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ScienceDirect
Clinical Psychology Review 26 (2006) 719–745
CLINICAL PSYCHOLOGY REVIEW

Depression, implicit memory, and self: A revised memory model of emotion

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Received 20 December 2004; received in revised form 23 June 2005; accepted 23 June 2005

Abstract

Cognitive constructs are explored for clinical psychologists interested in cognitive phenomena in depression. Both traditional and modern memory constructs are outlined and described with attention to their contribution to understanding depression. In particular, the notions of memory construction, self-schemas, and autobiographical memory (per [Conway, M.A. (2001). Sensory–perceptual episodic memory and its context: Autobiographical memory. Philosophical Transactions of the Royal Society of London: Biological Sciences, 356, 1375–1384.]) are discussed. Then, the phenomenon of implicit memory is described as a way to bring these constructs together to understand depression. The Rehm and Naus (1990) [Rehm, L.P., and Naus, M.J. (1990). A memory model of emotion. In Ingram, R.E. (Ed.), Contemporary Psychological Approaches to Depression (pp. 23–35). New York: Plenum Press.] memory model of emotion is updated and expanded to include these cognitive constructs, and depression is viewed from the perspective of understanding interactions between explicit and implicit memory processes.

Keywords: Depression; Implicit memory; Self; Emotion; Explicit Memory; Self-schemas

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doi:10.1016/j.cpr.2005.06.003

1. Introduction

The past two decades have witnessed an increased interest in partnering cognitive psychological theories with models of emotion, especially theories of depression (Bower, 1981, 1987; Clark & Teasdale, 1985; Rehm & Naus, 1990; Teasdale & Fogarty, 1979; Teasdale & Russell, 1983). During this same period, some cognitive researchers began to focus their attention on the study of implicit memory, or memory without awareness (e.g., Parkin, 1993; Roediger, 1990; Schacter, 1987). Consequently, quite a few empirical studies examining the impact of depression on implicit memory were published during this same period. Barry, Naus, and Rehm (2004) recently presented an in-depth review of the mood-congruent memory literature on depression and implicit memory, critically evaluating and organizing these studies within a cognitive framework. In general, however, there has been a delay in including the phenomenon of implicit memory into cognitive theories of emotion. The Barry et al. (2004) review was an attempt to draw attention to emotion and implicit memory, and it also served to set the stage for the current paper.

The purpose of the current paper is to explore the possible implications of the implicit memory literature on depression using the Rehm and Naus (1990) memory model of emotion. This model originally used memory as the center of the cognitive and emotional systems, and it understood depression as a result of cognitive processes, especially through the allocation of attention. The paper is organized as follows: (1) an overview of the memory system is presented, including the cognitive framework of transfer appropriate processing, the concept of implicit memory and the concepts of autobiographical memory and self; (2) three important memory models of emotion (associative network models, the strategic processing model, and schema models) are reviewed in the context of a cognitive framework; (3) a reformulation of the Rehm and Naus (1990) memory model of emotion is presented, including the recent cognitive psychological concepts of implicit memory and the self-memory system (per Conway & Pleydell-Pearce, 2000); and (4) the implications of these issues to memory models of emotion and to understanding the development and maintenance of depression are discussed. In accomplishing these goals, two prominent themes guide this paper and can be found threaded through each section: the theme of structure and process and the role of knowledge base schemas. Each of these cognitive constructs is first defined and discussed in the next section.

2. Cognitive constructs

A central aspect of cognitive psychology has always been memory—traditionally explicit memory, or memory requiring conscious recollection (see Lachman, Lachman, & Butterfield, 1979 for an introduction and Neath, 1998 for a more recent review). Cognitive psychologists interested in studying memory have historically conceptualized the memory system in terms of its cognitive structures and processes (i.e., Atkinson & Shiffrin, 1968; Craik & Lockhart, 1972; Shiffrin & Schneider, 1977).

2.1. Explicit memory

2.1.1. Structure

Memory structures are described as cognitive stores that are differentiable in terms of their characteristic features and are typically categorized as sensory memory, short-term memory, and long-term memory. Sensory memory represents the point at which information first enters the cognitive

system from the senses and is held for brief periods of time before it is processed. This gives the pattern recognition system, a system outside of sensory memory, time to identify the stimulus, especially when the stimulus exposure is brief (perhaps only milliseconds). A second structure, called short-term memory, represents a part of the memory system that is limited in terms of capacity, attentional resources, and duration. It is in the short term memory that conscious cognitive processing takes place. Shiffrin and Schneider (1977) posited that short term memory is made up of a temporarily active subset of information from long-term memory, the third memory structure. As such, short term memory capacity is affected both by the amount and the complexity of information being actively processed. The term "attentive processing" was originally used to describe the conscious cognitive activity that occurs in short-term memory. For example, these words as you are reading them, the thoughts and inferences they conjure, and whatever else you may currently be aware of *at this moment* are all considered a part of your short term memory.

Long-term memory constitutes the rest of the cognitive memory system, and was originally conceived as a "place" where general world knowledge and personal memories of experiences are stored. It has since been divided into various subsystems of memory (e.g., Sherry & Schacter, 1987; Tulving, 1972, 1983, 1985), including episodic memory, semantic memory, and procedural memory. Episodic memory refers to memory for specific events and experiences like your tenth birthday party or what you had for breakfast this morning. Semantic memory contains general world knowledge and factual information, like who George Washington was or what the capital of Texas is. Procedural memory refers to memory for executing sequences of events or how to perform behavioral activities, like riding a bike or typing (if you are an efficient typist). Both episodic and semantic memories are *declarative*, meaning that they can easily be spoken about or articulated and the rememberer is consciously aware of their existence. However, episodic memory differs from semantic memory in that "episodic memories are context bound, refer to times and places, and are closely associated with the experience of remembering" (Conway, 1990, pp. 3–4). Conway has further specified this notion of episodic memory to include autobiographical memory, which is examined later in this paper in the section called "Memory and Self" (Conway, 2001; Conway & Pleydell-Pearce, 2000). In addition, the work of Robinson (1980) on emotion and episodic memory established emotionality as a unique characteristic feature of episodic memory. Procedural memory differs from both semantic and episodic memories in that it is *non-declarative*, which means that it is used for activities, but is not usually articulated. At times, the term "procedural memory" has been used to include implicit memory (i.e., Neath, 1998), but most implicit memory researchers place it in a different category (see Carroll, 1989 for a more clearly delineated explanation). Thus, these three types of long term memory (episodic, semantic, and procedural) represent a continuation of the structural view of memory, conceptualizing memory in terms of its component structures, each housing qualitatively different types of memory/knowledge/information. This structural view is now seen by some cognitive researchers as bulky, as the number of stores or subsystems increases and there is disagreement as to what constitutes a "store."

2.1.2. Knowledge base and representation

The concept of a knowledge structure or knowledge base is central to a structural view of memory. The term *knowledge base* refers to information stored in memory that is acquired over a lifetime. Most commonly this term is used with reference to semantic long term memory, as Bjorklund (1987) noted: "the terms *knowledge* and *knowledge base* can be used interchangeably with the term *semantic memory*" (p. 94). As cognitive psychologists studied the knowledge base and its characteristics and content, they

developed structural-type models to describe its representation, particularly its organization, including episodic memory knowledge base (e.g., Conway, 2001).

Both network models (e.g., Anderson, 1983; Bower, 1981; Collins & Loftus, 1975) and schema models (e.g., Alba & Hasher, 1983) of memory have been proposed to describe the organization of the knowledge base. Network models propose that associations between concepts and features (called *nodes*) exist within memory, integrating information into a *network*. Nodes may represent concepts, events, ideas, or propositions, and "memory" happens when spreading activation within the network causes the information contained within the nodes to become activated and conscious (Bower, 1987). Schemas, on the other hand, are thought to be more holistic entities and prototypes of concepts that organize and store past experiences while guiding our subsequent perception and experience. Early work tended to consider networks in semantic memory and schemas in episodic memory, but more recent memory work does not differentiate these terms in such a limited way. Anderson (2000), for example, advanced the concept of schemas to include even artificial intelligence and computer science, where schemas specify various attributes of category members. In other words, category membership of encountered stimuli is determined based on how well the specific stimulus matches the category "schema." Anderson proposed that schemas represent both propositional information as well as perceptual information. Further, Rehm and Naus (1990) noted the lack of conclusive evidence for either a network or a schema conceptualization, and took the position of an expanded network model where schemas are represented by clusters of nodes. These clusters are activated in the same way as individual nodes when the relevant environmental configuration is present. In other words, a familiar stimulus may activate a set of nodes that, together, constitute a schema. We continue to adopt that position in this paper. Indeed, others comparing the network and schema models have concluded that although they differ in some ways, "they nevertheless show a remarkable degree of convergence in the predictions that they generate" (e.g., MacLeod & Mathews, 1991, p. 125).

2.1.3. Process

More recent theorizing about the nature of memory, however, has focused less on memory structure and more on process (cf. Cermak, 1989). This popular position was first championed by Craik and Lockhart (1972), who argued that the type of processing involved in memory explained more aspects of cognition than its underlying structure. They stated that memory can be viewed as a continuum of processing stages, where early stages may be thought of as sensory memory, while later stages may be thought of as short term memory or long term memory. Neath (1998) recently summarized the relevant research and provided an interesting simultaneous depiction of both structural and processing approaches to studying cognition. His depiction is modified slightly here to include episodic and procedural as well as semantic long term memory, and appears as Table 1. In this table, important characteristics of sensory memory, short term memory, and long term memory are compared, highlighting their key similarities and differences. Note the centrality of processing in this depiction: the notion of memory stores is a convenient way to describe sets of processing demands.

Arguably one of the most well-known researchers in the area of memory processing is Loftus, who has worked for decades trying to understand the constructive aspect of human memory (e.g., Loftus & Palmer, 1974; Loftus, Donders, Hoffman, & Schooler, 1989). Her work, and that of others in the area, has led to a very different understanding of the memory system than was previously held. In fact, according to Loftus, memory is so dependent on processing that it is, in effect, a constructive (or "reconstructive") process whereby memories often change or are distorted, often without the person

Table 1
A modification of the memory table of Neath (1998), presenting both the structural and processing views simultaneously

Store	Sensory memory	Short-term memory	Long-term memory		
Format	Literal copy	Phonological	Episodic (including autobiographical) perceptual, conceptual	Semantic conceptual perceptual	Procedural perceptual
Rehearsal	Not possible	Maintenance	Elaborative	Elaborative	Repetition
Capacity	Medium	Small	Infinite	Infinite	Infinite
Duration	500–2000 ms	Up to 30 s	Minutes to years	Minutes to years	Minutes to years

Note. For the structural view, read down in columns for each memory store. For the processing view, omit the first row and read each column down for an emphasis on processing.

being aware of these changes. Convergent evidence from many different areas of cognitive psychology shows that both episodic memory and semantic memory are subject to the same malleability, including omitting details and incorporating misleading information into the memory itself (Neath, 1998).

One other example of the importance of understanding memory processing comes from the Transfer Appropriate Processing (TAP) framework (e.g., Blaxton, 1989; Morris, Bransford, & Franks, 1977). TAP is a model of cognitive processing that incorporates and specifies the notion of encoding specificity (Tulving & Thompson, 1973). The encoding specificity principle states that memory recollection depends on the similarities of encoding and retrieval contexts. TAP further describes this relationship, and extends the notion beyond context considerations. The important considerations of TAP are: (1) memory is enhanced by the match of cognitive processing performed during encoding with that required during retrieval; (2) different types of memory tests necessitate different types of processing during encoding and retrieval; and (3) both encoding conditions and retrieval tests can be either perceptually driven or conceptually driven (Jahnke & Nowzcyk, 1998). Perceptually driven processing relies primarily on sensory or perceptual characteristics of the stimulus and it can be done rather superficially. What is perceived drives the subsequent processing. Conceptually driven processing, however, relies primarily on the meaning of the stimulus, rather than its surface features. Thus, memory tasks requiring perceptually driven encoding and conceptually driven retrieval do not represent a match of processing operations between encoding and retrieval. A memory task that requires conceptually driven processing at both encoding and retrieval, however, represents a match of processing. According to TAP, this will likely result in better memory performance.

2.1.4. Relation of structure to process

The term *activation* refers to the stimulation of a concept or node present in long term memory or knowledge base thus bringing it into short term memory or consciousness. In cognitive terms, some type of stimulation or activation occurs whenever information processing takes place. Schneider and Shiffrin (1977) described processing in short term memory as *controlled processing* or attentive processing. This type of processing includes strategies, which are purposeful processing efforts people use to learn new information or to remember previously learned information. On the other hand, Shiffrin and Schneider (1977) described a different type of processing in long term memory as *automatic processing*, where a relatively permanent set of associative relations (part of the knowledge base) is activated in response to some particular input. Importantly, automatic processing need not be available to consciousness, even for later retrieval. If attention has been allocated to the automatic process, it may be available to short term

memory, and thus to consciousness, otherwise it would remain outside of awareness. Later, Hasher and Zacks (1979) extended this type of processing distinction to include children, the elderly, and individuals under stresses including depression, in addition to normal adults. The critical point is that activation can occur both consciously and effortfully (as in attentive, strategic processing, also called controlled) and nonconsciously and effortlessly (as in automatic processing), and this differentiation has implications for cognitive models of emotion. Previous reviews of the cognitive effects of depression have focused only on explicit memory, and thus tell only part of the story. In an extensive review of the explicit memory literature, for example, Hartlage, Alloy, Vazquez, and Dykman (1993) considered automatic and effortful processing by depressed individuals. They concluded that depression interferes with effortful processing, and the extent of interference is modulated by the degree of depression as well as task demands. In contrast, for automatic processes, Hartlage et al. concluded that there is only minimal interference by depression. The reader is referred to the Hartlage et al. (1993) paper for its excellent description of cognitive processes in depression. Their review, however, did not include considerations of implicit memory, highlighting the need for the current revision of the Rehm and Naus (1990) memory model of emotion.

2.2. Implicit memory

Memory refers to the bringing to mind of something from the past. As noted earlier, usually this act is done consciously, so that the rememberer is aware of the retrieval process. Cognitive psychologists refer to this conscious awareness of memory as *explicit memory*. In contrast, *implicit memory* usually refers to memory without awareness. Varying definitions of implicit memory exist, but the original definition by Graf and Schacter (1985) stated, "implicit memory is revealed when performance on a task is facilitated in the absence of conscious recollection" (p. 501). This facilitation is often measured through *priming*. In priming, nodes that have become primed through spreading activation are partially activated and thus more readily vulnerable to subsequent activation (MacLeod & Matthews, 1991). An alternative way to describe the concept of priming is in terms of a cognitive task. Priming occurs when information is transferred from prior study (encoding) to later tests (retrieval) without conscious awareness (Roediger, 1990). That is, *performance* on a current task benefits from an earlier, not consciously recollected, experience. Similarly, memory *tasks* that do not require conscious awareness of a prior episode are said to be "implicit" tasks that reveal implicit memory. Conversely, memory tasks requiring conscious recollection of a prior episode are labeled "explicit" tasks that reveal explicit memory (Schacter, 1987).

2.2.1. Process

Currently, then, implicit memory is typically described as a non-intentional process in which the processing of current stimuli is affected by a specific prior episode (Carroll, 1989). Paralleling the structural/processing argument, it is sometimes thought of as a distinct, and primitive, memory system (e.g., Sherry & Schacter, 1987), that is present even in infants (e.g., Gerhardstein, Adler, & Rovee-Collier, 2000). It may be tempting, therefore, to understand explicit memory as a conscious short term memory phenomenon and implicit memory as a nonconscious long term memory phenomenon. The more recent consensus, however, is that implicit memory represents a type of cognitive processing under specified conditions (recall that implicit memory did not appear as a memory store in Table 1). For example, both perceptual and conceptual processing have been identified within implicit memory (Blaxton, 1989). In addition, in contrast to the Craik and Lockhart (1972) memory framework, and similar to the Loftus constructive model (e.g., Loftus, 1979), research on implicit memory focuses more on retrieval processes

of memory than encoding processes. However, encoding considerations are still important. This shift of focus from encoding to retrieval has important implications to the revised memory model of emotion espoused later in this paper. Further, the ideas of the TAP framework have been incorporated into the implicit memory literature, resulting in a better understanding of processing requirements and their role in memory performance (Roediger, Weldon, & Challis, 1989; Watkins, Martin, & Stern, 2000). TAP has also been successfully used to understand the literature on the development of implicit memory (Barry & Naus, 2001) and to explore depression and implicit memory (cf. Watkins, 2002). Similarly, Barry et al. (2004) used the TAP framework to review the literature on depression and implicit memory, successfully explaining the diverging results of the existing empirical studies in the area.

2.2.2. Automaticity

According to Hartlage et al. (1993), an automatic process must have the following criteria: take place without attention or awareness; occur in parallel without interrupting other processing operations; and not require intention or control by the individual. Implicit memory fits all three criteria, although it was not included in their review. For example, Schmitter-Edgecombe (1999) used the distinction Blaxton (1989) made between perceptual and conceptual implicit memory in combination with a divided attention task in order to examine automaticity in implicit memory. Importantly, however, she was not examining depression and none of her participants were depressed. Schmitter–Edgecombe had participants read lists of target words, while half of them also performed a digit response task in a divided attention condition. Then participants either completed a perceptual implicit memory task or a conceptual implicit memory task. Schmitter–Edgecombe found that participant groups did not differ in their priming on the perceptual implicit memory task. However, divided-attention participants did not demonstrate as much priming on the conceptual implicit memory task as did the full-attention participants. The author concluded that when processing considerations are taken into account, conceptual implicit memory is more similar to explicit memory than it is to perceptual implicit memory, supporting TAP. Thus, with some exceptions, experiences requiring conceptual processing are more likely to rely on explicit memory, while those requiring perceptual processing are more likely to rely on implicit memory.

2.2.3. Depression and implicit memory

Soon after implicit memory was first described (Graf & Schacter, 1985), empirical studies designed to understand depression and implicit memory began to appear. These studies generally fell into one of two categories: (1) the effect of depression on implicit memory generally; or (2) mood-congruent implicit memory biases in depression.

Several early studies of implicit memory and depression focused on specifying processing differences between depressed individuals and nondepressed individuals. For example, following a popular explanation of depression, Hertel and Hardin (1990) hypothesized that depressed individuals suffered from deficits in initiating strategy use. Using induced moods, they gave participants implicit and explicit memory tests. Participants in depressed moods performed as well as neutral-mood participants on an implicit memory task, but not on an explicit memory task. After giving depressed individuals specific instructions about the strategies to be used, however, differences on the explicit memory task between participants with and without depressed mood disappeared. The authors interpreted these results as indicating problems initiating the use of strategies in people with depression. Similarly, Danion et al. (1991) selected hospitalized depressed patients and matched controls for their experiment. They sought to provide evidence for an impairment of effort-demanding processing in depressed participants (the

explicit free recall task) compared with an "automatic" implicit memory task. Although depressed patients performed the implicit task more slowly than controls, their mean number of responses and priming effect did not differ from controls. As in previous research, depressed patients recalled significantly fewer words in the explicit task. Danion et al. concluded that these results indicated that depression interrupts an effortful memory process, namely the strategy of elaborating on information to be remembered. When conscious, effortful processing was not necessary, as in an implicit memory task, depressed participants could perform as well as controls. Other authors have noted this lack of effect of depression on implicit memory as well (Williams, Watts, MacLeod, & Mathews, 1997).

Later, Elliott and Greene (1992) presented implicit and explicit memory tasks to psychiatric inpatients and matched controls. Using neutral words as stimuli, and seeking to determine whether implicit memory would be affected by depression, they gave participants two implicit and two explicit memory tasks. The authors of this study found the expected deficits by depressed participants on the explicit tests, but also for the implicit tests. However, in this early study, methodological flaws in the study design explain their findings, as explicit contamination (e.g., Jacoby, Yonelinas, & Jennings, 1997) precluded conclusive interpretation of the results. Most recently, Jenkins and McDowall (2001) examined perceptual and conceptual processing within implicit and explicit memory in clinically depressed participants and controls. The authors sought to determine whether the TAP model or a structural model of memory would be supported when evaluating depressed participants. The TAP framework was supported in the Jenkins and McDowall study, with better performance in conditions with matching processing demands during encoding and retrieval. This was true for both implicit and explicit memory tests. This finding supports the idea that memory performance is enhanced when the processing considerations are considered primary; thus providing evidence for the processing view over a structural approach. It also leads to questioning the emphasis on strategic processing for understanding depression.

2.2.4. Mood congruent implicit memory bias in depression

In the last score of years, there have been quite a few empirical studies exploring the possibility of mood congruent memory (MCM) biases in depression, especially with respect to implicit memory. Results of these studies, however, continue to confuse the issue as many studies find such implicit MCM biases in depression, while others do not. The equivocal findings in the literature on mood congruent implicit memory bias in depression were addressed in Barry et al. (2004) and are beyond the scope of this paper. However, Barry et al. argued for a processing view of implicit memory, which then provided an explanation for the empirical findings since the TAP framework clarifies the conditions under which mood congruent implicit memory biases are found in depression. In the studies they reviewed, mood congruent implicit memory biases in depression were found when the processing requirements of encoding and retrieval were matched, but were not found when the processing requirements of encoding and retrieval were not matched (see Barry et al. 2004 for details on these studies).

The application of the TAP framework to implicit memory discussed earlier and in Barry et al. (2004) serves at least one vital purpose. It shifts the focus of implicit memory from representation to process. According to the TAP view of implicit memory, implicit memory does not have to be seen as a separate memory structure or subsystem, rather it is understood in terms of the same memory processes as other "types" of memory. Thus, the structure of the memory system becomes less important as the focus shifts to the use of memory. The notion of implicit memory as a process rather than a unique memory subsystem is not new: Consider Laird Cermak's remark that "memory is a process, not a repository" (Cermak, 1989, p. 121). This view of implicit memory does, however, serve to free those researchers

interested in exploring affect and memory to include implicit memory in their models, setting the stage for the present version of the Rehm and Naus (1990) memory model of emotion.

2.3. Memory and self

Memory is also used by some researchers to understand other aspects of cognition, such as the self. For example, Conway and Pleydell-Pearce (2000) developed a "cognitive–motivational model of autobiographical memory" to describe how personal memories are created and used. Cognitive researchers using a structural view of memory often place autobiographical memory as a subset of episodic memory (e.g., Gauvain, 2001; Neath, 1998). Conway is well known for his groundbreaking work on the nature and characteristics of autobiographical memory (e.g., Conway, 1990), and he subsequently expanded this model to specify the relationship of autobiographical memory to both episodic and semantic information about the self (Conway, 2001). His major premise is that "autobiographical memory is the knowledge base of the self" (Conway, 2001, p. 1377; and see Conway & Pleydell-Pearce, 2000for a discussion of the relationship between self and autobiographical memory). Like many other constructivist theories of memory (e.g., Loftus et al. 1989; Roediger & McDermott, 1995), Conway and colleagues argue that memories of experiences are not static records, but rather the autobiographical knowledge base creates temporary mental constructions of previous experiences, or autobiographical memories (Conway & Pleydell-Pearce, 2000). Their conceptualization of this autobiographical knowledge base is a network-type structure consisting of patterns of activation that sometimes "coalesce" into memories, but often do not even enter consciousness. This nonconscious activation has important implications for the revised memory model of emotion.

2.3.1. Knowledge base and representation in the self

The structure of the autobiographical memory knowledge base, according to Conway and Pleydell-Pearce (2000), consists of three levels of specificity, arranged heirarchically. These three levels are (1) lifetime periods, which contain (2) general events, which in turn contain (3) event-specific knowledge. *Lifetime periods* are broad-based representations of general knowledge of important people, locations, goals, and activities of a certain life period. Both thematic knowledge about features of the period and temporal knowledge regarding the lifetime period are contained within this level of the autobiographical memory knowledge base. Therefore, several lifetime periods may overlap with each other, such as "when I lived at X" and "when I was seeing Y." The second level of the autobiographical knowledge base, *general events*, includes both repeated events and single events. Thus, this level is both more diverse and more specific than lifetime periods, and may be temporally organized. These clusters often relate to the success or failure of attaining personal goals, highlighting the role of self in a memory system. Further, the specific details that are included with memory recollections are referred to as *event-specific knowledge* (ESK). ESK represents the third level of the autobiographical memory base, and includes sensory-perceptual knowledge, such as imagery, smell, sounds, etc.

2.3.2. Process

Autobiographical memories happen when a "stable pattern of activation over the indices of these knowledge structures [lifetime periods, general events, and ESK]" occurs (Conway & Pleydell-Pearce, 2000, p. 264). These memories, however, are constrained by access and control processes that regulate

access to and output from the knowledge base. According to Conway's cognitive-motivational model of autobiographical memory, autobiographical memories are constructed by a partnership of the self and its goals, called the *working self*. Together, these serve as control processes directing the patterns of activation across the autobiographical knowledge base. Representations of self in long term memory (self-schemas) thus direct behavior and cognition when activated, while they are constrained and limited by the goals of the working self.

2.3.3. The self-memory system

The self-memory system (SMS) is an emergent system created by the interaction of the working self and the autobiographical knowledge base (Conway & Pleydell-Pearce, 2000). In addition, the SMS is also a superordinate and constructive system whereby the two component parts result in autobiographical remembering when joined, a process that cannot occur within either of the component parts (working self or autobiographical knowledge base) alone. Even when not interacting, however, the two parts of the SMS are intimately and reciprocally related, such that the goals of the working self are constrained by the autobiographical knowledge base. Similarly, access to the autobiographical knowledge base is constrained by the goals of the working self, which can impact the type of memory that is constructed. Thus, the relationship between these two parts is vitally important. The SMS is also responsible for the selection and elaboration of cues that access the autobiographical memory knowledge base. Further, whether or not accessed knowledge is combined into an autobiographical memory is determined by the SMS. The constructive nature of memory is clearly evident in this model.

Once in effect, the SMS constructs memories either generatively or directly. According to Conway and Pleydell-Pearce (2000), *generative* retrieval proceeds purposefully and occurs as patterns of activation of the various levels of the autobiographical knowledge base are directed to elaborate, evaluate, and verify cues. The current purpose and goals, along with search criteria and task demands will determine the type of memory that is constructed. Therefore, verification of the memory is limited by goals specific to the self and general goals acquired through socialization experiences. These various criteria are combined into a "retrieval model" for the memory. For memories that are constructed with some frequency, this retrieval model may itself be represented in long-term memory. If this happens, the result is rapid retrieval and facilitated memory construction. From a cognitive viewpoint, perhaps this can be thought of as a type of automatic processing, since this associative network view of the autobiographical knowledge base results in a search stage that is independent of control processes. Activated knowledge is then available to (and evaluated by) control processes. A pattern of activation that fits the retrieval model is an autobiographical memory construction. In order for the memory to persist, though, it must be effortfully maintained or it dissipates as activation fades.

Unlike generative retrieval, *direct* retrieval results in spontaneous, unexpected recall of an autobiographical memory. It occurs when a cue activates ESK, which in turn activates the general events, which activation in turn spreads to the lifetime period. This pattern of activation is not enough by itself to "coalesce" into a memory, but if it becomes linked to current working memory goals, then the memory spontaneously occurs. From a cognitive viewpoint, this can be thought of as another type of automaticity, or perhaps, priming. When this type of memory occurs, it interrupts current processing, which is very disruptive, especially if the spontaneous memory also activates emotions. For this reason, it is suggested that control processes presumably spend much effort in inhibiting this type of direct retrieval so that processing is not continually interrupted. How this may occur is not yet understood, but

Conway and Pleydell-Pearce (2000) believe the strength of the relationship between the directly retrieved memory to current goals must be a part of determining whether or not it will be inhibited.

3. Memory models of emotion

As noted in the Introduction, cognitive and clinical researchers have been sharing ideas in recent years. As a result, there are at least three different types of memory models of emotion that use cognitive theories to guide and inform their understanding of emotions, particularly depression. However, Philippot, Schaefer, and Herbette (2003) noted that recent theories of cognition and emotion center on emotion's influence on memory, not on how the processes of memory influence emotion. This is not the case for the Rehm and Naus (1990) memory model of emotion, hence their model is the focus of this paper. After a brief discussion of three other types of models, the Rehm and Naus (1990) model will be revised to integrate the cognitive concepts presented herein and to explore the impact that memory processes may have on influencing emotion, especially through implicit memory.

3.1. Associative network models

Affect refers to the emotional valence of information, and this concept is one of the cornerstone pieces of research on memory and emotion. Historically, research on affect and memory has focused on explicit memory and not implicit memory, since interest in the former predates the latter. Similarly, research on the retrieval aspect of memory predates research on the encoding aspect of memory. Thus, it is not surprising that some of the first cognitive research on memory and emotion centered around retrieval. In their early reformulation of affect and (explicit) memory, Dutta and Kanungo (1975) suggested that in addition to its role during encoding, affective intensity may also play an important role as a retrieval cue. Although they did not reference any specific theory of memory, Dutta and Kanungo seemed to have been operating under the assumption of a network model of memory. Indeed, Gordon Bower and his students followed up on Dutta and Kunango's work and developed a research program designed to further elucidate the relationship of affect to memory in a network memory model (e.g., Bower, 1981, 1987; Bower & Cohen, 1982; Bower, Gilligan & Monteiro, 1981; Bower, Monteiro, & Gilligan, 1978).

In Bower's model, some nodes in the semantic network are "special purpose emotion nodes" which have output connections to (among other things) the events that happened when that emotion was strongly aroused (Bower, 1987). For Bower, affect comprised a collection of nodes within the network. Other work has examined the role of affect on memory in this way (e.g., Hanze & Hesse, 1993), and this approach has also been extended to theorizing about cognitive development (Barry & Naus, 1999; Leichtman, Ceci, & Ornstein, 1992). Thus, activation of emotion nodes within a semantic network could spread throughout the memory system, priming certain kinds of memories (Bower, 1981). Similarly, an emotion may become aroused if the event with which it is associated is activated in episodic memory. Bower's inclusion of emotion nodes within the semantic network is entirely compatible with our current conceptualization of the memory system as including both network and schema properties. Thus, it may be that implicit memory is at least partially the result of priming, an automatic (and therefore outside of awareness) and subthreshold activation of nodes which result in a concept becoming activated, but not consciously. Priming of emotions (and even emotions in implicit memory) may occur in the same way.

In his work on mood-congruency, Bower suggested that concepts and categories congruent with one's current mood are primed when an emotion is aroused. Importantly, however, Bower researched normal, albeit highly suggestible, participants who were induced into positive or negative moods by hypnosis. Clinical participants (i.e., those diagnosed with depression, or those who met the diagnostic criteria for depression) were not a part of his research program. Nonetheless, using induced moods, he found that the affective quality of personal episodic memories that tended to be recalled while in an affective state were congruent with the currently induced mood (i.e., mood congruent recall). That is, positive mood participants tended to recall positive memories and negative mood participants tended to recall negative memories. Bower also found that if participants learned two lists of words, one while happy, the other while sad, and then were tested on one of those lists while in either a happy or sad mood, recall was much greater if the mood state during encoding was the same as mood state during retrieval. This phenomenon has been referred to as state dependent memory, however, Bower was not able to replicate these findings.

Among both cognitive and clinical investigators there has often been confusion regarding the research on mood and memory. In particular, the differences between mood-state-dependency effects and mood-congruency effects have often been overlooked. In his review of the literature, Blaney (1986) defined the terms the following way: "State dependence implies that what one remembers during a given mood is determined in part by what one learned (or focused on) when previously in that mood; the affective valence of the material is irrelevant. Mood congruence assumes that some material, by virtue of its affectively valenced content, is more likely to be stored and/or recalled when one is in a particular mood; concordance between mood at exposure and mood at recall is not required or relevant" (p. 229). Blaney further noted that while research on state dependence requires that more than one mood be experienced by participants during the course of the study, this requirement does not apply to research on mood congruence. In summary, the associate network models follow the general trend noted by Philippot et al. (2003) wherein the focus is on mood's influence on memory, not the reverse.

3.2. Strategic processing model

In a different approach to mood and memory, MacLeod and Mathews (1991) provided an excellent review of research incorporating the information processing approach to understanding all aspects of depression. This review, however, covered only the affect-related explicit memory literature and did not incorporate implicit memory. This is understandable, considering the publication date of the review relative to the extant implicit memory literature. At the time of their review, MacLeod and Mathews were very familiar with the application of an information-processing approach to clinical issues. In 1988, Williams, Watts, MacLeod, and Mathews published a volume entitled *Cognitive Psychology and Emotional Disorders*, which was subsequently revised in 1997. Reflecting the view that "the field should move away from generalist theories of cognition and emotion (such as schema or network theories)," (Williams et al., 1997, p. xi), their model focused on encoding processes, while continuing to recognize the importance of retrieval processes. Thus, the approach of Williams, Watts, MacLeod, and Mathews (1988, 1997) made a strong argument for the centrality of processing considerations in understanding emotion.

The strategic processing model outlined a "cognitive style" that develops in response to traumatic events experienced early in life. Studies of depression, parasuicide, and post-traumatic stress disorder have all demonstrated overgeneral memories by affected individuals. In this model, overgeneral encoding processes are often paired with reduced short term memory capacity during retrieval, resulting in the well-

known deficits in long term memory of depressed individuals compared with controls. These include recalling predominantly negative memories of the past, more negatively valenced new material, deficits in free recall, etc. (Hartlage et al., 1993; Williams et al., 1997). The Williams et al. model also suggested a mechanism for the explicit memory patterns in depression: early developmental experiences result in an inability to fully control memory search processes, such that categorical levels of memory are later accessed at the expense of details. Although a thorough discussion of these ideas are beyond the scope of this paper, this notion will be explored in the revised model of emotion espoused herein. The reader is also referred to Williams et al. (1997). This cognitive model of emotion is based largely on empirical studies of anxiety, although explicit memory studies of depression are also incorporated into the model. In short, the Williams et al. (1988, 1997) model suggested that the existence of mood-congruent biases in anxiety means that anxiety may be due to automatic perceptual bias of anxiety-related information (a pre-attentive process), while depression may be due to strategic elaboration of negative information. The authors did point out, however, that these were not the only differences between anxiety and depression, and they concluded that "not all emotional states affect cognitive processing in the same way" (p. 316). Nonetheless, the name of the model reflects its focus on strategic processing.

In an experiment designed to test this hypothesis, Ruiz-Caballero and Gonzalez (1997) used a levels-of-processing task (which employs a comparison of perceptual and conceptual memory encoding) to disentangle the automatic from the conscious aspects of the implicit memory word-stem completion task in depressed participants and controls. Results indicated that depressed participants showed mood-congruent memory bias for negative words for both recall (the explicit task) and word-stem completion (the implicit task). Depressed participants were more likely than controls to complete the word stems with studied negative words. However, implicit memory was not enhanced by elaborative encoding compared with perceptual encoding. This is not surprising, because TAP would predict better performance for perceptual encoding with word stem completion (a perceptual implicit memory task). Taken together, and using the terminology of Bower (1981), these results suggested that mood-congruent information in the semantic network was more accessible than mood-incongruent information for both depressed participants and controls. This accessibility would thus appear to be a result of automatic activation. Therefore, it is unlikely that the distinction between anxiety and depression can be reduced to something as simple as automaticity versus strategic elaboration deficits, and as noted earlier, a complete theory of memory and depression must take implicit memory into account. The Williams et al. (1988, 1997) model, like the earlier Rehm and Naus (1990) memory model of emotion, is conspicuously lacking in this regard. Despite this, the Williams et al. model has been influential in maintaining the importance of processing considerations in models addressing cognition and emotion and, in fact, the authors of that model were well aware of the importance of perceptual and conceptual encoding in emotional disorders before there was much empirical work on the matter. Once again, however, the focus of this model is on mood's influence on memory, and not memory's influence on mood.

3.3. Schema models

Still other investigators have attempted to explain emotion and memory using other cognitive concepts. Beck's classic approach to depression constituted a schema-based explanation, whereby the person's cognitive structures (schemas) serve as filters for personal experience (e.g., Beck, 1967, 1987). Thus, a depressed individual has a depressive schema, and events and experiences are interpreted in a way consistent with the schema. In addition, the notion that schematic processing is involved when

appropriate conditions are present constitutes the cognitive-priming explanation of Riskind (1989), which he proposed to explain the pattern of results of mood and memory research. The cognitive-priming perspective, he explained, "assumes that the cognitive information provided by mood-producing events (e.g., success or failure, love or loss) can directly prime memory independently of subjective mood" (Riskind, 1989, p. 174). In other words, even if the individual does not feel sad, experiencing a loss may serve to prime negative emotions and therefore negative memories. Riskind accounted for most mood congruent memory results through the process of enhanced accessibility of memory by priming the events that produced the mood, not necessarily the mood itself. Riskind appears to have argued for a non-conscious pathway from mood to memory through emotional schemas that are activated by specific events. In fact, others have adopted similar schema-based models for affect and memory. Macaulay, Ryan, and Eich (1993) noted that this type of perspective initiated an approach to understanding memory based on the influence of emotional schemas. Such an approach assumes that when people have an experience while in a particular mood, they tend to initiate the appropriate emotional schema, which biases their processing through "prior association with the emotion, and its biased processing is referred to as *mood-congruent memory*" (Macaulay et al., 1993, p. 77).

Similarly, although Teasdale initially attempted to explain mood and memory research with an associative network model, his views have changed over the past two decades. Recently, Teasdale and colleagues argued for a schematic model of affect, specifically depression, and suggested that interacting cognitive subsystems explain mood congruent biases in memory that occur in people with depression. Basically, for those who may be vulnerable to depression, their schematic model of self-worth undergoes changes during depression cycles. That is, the depressed person's general way of understanding and accessing his or her view of self is altered, interacting with the current depressed emotion, as well as with memory and perception processes. Thus, the depressed individual's information processing is dependent on and interacting with both emotional and cognitive subsystems, which together comprise the individual's active schematic model of him/herself. During phases of nondepressed mood, the depressed individual's schematic model places less importance on performance outcomes or social approval, whereas during bouts of depression these schematic models are changed to place much more importance on these factors. Teasdale, Lloyd, and Hutton (1998) stated that this type of model "encode[s] the *inter-relationships* between core features of experience, providing the high order interpretative structure through which self and world are experienced" (p. 248). In other words, understanding the schematic model present during an experience can lead to an understanding of how the depressed person interprets experiences. In a study designed to contrast this model with that of Bower (1981), Teasdale et al. (1998) found that personal self worth for the depressed person is more dependent on social approval/disapproval and/or success or failure on tasks, compared with nondepressed individuals. In summary, the schema models specify the role of self and schemas in emotion, but do not clearly address the general influence of memory on emotion.

3.4. Rehm and Naus (1990)

It has been said that "if we had no memory, in the broadest sense of the term, we would not be able to function. Memory is essential for all activities" (Neath, 1998, p. 1). Because memory is so central to cognitive functioning, and because cognitive considerations have become central to the study of depression, the memory model of emotion of Rehm and Naus (1990) used a memory processing framework to account for all aspects of depression. The basic premise of their model was that "cognitive

processes and mechanisms are at the core of the major deficits of depression" (Rehm & Naus, 1990, p. 24). That is, depression itself is a manifestation of cognitive processing. Unlike the other models reviewed herein, this model is unique in its use of memory structures and processes to understand emotion. Specifically, the Rehm and Naus (1990) model had several core assumptions: (1) it placed memory at the center of the cognitive system, providing a basis for understanding other cognitive processes as well as the relationship of affect to cognition; (2) it assumed a multi-store conceptualization of the memory system, in the tradition of Atkinson and Shiffrin (1968) and Tulving (1983); (3) the role of emotion in cognitive functioning had a central place in the model. Per the information processing account of memory and emotion of Bower (1981), one unique aspect of the original model of Rehm and Naus (1990) was incorporating the concepts of both schemas and nodes into an integrated knowledge base structure. In addition, limited capacity notions regarding controlled, or effortful, processing were incorporated into the general model (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977); (4) the Rehm and Naus model suggested that attentional resources were allocated to depressive schemas, subsequently biasing the interpretations of current experience for depressed individuals; (5) the model assumed that affect lay on a continuum consisting of normal mood variations, to normal depressive reactions, to clinical depression. Additionally, like the model of Bower (1981), affect was seen as important in encoding and retrieving experiences. Thus, in the Rehm and Naus (1990) model, the emotional quality of events were thought to be represented in the memory structure with other aspects of the experience. In this way, mood congruency was implicated because the connection that actually facilitated recall was the emotional quality of the memory; (6) a developmental perspective was integral to the conceptualization of depression and how depression impacted cognition; and (7) Rehm and Naus suggested that the proposed connections between memory and emotion would have had evolutionary value, which is lost in a modern world where losses tend to be infrequent and minor in comparison.

The Rehm and Naus (1990) memory model of emotion was important for several reasons. To start, their cognitive conceptualization of depression was an important part of the movement in clinical psychology toward incorporating cognitive research and perspectives into clinical phenomena. As noted in the introduction, this movement continues to this day and indeed is stronger now than it ever has been. Also, their memory model of emotion attempted to provide a systematic cognitive framework within which previously isolated domains of research (i.e., depression, memory, perception, etc.) could be understood. In this conceptualization, memory took a central place in human cognition, providing a central framework within which to understand other cognitive phenomena. Further, the underlying developmental perspective in their model provided a theoretical account of the development of depression, and also provided for a dynamic and flexible view of the cognitive system that could also account for the empirical data on depression available at the time.

4. Revised memory model of emotion

The preceding review of cognitive constructs and cognitive models of emotion demonstrates the various terms and concepts that have been used to understand the cognitive and emotional features of depression. The models used different terms and focused on different aspects of depression. The purpose of this paper is to use the Rehm and Naus (1990) memory model of emotion to organize these ideas into a single cognitive framework. The revised model uses a processing framework placed within a structural model to account for explicit and implicit memory patterns in depression as well as the onset and maintenance of depression. In fact, the memory models of emotion reviewed earlier and the description

of self-schemas by Conway and Pleydell-Pearce (2000) converge into the revision of the Rehm and Naus (1990) memory model of emotion. Additionally, Conway and Pleydell-Pearce state, "Our view is that even when there are no simple tests of a model — and this may be true for most complicated forms of cognition — there is a range of phenomena to which the model should be applicable, and it is this that constitutes the main test of its validity" (p. 277). Thus, the Rehm and Naus (1990) memory model of depression is reformulated and updated to include the cognitive elements appearing in the first part of this paper to understand cognition and depression.

Despite the strengths of the Rehm and Naus (1990) memory model of emotion discussed above, their cognitive conceptualization of the memory system was far from complete in contemporary terms. Specifically, in light of the previous discussion of the literature on depression and implicit memory (Barry et al. 2004), the Rehm and Naus (1990) memory model is reformulated to include these concepts. The explicit memory patterns in depression are well-known and discussed elsewhere (see Hartlage et al. 1993; Williams et al. 1997). However, the revised memory model of emotion presented in this paper must account for both these explicit memory patterns as well as the implicit memory patterns. In order to do so, however, the notion of a self-schema must be elaborated. Although Rehm and Naus included this concept in a primitive discussion of its effect on memory and emotion, it now deserves a more central position in this comprehensive model, which must also include implicit memory. More sophisticated ideas of the notion of self-schema and incorporating constructive processes in the self-memory system with the formation of the autobiographical knowledge base are found in Conway and Pleydell-Pearce (2000) and Conway (2001). In fact, like Rehm and Naus (1990), and as condoned by MacLeod and Mathews (1991), Conway and Pleydell-Pearce (2000) used a combined network-schema conceptualization to explain aspects of memory, as described earlier. Although their model addresses affect and memory only briefly, its well-articulated and specific formulation of the role of schemas and automaticity fits nicely with the current aim of understanding the role of memory in depression. Moreover, recent advances in implicit memory and depression, including exploration of the role of automaticity, can further develop the memory view of depression, highlighting the value of using memory to understand cognition and self. Thus, the revised memory model of emotion that is developed herein incorporates implicit memory into its framework to understand depression. In fact, in the revised memory model, depression is viewed from the perspective of understanding interactions between explicit and implicit memory processes, and the bi-directional relationship between memory and mood is central to the revised model. Like the earlier model, however, the revised model continues to describe normal as well as clinical mood states and assumes that life events, daily and major events, influence mood. The rest of the paper describes the revised model more fully.

4.1. Structure and process

Relying primarily on a structural view in the earlier model, Rehm and Naus (1990) discussed the different ways in which knowledge (memory) structures can be organized. Episodic memory was described as primarily temporally and perceptually based, while semantic memory was proposed as primarily conceptually based. Blaxton (1989) stated just the opposite, that episodic memory is primarily conceptual and semantic memory is primarily perceptual. Conway and Pleydell-Pearce (2000) placed sensory–perceptual processing within one of the levels of the autobiographical knowledge base. It is evident now that both types of processing may occur in both episodic and semantic types of memory. Consistent with Transfer Appropriate Processing (TAP), these memory domains are not thought to be structurally distinct; rather they are conceptualized according to their organization (recall Table 1).

Nevertheless, most of the previous work on cognition and depression has focused on explicit memory and other attentive cognitive processes (attention, strategies, problem solving, self-schemas selecting input, etc., see Williams et al. 1997). In addition, and as noted earlier, the focus has tended to be on the effects of depression on encoding processes of memory. The revised model herein contends that implicit memory can also contribute to an understanding of depression through its nonconscious processing mechanism and because of its focus on retrieval processes of memory. In their earlier paper, Barry et al. (2004) emphasized the importance of both encoding and retrieval considerations to understanding the relationship of depression and implicit memory. That theme is continued here to understand memory and depression.

4.1.1. Encoding processes and depression

Each of the memory models of emotion discussed earlier (associative-network models, strategic processing models, and schema models) used encoding-based explanations for depression. Associative network models focus on the activation of nodes contained within the memory network at the time of the experience. These associations determine how that information will later be remembered. The strategy-deficits models focus on the lack of strategic processing by depressed individuals when presented with information. Thus, this explanation is primarily an encoding-deficit hypothesis, as the to-be-processed information is not adequately dealt with. Similarly, attention-narrowing models focus on the lack of attention given to incoming information because of the inappropriate use of attention by depressed individuals (Hartlage et al. 1993). They either pay attention to environmental stimuli not important to the task at hand (thus limiting their attention to the task), or they pay attention to depression-focused thoughts (again, limiting their attention to the task). Once again, this type of explanation is primarily an encoding-reduction hypothesis, hypothesizing reduced cognitive resources necessary to adequately encode incoming information. Finally, schema-based explanations focus on the biasing effects of depressive schemas, which work to selectively process, encode, and interpret input in a negative way.

In the Rehm and Naus (1990) model, as in the other models, the focus was primarily on encoding-deficit explanations of explicit memory. In this revised model, considerations of encoding are still important, and are more clearly laid out in Fig. 1. Fig. 1 is a representation of our structural/process model of memory encoding that incorporates Conway's ideas about autobiographical memory. In this schematic, encoding processes are important in understanding the effect of depression on memory and the effect of memory on depression due to their biasing effect on interpreting incoming experiences. In this model, attentive processes are diverted to depression-relevant thoughts in short term memory (consciousness). When combined with the reduced cognitive capacity of people with depression (Hartlage et al., 1993), the result is interference with encoding processes generally. In addition, the depression-relevant thoughts then interact with self-schemas and goal structures in a way similar to the interacting cognitive subsystems of Teasdale et al. (1998). In particular, self-schemas are largely negative in depressed individuals. Thus, depression-relevant thoughts and negative self-schemas combined with greater importance of performance outcomes and social approval further narrow cognitive capacity.

As the negative views of self feed into the working self (WS) and its goals, negative self-schemas also bias the processing of current experience in ways consistent with their interpretation. This accounts for the negative encoding bias of depressed individuals. Further, because the goals are so important to the WS and to the depressed individual, incoming information is more likely to be encoded at the level of general events and/or lifetime periods, leaving out much event specific knowledge (ESK). Although other cognitive models of depression address overgeneral memories, typically this is done as a retrieval process, not an encoding process. Our model includes reduced cognitive capacity and negative self-

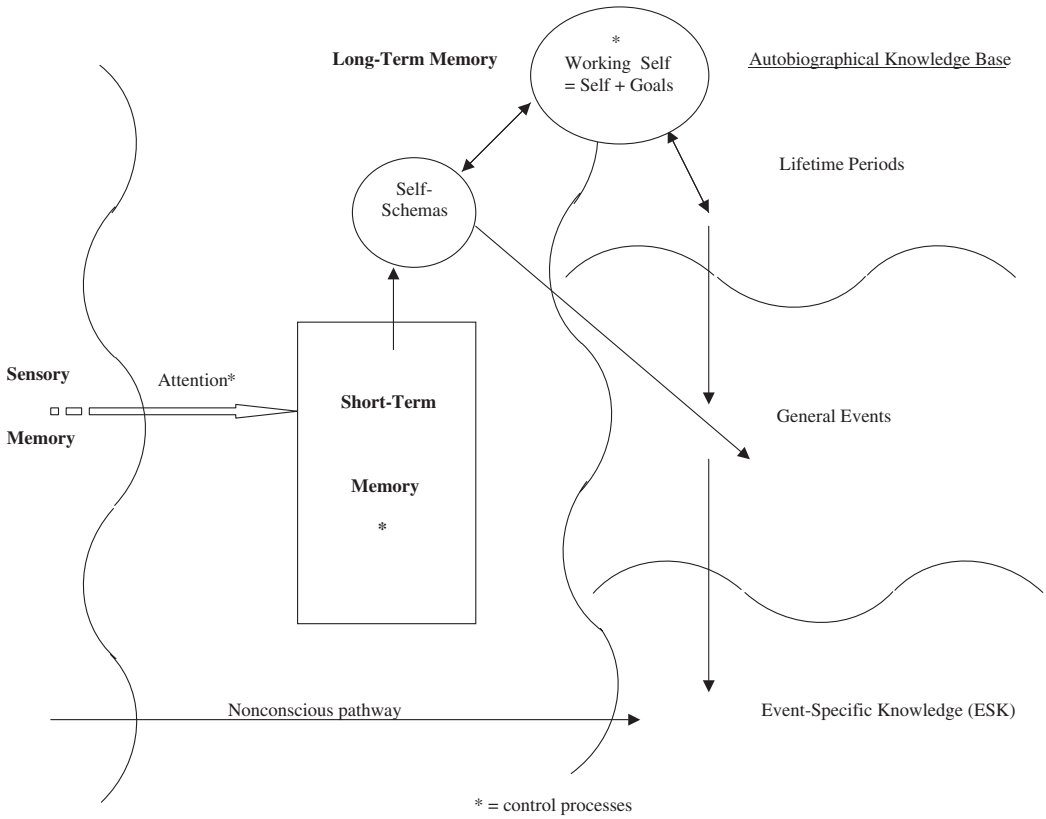

Fig. 1. Encoding processes in the Barry, Naus, and Rehm memory model of emotion.

schemas as mechanisms encouraging encoding of overgeneral memories. In addition, some material that is not attended to is nonetheless processed according to its sensory-perceptual features, and may end up in ESK. This automatic processing is not as affected in people with depression (Hartlage et al., 1993). Later, ESK may be unavailable to depressed individuals' explicit memory because of the different processing demands of the cues and goals active at the time of retrieval. This information may be available through implicit memory, however, if other aspects of the retrieval context (especially processing) support such remembering. For example, under transfer appropriate processing conditions, information automatically encoded into ESK may be retrievable. We contend that implicit memory in depression works primarily through the perceptual features available at retrieval, although considerations of conceptual implicit memory are still important.

4.1.2. Retrieval processes and depression

In addition to the role of encoding processes in depression, the role of retrieval processes in depression must also be considered. The associative network models primarily addressed retrieval processes in depression through priming. As a retrieval cue activates information in the memory network, that activation may spread to other related nodes. In this way, the retrieval processes are implicated in memories that may reach consciousness. The strategic processing model addressed retrieval primarily in terms of controlled searches of memory, and the strategies employed at retrieval to

access memories. Schema models addressed retrieval processes in their discussion of the roles schemas play in selecting appropriate memories or providing contexts for retrieval cues. For the most part, however, the role of retrieval processes in depression is relatively minimal in these models. In addition, most of these models addressed the automatic aspect of retrieval, although none directly addressed the role of implicit memory. Fig. 2 represents retrieval processes in memory, according to our structural/process model incorporating Conway's ideas. In this schematic, short term memory and the self-memory system (SMS) work together to retrieve an autobiographical memory. Attention directs short term memory (consciousness) to retrieve a memory. Short term memory then accesses the WS and its goals. For people with depression, these will likely include negative self-schemas. The WS selects cues to retrieve the memory, as directed by the self-schemas. The selected cues may contain depression-related biases, and the resulting knowledge accessed by the retrieval process is combined into an autobiographical memory construction.

Clinically depressed patients often have overgeneral memories (Williams et al., 1997), which are conceptualized as being restricted to Conway and the level of general events of Pleydell-Pearce (2000) because of their lack of detail. These overgeneral memories do not usually include ESK, and Conway and Pleydell-Pearce (2000) theorize that the negatively laden ESK is inhibited by control processes that limit access to the general events. This is a protective measure since the negative ESK are typically

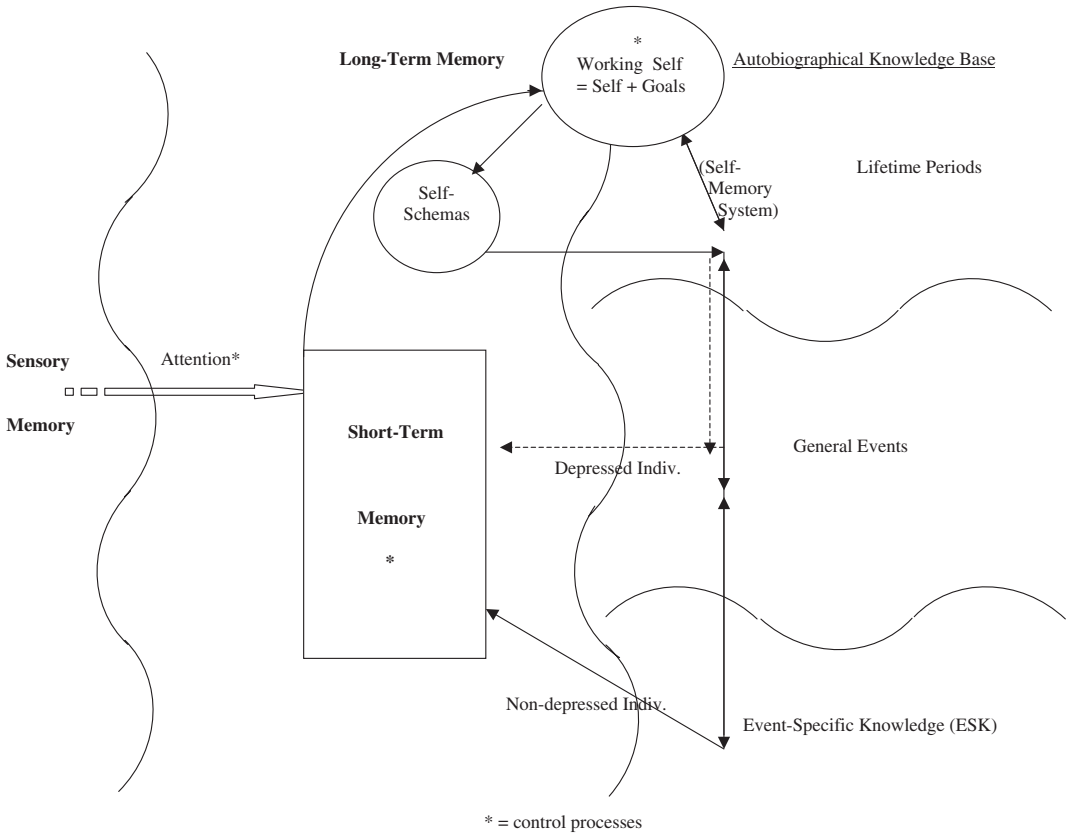

Fig. 2. Retrieval processes in the Barry, Naus, and Rehm memory model of emotion.

incompatible with the current goals, and inhibiting retrieval of ESK serves to maintain the stability of the goal system. However, it is unclear how depression affects this inhibition process, and how inhibition is related to goals.

It is our contention in this revised model that a more concise explanation involves implicit memory processes, not inhibition. For instance, implicit memory has been described as a "primitive" memory system that appears early and is developmentally stable (Gerhardstein et al., 2000). When the memory system is under stress, as in depression, more reliance on an earlier-appearing type of memory may result (Hasher & Zacks, 1979; Rehm & Naus, 1990). Conway and Pleydell-Pearce describe ESK as a "summary record of sensory–perceptual processing occurring during an experience" (p. 272). By definition, it seems to be very similar to perceptual implicit memory. Thus, it may not be that ESK are unavailable to depressed individuals because of inhibition, but it may be that this sensory–perceptual information is not available to a purposeful, explicit search of memory. If processing during encoding was not directed to ESK (due to any of the encoding-deficit explanations discussed earlier), much of it would not appear in the autobiographical knowledge base. However, what ESK were nonconsciously processed would likely be available only through implicit memory processing, especially under transfer appropriate processing conditions, as described in Barry et al. (2004). In fact, Conway and Pleydell-Pearce state that if ESK is accessed, it can indirectly influence cognition by priming. This makes sense considering that depressed individuals tend to recall lifetime periods and general events more often than ESK. When explicit memory is called for, the SMS selects cues based on its interactions with encoding and self-schemas. Most of these were limited to the level of general events, where goals play an important role. Therefore, the SMS may be affecting retrieval through its interaction with self-schemas and previous encoding processes, not through inhibition mechanisms. In Fig. 2, for example, the dotted line of autobiographical knowledge base retrieval represents the retrieval path of a depressed individual — retrieval occurs at the level of general events rather than ESK. The solid line of autobiographical knowledge base retrieval represents the retrieval of a nondepressed individual — retrieval continues to the level of ESK. Additionally, in this figure, the down arrows indicate generative retrieval while the up arrows indicate the likely path of direct retrieval. As described earlier, direct retrieval is very similar to priming in this model.

4.1.3. Schemas and self-schemas

Schemas, or abstracted representations of previous experiences with environmental regularities, exist for both episodic and semantic memory. Activation of a schema is automatic — Rehm and Naus (1990) stated that "evidence from the environment activates potential schemas, and active schemas produce an increased readiness for certain evidence and a decreased readiness for other evidence. . . .During retrieval, partial activation of some of the features of a particular schema will result in the others being 'filled in'." (p. 26). In this way, implicit memory is implicated, if not actually considered. Most implicit memory tasks, and all of those which are perceptual in nature, involve re-presenting all or part of the original stimulus to the individual. For example, the word completion task is a prototypical implicit memory task that partially re-presents the original stimulus during testing (Schacter, 1987). In this task, a list of words is presented to the participant. Later, the participant is given a seemingly unrelated word completion task where the first three letters from each of a list of words are presented, and s/he is to complete them with the first real word that comes to mind. Some of the words, however, were presented in the earlier list. To the extent that the participant is more likely to complete the word stems with previously encountered words without conscious awareness, implicit memory has been tapped.

Affect is another important feature of the memory episode being re-presented in memory. When an individual is depressed, and encodes information primarily using episodic memory, the emotional quality of the information is especially salient and becomes part of the depressive schema. During subsequent retrieval, the depressive schema is again activated when the testing conditions match the encoding conditions, resulting in a mood congruent implicit memory bias. Thus, without the person's awareness, activation of a schema occurs and proceeds automatically, maintaining depression. The internal or external conditions that must be met to maximize the likelihood of this activation are not yet known. However, automatic activation is likely a key mechanism.

Earlier it was pointed out that implicit memory tends to focus more on retrieval processes than encoding processes. In trying to answer the question of why understanding implicit memory might be helpful to understanding depression, Eysenck (1991) pointed out that in order to understand underlying schemas, implicit memory tests may provide more information than explicit memory tests. Further, Watkins (2002) stated,

> As a depressed person ruminates on unpleasant information, they are engaging in mood-congruent conceptual elaboration. Not only does this make the information more available to both explicit and implicit retrieval, elaborating this information in a mood-congruent fashion should also serve to enhance explicit and implicit retrieval of information related to this material (p. 398).

In addition, consider the role of knowledge base. Developmental researchers have studied the role of knowledge base in developing memory for some time (e.g., Bjorklund, 1987). For example, the seminal work of Chi (1978) on the expert/novice paradigm helped to highlight the importance of experience in building knowledge base, over and above the effects of age-related development. What Chi discovered was that the organization and content of the knowledge base was based in large part on experience, rather than age. In her studies, she demonstrated that children could exhibit better memory than adults, when the subjects being tested were within their "expertise" such as chess or dinosaurs (see Bjorklund, 1987 for a review of this work). Her findings were contrary to traditional memory research where adult memory was always superior to children's memory (see Kail, 1990 for an overview). Thus, expertise plays an important role in the structure and organization of the knowledge base, improving memory for to-be-remembered items within the domain of expertise. More recently Thompson, Skowronski, Larsen, and Betz (1996) explored the idea that our self-schemas are a part of our expert knowledge base. "Given that we have been developing our self-schemata for most of our lives, it can be reasonably argued that, if we are expert about anything, it is about ourselves. That is, we have expert knowledge about the self in the sense that we have an extensive, rich, well-articulated set of information represented in the self-schema" (p. 85). Thompson et al. also noted that information in our self-schema, as with any schema knowledge, may not always be accurate. Thus, just as information in our general knowledge base may not be accurate, our self-schemas may also contain inaccuracies due to the biasing effects of memory on perceptual and interpretive processes.

4.2. Developmental perspective to the onset of depression

As an example of how the revised model can be used to account for memory phenomena in depression, consider the case of chronic depression. The onset of depression can be understood through an examination of the development of autiobiographical memory and self-schemas as put forward by Conway and

Pleydell-Pearce (2000). Specifically, they address the lifespan retrieval curve, which includes infantile amnesia (see Pillemer & White, 1989, for a discussion of the issues) and the reminiscence bump (see Rubin, Rahhal, & Poon, 1998, for a discussion of the issues). These two phenomena are important to understanding the development of memory in childhood into adulthood. A key issue in autobiographical memory, according to Conway and Pleydell-Pearce, is the relationship of the memory system with the goal structure of the self, and these constructs are used to provide an explanation for both poor recall of early memories before age five (infantile amnesia) and enhanced recall of memories for events in early adulthood (the reminiscence bump).

Then how might we examine the development of chronic depression? Citing the work of Nelson (1993) on the appearance of autobiographical memory in early childhood (around the age of 4 years), as well as the discussion of Howe and Courage (1997) on the development of the "cognitive self", Conway and Pleydell-Pearce (2000) hypothesized that even very young children can form autobiographical memories related to their current goal structure (mainly basic safety, nurturing, and attachment needs). However, as the brain matures and the memory system changes, the self and its goals also undergo major changes around age five years (Conway & Pleydell-Pearce, 2000). Thus, it is suggested that children's memories change as they fully develop a sense of self that enables them to organize their experiences into a cohesive structure. This accounts for the inability for most people to access autobiographical memories before the age of about five years (i.e., infantile amnesia): Without a cohesive and consistent self-schema to help organize personal memories, most of them are lost.

A second major change in the sense of self appears in early adulthood. According to Conway and Pleydell-Pearce (2000), the time of emerging adulthood (adolescence to young adulthood) represents a critical period in the formation of a stable self-system. This entails the search for identity, a sense of self, and especially new goals after childhood. It is not until this period that a coherent "life story" schema emerges, representing a fundamental shift in the use of autobiographical memory. At this point, the sense of self includes future as well as past and the emerging sense of self is seen, during this period, as driving encoding. Then, during the latter part of this period, goal attainment is particularly salient, resulting in many autobiographical memories (i.e., the reminiscence bump, see Rubin et al., 1998) reflecting the success or failure of meeting these goals. In addition to the development of a sense of self, Ingram, Miranda, and Segal (1998) point out that while cognitive structures are developing and changing, so are affective structures. "Thus, cognitive self-structures could potentially become closely linked to sadness affective structures through this developmental process" (p. 233). For instance, the seminal work of Larson and Richards (1994) on the intensity of adolescents' emotions found that adolescents experience emotions more often and more intense emotions (both positive and negative) than their parents.

As depression is most often diagnosed after early adulthood (Rehm & Tyndall, 1993), it is reasonable to consider that the changing self-schema and incorporation of goals as just described may also be responsible for the onset of depression in vulnerable individuals. Conway and Pleydell-Pearce (2000) state that as the SMS is working to construct autobiographical memories, the goal structure of the working self is controlling the memory process in such a way as to incorporate success or failure of relevant goals. In the person vulnerable to depression, the failures may become more salient and more available, and become incompatible with the goals of the working self. "When the current goals and plans or possible selves of the working self are in opposition to autobiographical knowledge, then there has been a breakdown in the normal functioning of the SMS, and depending on severity the system may enter a pathological state" (Conway & Pleydell-Pearce, 2000, p. 271), resulting in the onset of depression.

4.3. Self-schemas and the maintenance of depression

The revised memory model of emotion delineated herein can therefore account for the onset of depression as well as its maintenance. As noted earlier in the review of the memory models of emotion, self-schemas are represented in the organization of the memory structure. In the chronically depressed person, these personally relevant organizations of self-memory are presumed to be made up predominantly of negative information. This is not to say that the depressed person does not have any positive information in his or her self-schemas — rather that he or she selectively attends to and remembers the negative information (Rehm & Naus, 1990; Riskind, 1989). The previous discussion of implicit memory suggests how this may occur non-purposefully, indeed, non-consciously, in the depressed person. Earlier Rehm and Naus (1990) posited that attention was allocated to depressive schemas as well as to these schemas in relation to new events. This notion is now expanded to include both implicit and explicit activation of such schemas. Rehm and Naus also stated that negative self-schemas may serve to maintain or even strengthen depression because of subsequent experiences being continually interpreted in a negative manner in the depression-prone person. The extant literature on depression and implicit memory reviewed in Barry et al. (2004) further suggests that a mood-congruent bias in implicit memory may also serve to maintain or strengthen depression. After considering the views of Conway (2001) on autobiographical memory, we would also add mood-congruent biases in episodic memory to this list.

In the cognitive-priming formulation of mood and memory of Riskind (1989), he explained the maintenance of depression as priming schemas that refer to the self, resulting in "increased recall of schema-congruent self-referential information" (p. 177). Thus, depressed individuals show enhanced retrieval of emotionally negative memories compared to controls. Further, the self-schemas enacted during the depressive episode also drive encoding, causing enhanced encoding of mood-congruent material. Then this and other related information becomes more accessible after repeated use. These ideas are entirely compatible with the maintenance mechanism presented above. Similarly, Tobias, Kihlstrom, and Schacter (1992) decribed mood as a contextual cue that influences retrieval because of its role in the encoding process, echoing Dutta and Kanango (1975). The chronically depressed or dysthymic individual may in fact be caught in a cycle of mood-congruent implicit memory bias based on automatic activation of negative self-schemas. Once this cycle begins, this automatic activation of these negative self-schemas ensures that the cognitions of the depressed individual are biased toward negatively valenced material. In Bower-like fashion, the network becomes saturated with negative emotion nodes, continuing the cycle of automatic activation. Through the changing goal structure of self, these biases also become explicit so that both implicit and explicit memory processes are affected by depression. In other words, both automatic activation and effortful elaboration processes are affected in the depressed individual, influencing each other and making depression especially difficult to overcome.

For example, negative experiences in childhood (including loss, rejection, negative evaluation, or failure) may serve to develop the negative self-schemas discussed above as they are incorporated into the developing sense of self. Since young children tend to be egocentric (Piaget, 1976), they may be more likely to incorporate negative occurrences that are attributed to themselves into their self-schema. Similarly, as noted by Conway and Pleydell-Pearce (2000), even young children have attachment needs set in their goal structure, and any challenges to these goals may be incorporated into their developing self-schemas. Thereafter, the negative self-schemas may be perpetuated by mood congruent implicit memory bias as described in Barry et al. (2004). Onset may occur when this bias is sufficiently activated, and thereafter a cycle may develop whereby negative self-schemas are activated, integrated

into other experiences, maintained, and subsequently re-activated automatically through implicit memory.

Conway and Pleydell-Pearce (2000) also used the notion of schemas to explain the maintenance of depression. They stated that it is difficult to recall memories that are inconsistent with a lifetime period, the "highest" level of their hierarchical autobiographical knowledge base. Thus, the control of memory is a vital function of the self-memory system, with important implications for mental health. Since memories are conceptualized as related to goals, and since subgroups of goals may increase accessibility of certain memories, a bias toward memories that are congruent with the current goals may result. Once a depressed mood is experienced, it may have a tendency to maintain itself through restructuring goals relevant to the self. Thus, the self may act as an organizing and stabilizing process generally, but may also change with mood. During bouts of depression, negative goal structures are considered to be accessed both implicitly and explicitly, further influencing the perception and interpretation of current experiences as well as mood.

5. Conclusion

The revised memory model of emotion presented herein suggests several different treatment approaches to depression. First, identifying negative biases can help to draw attention explicitly to memory processing. In combination with helping depressed individuals learn strategies to help direct their memory, they would gain more control over their memory. Second, redirecting the depressed individual's attention during encoding experiences will help to make subsequent retrieval more likely, especially after the use of a search strategy. Understanding self-schemas and the role they play in memory processing can lead to treatments based on changing self-schemas and actually using them to a memory advantage: having them help identify and change goals present in the working self and self memory system. In addition, other interventions, including behavioral activation and medication, also serve to influence mood, self-schema, and goals. In turn, these influence the kind of priming and memory retrieval that occurs.

Although many important inroads into the understanding of depression and implicit memory have been made, it is clear that there is much more work to be done in terms of a better understanding of both theoretical and clinical implications of this view. Because implicit memory by definition is a nonconscious type of processing, it may present a challenge for clinicians attempting to treat depression. In particular, getting at the unconscious schema held by depressed individuals may prove especially difficult, particularly given their automatic activation. However, the implicit memory field has developed its own tasks and methodology, which may prove useful to interested clinicians. After all, the ultimate test of a model is its utility.

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