Reconsolidation of Emotional Memories in Psychotherapy:

How Corrective Emotional Experiences Facilitate Enduring Change

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Abstract

In recent years there have been exciting developments in basic memory research demonstrating that memories are not fixed but are modifiable under certain circumstances, a phenomenon known as memory reconsolidation. This discovery creates the opportunity for the blueprints of behavior to be altered in a way that will result in enduring change. Moreover, it is now understood that semantic memories are a distillation of episodic (event) experiences, which means that certain kinds of episodic experiences in psychotherapy, particularly ones that are emotionally potent, can alter and potentially transform semantic memories. Corrective experiences, a concept originating in the psychodynamic tradition, has recently garnered increasing interest as a foundational change mechanism applicable to multiple psychotherapeutic modalities.

Neurobiological approaches to memory-emotion interactions highlight the arousal aspect of emotion, which is associated with increases in cortisol and norepinephrine that promote synaptic changes that enhance memory encoding. Although well established, these molecular mechanisms do not address the content of the memory that is so encoded. This chapter will extend this perspective by highlighting the appraisal aspect of emotion, and its relevance to altering the implicit construal of problematic situations through a predictive processing mechanism. This focus shifts the emphasis to the meaning that is inherent in corrective emotional experiences that update a type of semantic memory called schematic memory, leading to alterations in the construals and behavioral responses these revised schemas generate. As such this theoretical advance helps to explain why new emotional experiences in psychotherapy may be even more important than the patient's enhanced understanding in promoting change and

provides a neurobiologically-informed explanation for how corrective emotional experiences work.

Key Words

Corrective emotional experiences, memory reconsolidation, schematic memory, appraisal, mechanisms of change, psychotherapy

Introduction

The concept of corrective emotional experiences (CEE) was originally put forward by Alexander and French in 1946 in the psychoanalytic literature [1]. In their view psychoanalysis up to that time had put too much emphasis on interpretation and insight, and not enough emphasis on new emotional experiences in interaction with the therapist. They said, “The “corrective emotional experience” was the fundamental therapeutic principle of all “etiological psychotherapy.” In their definition it meant "to re-expose the patient, under more favorable circumstances, to emotional situations which he could not handle in the past. The patient, in order to be helped, must undergo a corrective emotional experience suitable to repair the traumatic influence of previous experiences… Intellectual insight alone is not sufficient."

The concept of CEE was not well received within their own field of psychoanalysis [2]. Alexander and French held that the analyst should purposefully interact with the patient in a way that would induce emotional experiences that would counteract and undo the past emotional trauma. This was criticized for introducing contrived and artificial interventions that did not emanate from the natural, spontaneous interaction between patient and analyst. In addition, the concept of CEEs was also viewed as unnecessary, as it was widely understood within analytic circles that interpretation and insight, particularly when it was generated in the context of the transference relationship with this therapist, carried with it a powerful emotional impact. This skeptical view of CEE within psychoanalysis and psychodynamic psychotherapy has persisted to the present [2], although there are some exceptions [3, 4]. The debate within psychoanalysis centers around whether new insight and understanding or new interactive experiences are the critical drivers of change [5, 6].

The broader concept of corrective experiences, as distinct from CEEs, has been more favorably received within the wider field of psychotherapy research and practice, where interventions other than promoting insight are prioritized. A recent compendium reviewed the utility of the concept of corrective experiences from the perspective of a variety of psychotherapy modalities [7]. Although there was wide agreement that corrective experiences were useful, the concept has been applied in many different ways, and there is as yet no consensus about how they work. For example, a general definition of corrective experiences is that they consist of events or experiences that are unexpected and result in some kind of shift [8]. This lack of consensus is understandable, as this issue is inextricably linked to the more general questions of what it is that psychotherapy seeks to change, how change occurs in psychotherapy and the role emotion plays in the change process.

Inherent in the concept of CEE is that it is corrective. This means that past history is contributing to current difficulties, as there is something currently in place that needs to be corrected. As noted above, according to Alexander and French [1], the difficulties pertain to expectations based on past experiences, particularly traumatic experiences, which in turn lead to maladaptive patterns of behavior. Here trauma can refer to circumstances in which the person feels emotionally overwhelmed and unable to cope and does not necessarily refer to situations that were life-threatening. Inherent in the concept of CEEs is that there is something about certain kinds of emotional experiences in therapy that make it possible to change these expectations and patterns in a way that surpasses what new understanding and insight can achieve, and such changes constitute a new solution to preexisting difficulties. Although CEEs most commonly refer to a shift from more negative to more positive expectations, it is conceivable that CEEs could also promote more accurate assessments of reality by promoting

awareness of unpleasant realities concealed by inappropriately positive appraisals. These considerations highlight that emotions must somehow be interacting with cognitive processes in order change expectations and patterns of behavior that were imperfect solutions to previous problems.

In a recent paper [9] and book [10] my colleagues and I described a core mechanism of enduring change in psychotherapy that highlighted the critical and essential role of CEEs. Importantly, we put forward the view that the contextual specificity of problematic patterns of behavior are provided by memory and the change process consists of changing memories through a phenomenon called memory reconsolidation. This perspective drew upon recent advances in the neuroscience of memory demonstrating that memories are not fixed but in fact are modifiable [11]. Moreover, emotion plays a critical role in memory because it is impossible, and probably undesirable, to remember everything that happens to us, and yet it is adaptive to remember what is most important, including updates of old memories based on new emotional experiences [9]. Given that emotional responses result from the ongoing automatic evaluations of the extent to which needs, goals or values are being met or not met in interaction with the environment [12], emotion (broadly defined to include bodily responses and as well as experiences) is nature's way of determining and marking what is most important to a given person. Importantly, current neuroscientific evidence highlights the importance of biological mediators of emotional arousal consisting of neurotransmitters and hormones (norepinephrine and cortisol) that induce changes in neuronal synapses that enhance memory encoding [13]. Although this mechanism helps to explain *how* emotion and memory interact, it does not explain *why* an emotional experience can be corrective by changing expectations and problematic

behaviors, or *why* a new experience in psychotherapy can surpass new understanding in its effectiveness.

A key thesis of this chapter is that emotion can be broadly partitioned into appraisal components and response components that include arousal, and the combination of appraisal and response can explain the mechanism of the clinical benefits of CEEs in a way that the latter alone cannot. Whereas neuroscience to date has highlighted the arousal/response component in explaining the interaction between emotion and memory during encoding, newer evidence highlights the influential role of the appraisal component of emotion in facilitating memory that alters future behavior. For example, imaging evidence indicates that goal-relevant contextual stimuli facilitate encoding of memory for neutral faces, and subsequently improve recall, relative to goal-irrelevant contexts [14].

In essence, this emphasis on the appraisal component of emotion means that CEEs in interaction with a therapist inherently and automatically change expectations and associated behavior patterns in previously problematic social contexts, which arose from emotional experiences in interaction with caretakers and important others in the past. As such, emotional experiences, when interacting with and updating memories, have inherent meaning that alter how future situations will be construed and responded. Moreover, this change in cognitive functioning happens automatically without intention or effort, in contrast to interpretation, which requires effortful, controlled cognition that specifically aims to make previously unconscious processes conscious.

To explain and support this complex proposal, this chapter will review the phenomenon of memory reconsolidation, the interaction between emotion and memory, the theory of enduring change involving emotion-memory interactions and the differential role of the appraisal and

response components of emotion in bringing about clinical change. The chapter will then discuss the implications of this formulation for emotion-focused therapy, cognitive-behavioral therapy (CBT and psychodynamic psychotherapy, which will include refining our understanding of why CEEs are effective, how to optimize their use in clinical practice and how to understand the roles of new experiences and new narratives or interpretation in clinical practice.

Memory Reconsolidation

Memory consolidation refers to the transformation of memory from short (temporary) to long term (enduring) storage. The traditional view of memory consolidation suggests that immediately after learning there is a period of time during which the memory is fragile and labile, but after sufficient time has passed, the memory is more or less permanent. During this consolidation period, it is possible to disrupt the formation of the memory, but once the time window has passed, the memory may be modified or inhibited, but not eliminated. In contrast, multiple trace theory (MTT), a relatively new innovation in memory research, suggests that every time a memory is retrieved, the underlying memory trace once again enters into a fragile and labile state, and thus requires another consolidation period, referred to as "reconsolidation" [15]. The reconsolidation period provides an additional opportunity to amend or, under appropriate circumstances, even disrupt the memory.

MTT proposes that each time an episodic memory is recollected or retrieved, a new encoding is elicited, leading to an expanded representation or memory trace that makes the details of the event more accessible and more likely to be successfully retrieved in the future. This process is primarily initiated by active retrieval or recollection, although off-line reactivation that occurs during sleep and indirect reminder-induced reactivation can also trigger

it [16-19]. Critically, each time an event is recollected and re-encoded, an updated trace is created that incorporates information from the old trace, but now includes elements of the new retrieval episode itself—the recollective experience—resulting in traces that are both strengthened and altered. This altered trace may incorporate additional components of the context of retrieval as well as new relevant information pertaining to the original memory. In this regard, MTT holds that memories are not a perfect record of the original event, but undergo revision and reshaping as memories age and, importantly, are recollected. The reconsolidation process, by this view, results in memories that are not just stabilized and strengthened, but are also qualitatively altered by the recollective experience.

This dynamic interplay between retrieval of the memory and reconsolidation has been demonstrated experimentally both in animals and humans. Animal studies have shown that well-established, supposedly consolidated, memories can be disrupted after reactivation [20].

Integrated Memory Model

In 2015 my colleagues and I [9] described the "integrated memory model" which states that there are three phenomena that always interact: episodic or event memories, semantic memories or generalizable knowledge, and emotion. Whenever one is activated so are the other two. In light of the phenomenon of memory reconsolidation, this means that previous knowledge or expectations based on semantic memory will influence how the current situation is interpreted and experienced; when a new experience occurs in psychotherapy (i.e. when an episodic memory of the experience is formed) the emotional content of that experience will contribute to the content of the event memory and influence how likely it is to be recalled and in what context in the future. Furthermore, both the narrative content of the event and the associated emotional

experience will update the relevant semantic memory through reconsolidation. This in turn will influence how similar situations in the future are construed and responded to. Thus, CEEs influence future behavior by updating semantic memories.

Episodic and semantic memory seem, at least phenomenologically, quite different from one another. Episodic or autobiographical recollection involves thinking about a past event—it is personal, emotional, imbued with detail, temporally and spatially unique, and it often has great relevance to our sense of self and the meaning of our lives. Semantic memory, on the other hand, has to do with the knowledge and rules governing behavior that have been acquired through a lifetime of experiences—it is typically factual, devoid of emotion or reference to the self, or specific times and places. While semantic knowledge conveys meanings, it is rarely the kind of personal meaning embodied in autobiographical and episodic memories. Instead, it provides us with expectations and allows us to predict the outcome of new situations using the generic knowledge gained from similar situations in the past. This formulation suggests that episodic and semantic memory are representational systems that together capture both the regularities and irregularities of the world, allowing one to create concepts and categories (semantic memories), and also capture the time and place when one particular combination of entities was experienced, yielding an episode that may or may not be consistent with one's prior expectations [21].

It has long been assumed that these two types of memories are relatively independent of one another, both functionally and anatomically [22-25]. Recent research, however, has called this independence into question [21]. In a series of functional MRI studies, Ryan and colleagues demonstrated that both semantic and episodic retrieval results in a similar pattern of hippocampal activation, particularly when the tasks were matched for spatial content [26-28]. Consistent with Tulving [29], semantic memory and episodic memory are seen as interactive and complementary

systems. Both semantic structures and singular episodic memories are important for identifying familiar circumstances, interpreting novel events and predicting outcomes, and choosing appropriate behaviors in response to situations and personal interactions.

Barsalou [30] has long championed the idea that semantic knowledge is embedded within a network of autobiographical memories. Episodes are represented as single events that are connected to other related episodes. Semantic memory is essentially derived from similar event memories that can be convolved to emphasize common information that is experienced across contexts, giving rise to what we call semantic memory. This idea is the basis of latent semantic analysis models [31]. By this view, semantic information may be indistinguishable from episodic memory at the level of the brain when it is first acquired, and only later becomes differentiated as similar experiences accumulate and structural regularities and rules are derived. This information can then be retrieved separately from a specific context if necessary.

Semantic memory is therefore not simply a stable record of past learning, but something that is generative, flexible, contextually bound, and subject to revision through personal experience. Semantic memory is generated anew each time it is required, in much the same way as Bartlett [32] and others [17, 33] have noted that episodic memories are reconstructed and revised over time through multiple retrievals. This stands in contrast to the classic distinction between episodic and semantic memories and the assumption that semantic memory is a faithful record of prior learning.

From the perspective of psychotherapy and the phenomenon of recurrent maladaptive patterns that are the focus of treatment, a particularly important category of semantic memory is schematic memory. Schemas may be defined as “superordinate knowledge structures that reflect abstracted commonalities across multiple experiences, exerting powerful influences over how

events are perceived, interpreted, and remembered" [34]. From the perspective of CBT, Beck and Haigh [35] define schemas similarly as "internally stored representations of stimuli, ideas or experiences" that influence automatic and strategic/conscious information processing. Cognitive distortions and maladaptive beliefs about the self and the interpersonal world are thought to be the result of pathogenic schemas resulting from trauma or other adverse circumstances that in turn lead to maladaptive behavioral and emotional responses that are the reason for seeking care [36]. From the perspective of emotion-focused therapy, which attempts to expand upon cognitive concepts like knowledge structures to include emotion, emotion schemes constitute an internal mental organization that consists in (a) an affective component with bodily/expressive elements; (b) a behavioral component (e.g., an action tendency [37]); (c) a cognitive symbolic/conceptual representation possibly in the form of verbal statements or non-verbal representations (e.g., an image); (d) some situational and/or interpersonal context that acts as a cue or releasing component that sets the scheme in motion, and (e) the inclusion or close association with a motivational component in the form of desires, needs, wishes, or intentions [38, 39]. It is notable that the concept of emotion scheme includes elements of both appraisal (d and e) and response (a, b and c). As understood in CBT, emotion schemes may also be maladaptive, e.g. feeling worthless, insecure or ashamed. Relatedly, the term "emotion schemas" has been used by Bucci [40] to describe the subsymbolic and symbolic processes that must be integrated in psychoanalytic treatment, the term "person schema" has been used to describe schemas of the self, schemas of the other and the scripts that describe interactions between them [41], and the term "early maladaptive schema" has been used to describe the emotion-based maladaptive attachment patterns that can arise from early childhood abuse and neglect [42]. What they all have in common is that schemas (or schemes or recurrent patterns) are expressions of semantic

memories that determine how situations in the moment are construed, and they vary in terms of how much emphasis is placed on the emotional, behavioral and interpersonal concomitants that follow from these construals.

Process of change

In our 2015 paper [9] we outlined a 3-step model of change that explains how schematic memories with emotional content may be revised. During therapy, patients are commonly asked to recall and re-experience a painful past event, often eliciting a strong emotional reaction, which is step 1 in the model of change. If the psychotherapy process leads to a re-evaluation of the original experience, a new, more adaptive and perhaps more positive, emotional response may ensue (although the change in valence is not always in this direction; see below). The CEE occurs within a new context, the context of therapy itself, which can then be incorporated into the old memory through reconsolidation, which is step 2 in the model. Next, the new way of construing and responding to familiar problematic situations must be implemented in a variety of circumstances, which is step 3 or the "working through" process. It is conceivable that once this transformation has taken place the original memory including the associated emotional response can no longer be retrieved in its previous form. By this view, psychotherapy is a process that not only provides new experiences, but also changes our understanding of past experience in fundamental ways through the interaction between memory and emotion and between different types of memory.

As noted above, the second step in the change process is CEE. In contrast to the artificial and manipulated CEE attributed to Alexander and French by their critics [1, 2], a CEE can be understood as the process of making use of the authentic emotional responses generated by the

interaction to provide the patient with what she needs. For example, psychotherapy can provide the experience of being understood, cared for and even loved when criticism, judgement, and shame are expected. Or, psychotherapy can provide the experience of being taken seriously and protected from harm when earlier life trauma had been associated with being ignored and unprotected. If this CEE occurs when the old memory and old painful feelings are activated, this may constitute the kind of critical moment described by Daniel Stern [43], which is the second step in the three-step process of change that we describe.

The third step in the model is the transition from episodic to semantic memory and the "working through" process. By providing new experiences in therapy that update prior event memories through reconsolidation, the semantic structures derived from experiences will also change. Applying the new knowledge and experiencing the results in a variety of contexts can be conceptualized as creating multiple episodic experiences that will broaden the range of applicability of new knowledge encoded in semantic memory. As proposed in our integrated memory model, linkage to emotional responses consistent with the CEE is expected to translate into greater adaptive flexibility and success relative to the difficulties that led the patient to seek treatment. Given the inevitability of important schemas being reactivated and made labile during daily experiences, stability of the new, more adaptive way of construing and responding can only be achieved by ongoing practice.

The Appraisal and Arousal Components of CEEs

A critical element in this model of change is the assumption that changing memories will change future construals, emotional responses and behavior. If the purpose of memory were simply to create a record of the past, the influence on future behavior might be restricted to only

those occasions when old memories were explicitly recalled in relevant situations. However, it is important to recognize that the reason we remember experiences from the past is to serve as a guide to future behavior [44]. With the advent of computational neuroscience and the discovery of the importance of predictive processing, the role of memory in future events becomes much clearer.

Specifically, we now understand that the perception of current situations is based primarily on predictions, and that sensory data serve the purpose of updating predictions, not generating perceptions from scratch [45]. Predictions or expectations are based on past experiences. Therefore, perceptions of current situations are largely based on automatically-generated predictions derived from past experiences. In the domain of recurrent maladaptive patterns of social interaction, these predictions are based on schematic memories, and psychotherapy aims to update these schematic memories with new episodic experiences that are sufficiently potent (or "precise" to use computational language) to modify predictions based on a multitude of previous experiences.

Here is where the differential contribution of the appraisal and response components of emotion contribute to the model. When a CEE occurs in psychotherapy, the arousal component of the experience includes physiological responses (norepinephrine and cortisol release) that facilitate encoding of that experience. This encoding constitutes an updating of the problematic schematic memory. By virtue of this updating, the new version of the schematic memory is then ready to be reactivated in relevant situations. When this reactivation occurs, it generates predictions about what will transpire. Those predictions have just been updated by virtue of the CEE. Whereas previously a patient might predict ridicule or rejection in a particular context, by virtue of having a CEE with the therapist in that context a much more benign prediction or

expectation becomes possible. As such, future situations are appraised differently, the emotional responses they generate can shift and the behavioral responses can more readily align with the CEE rather than with the traumatic experiences from earlier in life.

This may be illustrated by the following case vignette. A woman with social phobia feared rejection by others and tended to avoid social engagement whenever possible. She had parents who she experienced as critical and demanding. She anticipated criticism in part because she expected that people would notice she was awkward and anxious, which further increased her anxiety. In therapy she experienced her therapist as caring and empathic, even when she felt anxious and awkward. This was all the more meaningful to her because she knew that her therapist still viewed her positively despite the fact that she viewed herself so negatively. This was a CEE in that her experience in therapy was much more positive than the experience she anticipated based on previous trauma. With the therapist's encouragement, she then took chances in interacting with acquaintances she would have previously avoided. She now had the courage to venture outside her comfort zone because she was now more likely to consider the possibility that the social encounter might turn out better than previously expected. In fact, she was surprised to receive friendly responses, which contributed further to the updating of the relevant schematic memory. Over time her expectation of criticism and rejection decreased and she became more socially engaged. As she and her therapist discussed what had transpired, a new narrative was constructed that helped her understand how expectations generated in her childhood were now updated, leading to a change in social perception and an accompanying change in behavior and emotional responding. By virtue of this new explicit understanding, she could use this new understanding and new set of expectations in anticipatory social problem solving.

In summary, arousal associated with the CEE does not itself explain why it leads to changes in construals, emotional responding and behavior. The actual content of the CEE is encoded by mechanisms that we do not yet understand. This content is responsible for determining in what circumstances the updated schematic memory will be deployed as well as the predictions regarding the emotional responses of self and other that are likely to occur in that situation. The arousal component helps to ensure that the CEE will be retained but the prediction or appraisal component accounts for the adaptive changes in emotional and behavioral responding in previously problematic situations.

Discussion

This chapter has presented a more detailed mechanistic explanation of a previously proposed model of enduring change in psychotherapy [9, 10]. That original model focused on new neuroscientific knowledge regarding memory as something that can be modified and updated for clinical benefit, as well as the important role emotion plays in facilitating the encoding and retrieval of memories and in providing specific content within those memories. This chapter has further expanded discussion of the neuroscientific basis of enduring change by describing the relevance of predictive processing and the important role of interactions between emotion and memory at the implicit level.

An advantage of a neuroscientific perspective is that it describes the infrastructure underlying psychological processes. As such, CEEs may apply to many different kinds of emotional learning, and potentially many different kinds of psychotherapy. As a foundation for applying the CEE concept to a variety of different kinds of psychotherapy, a nomenclature or classification system needs to be developed for different types of memory with emotional

content and this classification system should define and differentiate the neural basis of each. These include, but are not limited to, (a) classical conditioning—associative learning that involves pairing a conditioned stimulus and an unconditioned stimulus; (b) associative learning in which content that is emotionally neutral is remembered better because of coincident and unrelated emotional arousal; (c) reinforcement learning in which the affective consequences of an action change its value and the likelihood of recurrence [46] — one important example being negative reinforcement, in which avoidance behaviors are reinforced by the associated reduction of distress that they cause (e.g., procedures or actions that serve an emotion-regulatory function through avoidance, such as avoiding eating or speaking in public places); (d) episodic memories with strong emotional content versus those without; (e) schemas with inherent emotional content such as the implicit affective learning described by Ecker [47]; and (f) a combination of schemata that constitute an internal working model of the social world that captures expectancies regarding interpersonal interactions and emotional responding in prototypical situations. A comprehensive explanation of whether and how CEEs apply to the many different types of psychotherapy that currently exist will need to take such a classification system into account.

Although achieving such a goal will require considerable time and effort going forward, and is far beyond the scope of the current chapter, it is possible now to consider the implications of the proposed model for certain selected modalities. Consistent with the modalities addressed in our 2015 paper, the implications for EFT, CBT and psychodynamic psychotherapy will be discussed next.

Implications for Emotion Focused Therapy

Previous explanations of how CEEs work have focused on mechanisms at the level of conscious emotional experience. For example, Les Greenberg, the creator of emotion-focused therapy in the gestalt tradition, quotes Spinoza in saying that "the only way to change emotion is with emotion" [48]. This perspective draws upon the intuitive notion, traceable to Descartes and his forerunners [49], that conscious thought and conscious feeling are very different mental phenomena. Indeed, much evidence supports the claim that activating more positive emotional experiences while experiencing the painful emotions associated with past experiences can change the nature of emotional experience in problematic situations and improve adaptations and symptoms in the future [50]. This innovation and the empirical evidence supporting it invite further exploration as to *why* this is true. To do so requires a closer look at what may be happening at the implicit level.

If one defines cognition as information processing as opposed to conscious thought, one can argue that all of the different elements of emotion, including the evaluation, the embodied response and the experience, are cognitive in nature [51]. Moreover, from a neuroscientific perspective there are no brain structures that are specifically devoted to either emotion or cognition [52], consistent with the notion that emotion may be conceptualized as a type of cognition [53]. As noted above, emotion is typically initiated by a very complex, automatic appraisal process outside of conscious awareness that evaluates the extent to which a person's needs, goals or values are being met or not met in interaction with the environment [12]. That evaluation is determined in part by predictions about how other people are likely to respond emotionally in a given situation. As illustrated by the example of social phobia, if it is predicted that other people will be friendly rather than critical, the appraisal of a social situation, and the response to follow, is altered considerably. The CEE in that clinical example results in a change

in the patient's emotional experience in the problematic situation, i.e. emotion has changed emotion, but this is because complex emotion-cognition interactions have occurred outside of conscious awareness. Put another way, the clinical observations and techniques associated with EFT are not altered by the model proposed here, but the nature of how it operates is expanded to include complex interactions between emotion and cognition at the implicit level.

Implications for Cognitive-Behavioral Therapy

The purpose of this chapter has been to explain how corrective emotional experiences work. They play an important role in EFT and psychodynamic psychotherapy but traditionally are not featured in CBT. In CBT emotional distress plays a central role, primarily as a symptom to be treated, such as depression or anxiety, but emotion is not a mechanism of change per se. Moreover, although memory-emotion interactions are important in CBT, it is not clear that change in CBT occurs through memory reconsolidation. Two well-established memory-related change mechanisms particularly relevant to CBT are extinction and new learning that outcompetes older problematic learning. Nevertheless, many of the essential components of the current model of change described here overlap with concepts that are central to CBT, including the importance of schemas ([35]), appraisal processes ([54]), the functions of autobiographical memory[55] and the role of internal appraisal processes and external social interactions in the reconstruction of memories ([56]). These psychological models will inform future research that seeks to better specify the neurobiological model of change presented here.

Whereas reconsolidation is assumed to actually change components of the reactivated memory, extinction is assumed to create a new memory that over-rides the previously trained

response [57]. Thus, an “extinguished” response is not really gone, since it can spontaneously recover over time, or be reinstated if the organism is exposed to a relevant cue in a new context. For example, extinction of conditioned fear, the basis for exposure therapy, involves creating a new memory of the neutral conditioned stimulus in a new context which inhibits the original learning, as opposed to altering the memory of the original learning that paired the neutral stimulus with the unconditioned stimulus. The fact that the old memory is inhibited and not altered creates greater vulnerability to relapse than in memory reconsolidation. Recent work has shown that the cellular/molecular cascades in these two cases are different, and whether reconsolidation or extinction is initiated depends upon the temporal dynamics of the test procedure, and how recently the memory in question was formed and/or reactivated [58-60]. Relatedly, Gershman and colleagues propose that the critical issue in determining whether a *new* memory is formed or an *old* one is modified is the latent causal structure of the situation [61]. CEEs need to be temporally juxtaposed to the memories and emotions that need correcting and the new situation needs to resemble the old in many ways.

Another important change mechanism is retrieval competition such that new learning out-competes problematic learning from the past. Although there is evidence that PTSD symptoms can improve due to propranolol-assisted memory reconsolidation therapy [62], there is also evidence that traumatic memories sufficient to produce PTSD are retained and symptoms improve by virtue of competition from safety and resilience learning [63]. Again, the problematic emotional learning remains intact, as does the vulnerability to relapse, but follow up treatment can certainly be provided should relapse occur.A modified approach to extinction training has been developed to increase the likelihood of reconsolidating conditioned fear by preceding extinction training with a reminder of the threat. The purpose of the reminder is to put

the problematic memory into a labile state so that it can be modified or transformed by the extinction training. To date, however, this procedure has not succeeded in altering the vulnerability to relapse [64]. It is possible that the kinds of memories that are the basis for the clinical conditions treated by CBT, such as classical and operant conditioning, are less amenable to reconsolidation than the schematic memories highlighted in the current proposal.

Implications for Psychodynamic Psychotherapy

The model of change described here aligns with advances within the field of psychoanalysis, from which the concept of CEE arose. This shift is captured by the following quote: "Psychoanalysis is more than the creation of a narrative; it is the active construction of a new way of experiencing self with other" [5]. In other words, a new narrative, a new way of understanding what transpired in one's life and how it affects current behaviour, is the traditional goal of interpretation-focused treatment; the construction of a new way of experiencing self with other means the relationship between the therapist and patient is critical and this interaction changes the nature of future interactions with other people; harkening back to Alexander and French, interpretation alone is not enough [1].

The theoretical significance of this shift is profound. The Boston Change Process Study Group (BCPSG) expressed the view that traditional psychoanalysis had it backwards when it viewed intrapsychic processes (such as conflicts and defenses) as foundational and interpersonal interactions in the external world as superficial and of considerably less little interest as a focus of therapeutic interaction [6]. The BCPSG drew upon research on emotional development in childhood to create a new view of how emotional change occurs in psychodynamic treatments. Specifically, automatic real-world interpersonal interactions, which they call the implicit process of relational knowing (IPRK), are encoded and are the basis for internal representations

including relational patterns (e.g. attachment style), conflicts and defenses, not the other way around. These internal representations make future interactions more predictable and more likely to be sources of satisfaction rather than distress. As such, interactions in psychodynamic psychotherapy between the patient and therapist are part of the IPRK, and emotions that are activated and experienced in this exchange directly influence schemas that guide future social interactions.

Interpretation in psychoanalysis classically derives from the assumption that the underlying problem in maladaptive behavior is unconscious motivations of which the patient is unaware, and these unconscious mental contents need to be brought to conscious awareness so they can be better regulated [65]. For example, rather than having maladaptive behavior driven by unconscious guilt or anger, a person can become aware of how such emotional factors arose earlier in life and now influence their behavior in adulthood. Armed with this new information, it is assumed that the patient will be better able to control future behavior and decision-making to better ensure that needs are met. A related assumption is that the motivational power of these unconscious factors will be reduced over time once they are exposed to conscious regulation. This is to be contrasted with the reconsolidation of schematic memories through CEE, which according to the formulation offered here changes automatic intentions directly without the need for conscious reflection and symbolic representation inherent in interpretation. Essentially interpretation is not necessary as a way of changing meaning in problematic situations because CEEs change emotional predictions in those situations and thus inherently change their meaning automatically. By contrast, interpretation without appropriate emotional activation and updating amounts to understanding what the maladaptive pattern is but does not in itself change the pattern.

It is possible that when interpretation works it does so through mechanisms that differ from those just described. According to this alternative view, rather than success being due to making the unconscious conscious, explicit reference to the childhood origin of a problem ensures that the relevant episodic and semantic memories are activated, an essential first step in the reconsolidation process. When the therapist interprets the developmental origin of the motivation underlying a current problematic behavior of which the patient may be ashamed or guilt-ridden, a CEE may be activated, unbeknownst to the patient or therapist, at the implicit level through the non-verbal communication of empathy, compassion and acceptance of the patient by the therapist. Through empathic interpretation the therapist is saying *indirectly*, "You are judging yourself harshly and unfairly because of what you did, but you may have done what you did because of childhood influences of which you were not aware. I don't reject or judge you; in fact, I am with you and want nothing but the best for you." As such, an interpretation that is successful because it is accompanied by such implicit emotional messages may, unbeknowst to the therapist, constitute steps 1 and 2 of the 3-step process of change. The "working through" process would address step 3.

It should also be emphasized that the accuracy of an interpretation is important from a relational perspective. Accuracy conveys that the patient is really seen and understood, and this promotes a sense of closeness within the therapeutic dyad. The manner and tone in which this interpretation is delivered, however, may be even more important because it determines the patient's experience of what it feels like to be close in the context of the IPRK.

The memory reconsolidation perspective highlights a technical element of the interaction that is not emphasized in psychodynamic theory, and may explain why interpretation is not always successful. Specifically, it is not enough to activate a reminder of the older problematic

situation and explain its origins and current manifestations. It is also necessary to activate *the experience* of the old painful emotion associated with the old memory. Moreover, the new, corrective emotional experience induced by the implicit messages that accompany an interpretation must be counter to expectation and must counteract the negative emotion that lies at the heart of the recurrent pattern. These elements of heightened experiential intensity of the emotion accompanying both the reactivated memory and the new experience are not typically recognized as important in traditional psychodynamic psychotherapy teaching. As such, memory reconsolidation theory is not simply explaining what is already being done, but rather can provide specific guidance regarding potential alterations in technique that can enliven or even rescue a treatment that is stagnating or failing.

One of the reasons this may not be highlighted in psychodynamic teaching is that the mechanisms involved in psychodynamic psychotherapy and psychoanalysis may differ. The latter involves meeting with a patient three, four or even five times per week, perhaps for years, whereas the former typically involves one visit per week over a shorter period of time. When interactions are more frequent, more subtle CEEs may be at work that do not reach the level of noticeable emotional experiences within the patient [66]. Particularly when early life trauma consisting of abuse or neglect are part of the clinical picture, the patient's experience of interpersonal relationships often does not include secure attachment and in fact requires creation and presentation of a false self in order to minimize the likelihood of mistreatment. The therapeutic relationship characterized by respect, empathy, compassion and the promotion of emotional closeness likely creates a prediction error that is registered implicitly as part of the IPRK. Repeated experiences of this kind may create shifts in expectations that lay the groundwork for the relatively few experiences of "critical moments" that patients consciously

recall as critical to the success of the treatment [43]. The latter CEE, an episodic memory, may be part of a broader updating of the relevant schematic memory that occurs over time. From the perspective that recurrent maladaptive patterns are an expression of schematic memories that arise in childhood and persist in maladaptive adult relationships, the gradual changes that occur in the IPRK may be thought of as updating a schematic memory that constitutes a "corrective emotional **relationship**."

From this perspective, interpretation or a new narrative does not create the change so much as facilitate consolidation of the gains that are achieved directly through new experiences. Bringing what transpired in the therapeutic relationship to conscious awareness through interpretation makes what is experienced consciously accessible so it can be incorporated into conscious decision-making and social problem solving. As noted, step 3 in the change process involves applying the changes that occur in therapy to the outside world. This working through process is facilitated by knowing what needs to be worked on and intentionally seeking out situations that permit generalization of what has been learned in therapy. According to this view, new experiences are essential for change and a new narrative is helpful but perhaps not essential. By contrast, interpretation is likely neither necessary nor sufficient, explaining why many types of therapy are successful without including interpretation of unconscious mental contents.

A cardinal principle in psychodynamic psychotherapy or psychoanalysis is use of the transference relationship with the therapist to effect change [65, 67]. Transference is an example of predictive processing par excellence – aspects of problematic relationships in the past are experienced as real aspects of the current relationship with the therapist. This sets the stage for memory reconsolidation especially well, because the goal is to update an old memory, and the transference relationship with the therapist inherently involves reactivation of the old schematic

memory and the painful emotions associated with it. Memory reconsolidation (changing the old memory) is favored when the new situation resembles the old in many ways and changes are slow and gradual, as opposed to abrupt [61]. These principles fit psychodynamic psychotherapy and psychoanalysis rather well [66]. Moreover, the fact that memory reconsolidation is associated with enduring change because the problematic memory is itself changed is also another point of compatibility between memory reconsolidation and psychodynamics [66].

Conclusions

The central thesis of this chapter is that certain kinds of conscious emotional experiences in therapy are more effective in producing change than gaining insight. Emotion has two basic components: appraisal (of concern-relevance) and response (including arousal). The arousal component of emotion mediates memory encoding whereas the appraisal component influences the emotional content of the memory that is encoded. Emotional updating of schematic memories through CEEs in psychotherapy changes how problematic situations in the future are evaluated. Evaluation depends on expectations based on past experiences and operates through an implicit predictive processing mechanism to change their meaning and the subsequent responses. CEEs can be effective in changing symptoms and behavior without insight. Understanding (insight/new narrative) is useful in promoting enduring change but may not be essential, whereas new emotional experiences likely are.

Research Recommendations

1. Develop an operational definition of enduring change that can be used for any psychotherapy modality.
2. Determine whether reminders alone are sufficient, or whether the degree to which painful emotions are also experienced when maladaptive emotion-laden schematic memories are reactivated determines the degree to which they can be successfully reconsolidated.
3. Controlling for modality and number of sessions, how do successful vs. unsuccessful psychotherapies compare with regard to the number of: a) step 1 experiences [activating old memories and old painful emotions]; b) step 2 [corrective emotional] experiences; and c) step 3 experiences [practicing new ways of construing and responding to problematic situations]?
4. Controlling for modality and number of sessions, are maladaptive predictions more likely to be updated by non-emotional (informational) or emotional (experiential) prediction errors?
5. Determine whether a corrective emotional experience in psychotherapy immediately changes social appraisal options and the probability that a given appraisal option will be selected.

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