala–hippocampal) to be responsible for pattern completion in transference. Although Freud suggested that the analyst must be completely neutral, like a “blank screen,” in psychoanalytic therapy, there are many critics who believe it not only to be impossible, but also nonfunctional. Anonymity is practically impossible because every aspect of the therapist’s behavior, physical appearance, tone of voice, or even the environment of the office evoke patterns and make associations in the mind of the analysand (Gabbard, 2006; Hoffman, 1998; Westen & Gabbard, 2002).
Furthermore, for old patterns to complete new relationships, there must be some stimuli to evoke them. If there is no pattern presented, there is no pattern completion. If there is presented only complete anonymity and a blank screen, no pattern of relatedness can be evoked and completed, unless perhaps the patient suffered from some form of infantile attachment difficulty. Then the so-called “blank screen” might provoke a primitive defensive template of sorts. Recall the experience of Pritchard (1961) with visual pattern completion. There must be some blurred images received by visual processing areas in the thalamus in order to activate autoassociative, pattern completion. If the person is blind or blindfolded, there will be no illusionary experience, as Pritchard describes.

Similarly, the patient in analysis must have some perception of the analyst on which to project his/her patterns. Transference depends, then, upon the processes of not only reciprocal data exchange as inputs, but also upon the enlistment of unconscious, concordant and complementary, autoassociative, pattern completion loops between patient and analyst. With only a blank screen, there would probably be no transference. An analyst who is not completely anonymous, but also not self-revealing, accesses easily and synergizes well with the neuropsychological structures and functional systems, which automatically (unconsciously) utilize the mirror neuron and autoassociative, pattern completion systems.

Although the analyst is vulnerable to transference and to countertransference, he does not behave in the way the patient expects him to do. Although the patterns are completed in the neuropsychological matrix of the patient, the analyst neither leaves the relationship, nor does he or she behave the same way, as those templates of the patient’s archaic, internalized, object-/self-representations of parental relatedness might evocatively pressure the analyst to enact. This paradox facilitates the patient’s skepticism of the veracity of completed patterns. The patient learns that he or she cannot realistically match the therapeutic relationship.

This necessary development of a self-observing ego, wherein analytic potential space becomes accessible, helps the patient correct those archaic, rigidified patterns. As a result, the therapeutic relationship is an opportunity for completion of patterns, for their testing, and then, for their corrective revision. Effectively, psychoanalytic psychotherapy is a method of pattern correction. It is also a developmental process of expansion of capacity for neural plasticity to engage the arrested ego function of reality testing. Furthermore, the patient consolidates and synthe-
sizes new patterns of relatedness through the process of analysis. While the patient’s defective and limited resources of adaptive patterns of relatedness are correctively revised, he or she imprints (introjectively identifies with) aspects of the analyst’s revisions, allowing more healthy and adaptive patterns to enrich his/her reservoir of relatedness patterns.

Therapeutic work can correctively revise maladaptive patterns both cognitively and emotionally. Since the patient learns about his/her repetitive patterns of relatedness, he or she has an opportunity to soften and revise the memory imprinted system that has stored archaic and pathological patterns. The patient consciously tests and changes the old patterns that had been rigidified. Furthermore, through therapy, he or she learns and adds new patterns of relatedness to the reservoir of the old patterns. These new patterns, repetitively tested and worked through, will help the patient to be more precise in future pattern completions.

Additionally, through a corrective emotional experience during therapy, the archaic, affectively laden, amygdalar patterns that override and substitute for variant conceptual data, thereby evoking wrong conceptual patterns, are also modulated. In other words, while cognitive correction works through memory patterns and imprinted templates, affective contextual revision of the patterns of relatedness takes place in the limbic system (especially in the amygdala–hippocampus linkages). Furthermore, the patient who receives empathically attuned mirroring from the therapist has a valuable opportunity to correctively revise patterns involving the self–representations, as well as patterns of self–perception and self–relatedness. In other words, the patient internalizes from the therapist new patterns of relatedness that can be useful for better understanding of the environment and the self.

Therapeutic effect occurs at both the conscious and unconscious levels. Consciously the patient becomes aware of, and tests, the validity of the stored, repeatedly evoked patterns. At the unconscious level, however, the neuropsychological matrix corrects the old patterns by imprinting and adding the healthy patterns of conceptual, affective, and cognitive/symbolic relatedness to its reservoir. Thus, part of the therapeutic effect occurs without the patient’s, nor even the therapist’s, conscious awareness.

Because an increased level of anxiety evokes anxiety–related patterns of relatedness through the more primitive, and thus rigidified,
change–averse amygdala–hippocampal pathways, decreasing anxiety through ego–strengthening psychoanalytic therapy or even through medications (such as benzodiazepines) might decrease the rate of firing of amygdala–hippocampal driven anxiety. The overriding of more realistic pattern completions is thus mitigated, leaving potential space for more conscious analysis of relational patterns. Thus, prefrontal–dominated critical analysis of the relational environment, and a more precise understanding of significant others is more accessible (Javanbakht 2005). However, unnecessary use of medications, by limiting affects, disrupts opportunities for affectively laden transferences to be engaged. Medications may interfere with the working through of some transferences (possibly, and particularly, the transference neurosis). Thus, the psychoanalytic therapy may remain incomplete. Commonly after medication is stopped, some affect–laden patterns arise. Judicious and timely use of medication is crucial for working through. The therapist finds archaic patterns of relatedness, tests them collaboratively with the patient, and facilitates the patient’s conscious (and unconscious) corrective revisions. Here is a bridge between psychoanalytic and cognitive psychotherapy. Cognitive therapy serves conscious insight and mastery for suppression.

This model clarifies the concept of repetition compulsion. It suggests repetition compulsion is an attempt for mastery over unknown and ambiguous percepts of interpersonal relationships in the present, rather than the past. This security maneuver overrides the pleasure principle. This model partly corresponds with Levy’s (2000) theory that suggests repetition compulsion has two dimensions: the continual reexperiencing and repeating of past thoughts and feelings; and the compulsive repetition of rigidified defenses. The first part of his model matches with pattern completion. The second part correlates with imprinted templates of reactions to the pathologically perceived patterns. Furthermore, since many behaviors of significant others (even if negative) are reactions to the pattern completion–based templates of the patient, projective identification must be carefully considered in the analysis of patients’ relationship with their significant others. Pine (1985) has stated that psychopathology can be defined as the degree to which perception and behavior are determined by those images, roles, and expectancies from the past rather than by current realities. If dysfunctional pattern completion can evoke hallucinations and delusions in persons with psychotic disorders, it can also evoke illusionary transferences and repetition compulsions in persons with nonpsychotic disorders.
References


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