

Automatic and Effortful Processing in Depression

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Automatic processes require few attentional resources, but effortful processes use attentional capacity. Research on cognitive processing by depressed individuals is reviewed and the following is concluded: (a) Depression interferes with effortful processing. The degree of interference is determined by the degree of effortfulness of the task, the severity of depression, and the valence of the stimulus material to be processed. (b) Depression interferes only minimally with automatic processes. Hypothetical causal mechanisms for interference in effortful processes by depression, whether interference in effortful processing is unique to depression or characteristic of psychopathology in general, and whether negative automatic thoughts are associated with current depression or depression proneness also are addressed. The effortful-automatic perspective has implications for understanding depressive clinical features, treating depression, and conducting future research.

Individuals can pay attention to only a finite amount of information at any one time. Stated in another way, they have a limited capacity to process information (Ingram, 1984b). Automatic processes do not require attention, but effortful processes use attentional capacity. The notion that cognitive resources are limited is a long-standing one in psychology, having first been introduced by William James (1905/1981). Later, Kahneman (1973) hypothesized that mental operations differ in the amount of attention they require. Adherents of automatic and effortful processing theories argue that, with extensive practice, some complex operations, such as driving an automobile, can occur with only minimal attentional requirements. A number of researchers proposed theories of automatic and effortful processing (LaBerge, 1973; LaBerge & Samuels, 1974; Neisser, 1967; Posner & Snyder, 1975; Schneider & Shiffrin, 1977; Shiffrin & Dumais, 1981; Shiffrin & Schneider, 1977). Most important for our present purposes, Hasher and Zacks (1979, 1984) argued that effortful processes were reduced under conditions of stress, including depression, because stress was thought to decrease cognitive capacity required for effortful processing. They suggested that no such reduction occurred in automatic operations.

Definitions of Automatic and Effortful Processes

Most of us are familiar with the expression "a thought just popped into my mind." It is as if the thought comes from nowhere. We are not consciously trying to produce the thought. In fact, we are thinking about something else at the time. Yet, once produced, the thought intrudes on us. The thought in this exam-

ple is said to have been produced by an automatic *process* (see Posner & Snyder, 1975). Specifically, almost all definitions of automatic processes (Table 1; see also Palmer & Jonides, 1988) include the following criteria: (a) The processes take place without requiring attention or conscious awareness; (b) automatic processes occur in parallel without interfering with other operations or stressing the capacity limitations of the cognitive system (many automatic processes can take place at one time); and (c) automatic processes occur without intention or control.¹ In addition, Schneider and Shiffrin (1977) and Hasher and Zacks (1979) concurred that, once activated, automatic processes run to completion and are difficult to suppress, modify, or ignore. LaBerge (1973) and Schneider and Shiffrin (1977) included as part of their definition the criterion that automatic operations require an appreciable amount of practice to develop and that all well-learned stimuli are processed in this way.

Note that the concept of automaticity is confusing in the literature. Part of the confusion appears to arise from a failure to distinguish between automatic processes and the thoughts, or products (Ingram & Kendall, 1986, 1987; Ingram & Wisnicki, 1991), that are produced by automatic processes. Ingram and his colleagues distinguished between cognitive processes or operations (i.e., the processes by which the information-processing system operates) and cognitive products (i.e., the end results of the operations of the cognitive system). The first two criteria

¹ Shiffrin and Dumais (1981) claimed that automatic-attention responses, as demonstrated by Schneider and Shiffrin (1977; Shiffrin & Schneider, 1977), violate the first two criteria by giving rise to conscious awareness and interfering with ongoing activity. Thus, they proposed a second definition of automatic processes to encompass automatic-attention responses: "any process that does not use general nonspecific processing resources and does not decrease the general nonspecific capacity available for other purposes" (p. 116). This second definition of automatic processes may not be necessary, however, because it is unclear whether Schneider and Shiffrin demonstrated that attention responses occur automatically. Their subjects' task was to locate targets; hence, even items in the to-be-ignored location were likely to have received some attention (Bargh, 1984).

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Table 1
Criteria for Automatic and Effortful Processing

Criterion	Definition
Automatic processing	
1	The operation takes place without requiring attention or conscious awareness.
2	The process occurs in parallel without interfering with other operations or stressing the capacity limitations of the system.
3	The process occurs without subject intention or control.
Effortful processing	
1	The process requires attention and thereby takes place serially, inhibits other pathways, and is influenced by cognitive capacity limitations.
2	The efficiency of the process improves with practice.
3	The process can be used to cause learning.

of automatic processes are that they take place without conscious awareness and do not interfere with ongoing mental activity (e.g., Hasher & Zacks, 1979; Posner & Snyder, 1975). However (as our example illustrates), in contrast to automatic processes, the products of automatic processes (i.e., the thoughts themselves) can reach conscious awareness and interfere with ongoing mental activity. Consistently, Hasher and Zacks stated that "the *outputs* [italics added] of . . . automatic processes are accessible to consciousness" (p. 361). They also pointed out that "a person can pay attention to . . . information that would otherwise be automatically [processed]. . . . One can, for example, actively pay attention to the frequency of events" (p. 359).

A difference in emphasis may also lead to confusion when we discuss automatic and effortful processing in depression. Cognitive psychologists emphasized automatic and effortful processes such as judging the frequency of events (Hasher & Zacks, 1979) and encoding operations, whereas clinical psychologists often talk about products such as self-referent content and negative attributions. To further complicate the matter, Beck referred to "automatic thoughts" (the product; e.g., Beck, 1967, 1976), but it is not clear whether these thoughts are processed automatically according to criteria set forth by cognitive psychologists (see Does Beck's Concept of Automatic Thoughts Fit Empirical Criteria for Automaticity?).

Characteristics of effortful processes (see Table 1)—or control processes, conscious strategies, or serial processes as they are alternatively named—that have been agreed on include the following criteria: (a) They require attention and thereby take place serially, inhibit other pathways, and are influenced by cognitive capacity limitations; (b) their efficiency improves with practice; and (c) effortful processes can be used to cause learning. Some theories include the criteria that the use of effortful processes is voluntary (Hasher & Zacks, 1979; Schneider & Shiffrin, 1977) and requires effort (Hasher & Zacks, 1979; Posner & Snyder, 1975). Automatic and effortful processing theorists, except Schneider and Shiffrin, agree that people are

consciously aware of these operations. Schneider and Shiffrin differentiated between effortful processes of which subjects are consciously aware and those of which people are unaware. Accessible control processes, as exemplified by rote rehearsal, are easily perceived by the subject, are slow, and can be instituted and modified by instruction. Veiled control processes, like serial comparison of items in short-term store, are not easy to perceive, occur quickly, and are difficult to modify through instruction. Schneider and Shiffrin's accessible control processes are analogous to Hasher and Zacks's effortful processes and Posner and Snyder's conscious processes.²

Continuum of Automatic and Effortful Processes

Several contemporary theorists (Hasher & Zacks, 1979; Kahneman & Chajczyk, 1983; Logan, 1985; MacLeod & Dunbar, 1988; Schneider & Shiffrin, 1977; Shiffrin, 1988) suggest that automaticity is on a continuum.³ The continuum of automatic through effortful processes may be as follows: hereditary automatic processes, learned automatic processes, veiled effortful (control) processes, and accessible effortful (control) processes. The nervous system is prewired to acquire hereditary automatic processes with little learning.⁴ The encoding of frequency, spatial location (i.e., the location at which a stimulus was presented),⁵ and time of events are examples of hereditary automatic processes. Learned automatic processes are ac-

² Automatic and effortful processing theories have been criticized by Ryan (1983) and Navon (1984), among others. All of Ryan's objections centered on item-recognition data, which he contended violate every existing defining characteristic of the two classes of operations. Shiffrin and Schneider (1984) countered that a variety of processes could produce the prememorized-list results of Atkinson, Juola, and others, including the automatic processes of familiarity judgment, automatic detection, and category classification and/or a complex mixture of controlled and automatic components. Thus, they contended that the data cannot be used to either support or falsify their concepts. Navon's (1984) thesis was that effects that are interpreted to indicate that the process in question is attentional resource dependent can be explained equally well without this assumption. For example, difficulties in dual-task performance may be explained by dependence on resources, but tasks may also interfere for various other reasons such as harmful side effects (e.g., increasing anxiety). Kahneman (1973) and H. C. Ellis, Thomas, and Rodriguez (1984) also noted the impact of factors such as arousal on task performance, but they contended that neither capacity limitations nor other factors were a sufficient explanation in and of themselves for performance deficits. If postulating limited resources does not lead to explaining and predicting a wide range of empirical observations, Navon contends, then it may turn out to be "excess baggage."

³ We refer to automatic and effortful processes as being on a continuum. Such statements are designed to simplify the discussion. In reality, we assume that all tasks are accomplished with a mixture of both automatic and effortful processes (Schneider, Dumais, & Shiffrin, 1984).

⁴ The notion of "preparedness" in animal learning (Seligman, 1970) is also a concept regarding ease of acquisition. Rats, for example, may more readily learn to associate gastric distress with novel tastes and odors than with sights or sounds (Garcia, Ervin, & Koelling, 1966).

⁵ Naveh-Benjamin (1987, 1988) and Waddell and Rogoff (1987) argued that memory for spatial location was not exclusively mediated by automatic encoding processes, however.

quired through practice. Activation of word meaning while reading (LaBerge & Samuels, 1974) is an example of a learned automatic process. In contrast to hereditary automatic processes, learned automatic processes may show considerable individual differences. Activation of word meanings may take place faster in people who are speed readers than in average readers, for example. Learned automatic processes may be subject to various degrees of disruption (Kahneman & Chajczyk, 1983; Lambert & Jakobovits, 1960; MacLeod & Dunbar, 1988). Some studies indicate that activation of word meaning, for example, may be disrupted when material is difficult (Hardyck & Petrinovich, 1970). There is no evidence that hereditary automatic processes can be completely disrupted.

Overview

In this article we review research on cognitive processing by depressed individuals and conclude the following: (a) Depression interferes with effortful processing. The degree of interference is determined by the degree of effortfulness of the task, the severity of depression, and the valence of the stimulus material to be processed. (b) Depression interferes only minimally with automatic processes.

Our review of the literature indicates that interference in effortful processes by depression is dependent on the degree of depression and on the nature of the task. Within the effortful-automatic continuum, effortful processes appear to vary in the amount of cognitive resources they require and, hence, in their degree of effortfulness. For example, recall memory is more effortful than recognition memory; imposing organization requires more cognitive resources than perceiving organization that already exists; and reading comprehension requires more resources than word recognition. Depression seems to interfere more with highly effortful tasks requiring a great deal of attentional capacity than with less effortful tasks requiring fewer attentional resources.

All things being equal, severity of depression also appears to be positively related to the degree of interference in effortful processes. Thus, interference in effortful processing seems to be greater for depressed inpatients and outpatients than for individuals who are not patients but who show mild to moderate depressive symptomatology on psychological tests (e.g., Beck Depression Inventory [BDI]; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

Although depression often interferes with effortful operations, we believe that depressives (who are not extremely depressed) still are able to engage in some effortful processes. We argue that depressives use the cognitive resources that they do have primarily to focus on specifically depression-relevant themes. As a consequence, depressives' performance on effortful cognitive tasks depends on the content of the stimulus material. One body of research focuses on the effects of depression on performing traditional intellectual tasks (e.g., intellectual functioning, problem solving, speed of performing). These types of tasks can be considered to be neutral in that the content of stimulus materials is neither positively nor negatively valenced. The performance of depressives on these tasks appears to be related to the degree of effortfulness of the task and to the severity of depression, as described previously. Another

body of research focuses on the effects of depression on effortful cognitive operations with valenced material (e.g., recall of negative, neutral, and positive words by depressives and nondepressives; Ingram, 1984a). These tasks seem to result in an interaction between depression status and stimulus valence such that depressives perform better than nondepressives when the stimulus material is negative rather than neutral or positive.

Several causal mechanisms have been proposed for interference in effortful processing by depression: motivational deficits (e.g., McAllister, 1981; Miller, 1975; Seligman, 1975), conservative response style (i.e., depressives remember as well as normals but are less willing to report what they remember; Johnson & Magaro, 1987), reduced cognitive capacity (e.g., Hasher & Zacks, 1979), and narrowing of attention to focus primarily on task-irrelevant thoughts or on specifically depression-relevant thoughts (e.g., H. C. Ellis & Ashbrook, 1988). Motivation may affect whether effortful processes are performed but not whether depressives have available cognitive capacity to perform them. Motivational (e.g., Hertel & Rude, 1991) and conservative response-style (e.g., Williams, Watts, MacLeod, & Mathews, 1988) explanations have been discussed elsewhere. In this article, we focus on explanations that relate depressive deficits in effortful processes to available cognitive capacity. The capacity-reduction hypothesis implies a decrease in total cognitive capacity such that depressives have fewer cognitive resources to devote to any cognitive activity. The narrowing of attentional focus hypotheses, on the other hand, suggest that total cognitive capacity remains the same in depression but that attention is allocated to a smaller subset of cognitive activities. Assuming a narrowing of attention model, attention may be narrowed to focus primarily on any task-irrelevant cognitions or on specifically depression-relevant (but task-irrelevant) cognitions. It should be pointed out that we do not view the limited cognitive capacity model and the narrowing of attentional focus model as mutually exclusive.

Interference in effortful processing may be associated with psychopathology in general or with depression specifically. We address the degree to which interference in effortful versus automatic processes is associated with anxiety, schizophrenia, and Alzheimer's disease as well as with depression.

Although the research is sparse, there is fairly good evidence that processes that are automatic for people in general are maintained in depression. In other words, depression seldom interferes with automatic processes. Those studies that do exist indicate that frequency judgments, spatial location performance, and the processing of self-relevant information remain intact in depressed individuals.

A clinically derived concept of automatic thoughts is central to Beck's (1967, 1976) cognitive theory of depression. We address whether this clinically derived concept appears to fit empirical criteria for automaticity. Similarly, we address whether or not attributional inferences, constructs central to the hopelessness theory of depression (Abramson, Alloy, & Metalsky, 1988; Abramson, Metalsky, & Alloy, 1988, 1989; Abramson, Seligman, & Teasdale, 1978; Alloy, Abramson, Metalsky, & Hartlage, 1988), are processed automatically. In this regard, we discuss whether negative automatic cognitions should be associated with current depression or depression proneness.

Finally, we discuss the implications of our model for under-

standing the clinical features of depression, treating depression, and conducting future research.

Effortful Processing in Depression

Depression appears to interfere with effortful processing, specifically, of neutrally valenced information (e.g., copying, anagrams, word-list recall). In contrast, depressives often seem to perform better than controls when the stimulus material is negative (e.g., on recall of negative words). The degree of interference in processing of neutrally valenced material appears to be directly related to the severity of depression and to the degree of effortfulness of the task. In the following sections, we discuss the evidence for depression's interference in effortful processing of neutrally valenced material, hypothesized causal mechanisms for interference in effortful processing by depression, and whether interference in effortful processing is unique to depression or characteristic of psychopathology in general.

Interference in Effortful Processing of Neutral Material

Automatic and effortful processes are on a continuum. Degree of depressed mood also lies along a continuum from mild to moderate to severe (e.g., Coyne & Gotlib, 1983). Our review of the literature indicates that, as people become increasingly depressed, they engage in fewer processes requiring attention. Thus, depression appears to interfere more with effortful processes than with automatic processes (e.g., Hasher, Rose, Zacks, Sanft, & Doren, 1985). Even mild depression seems to interfere with accessible effortful processes that demand a great deal of cognitive capacity. However, only in severe cases does depression appear to interfere with automatic processes.

Unfortunately, there has been no systematic examination of the attentional demands required by experimental tasks used to assess psychological deficit in depression. Even for normal subjects, the attentional requirements of specific cognitive tasks have not yet been well ordered (H. C. Ellis & Ashbrook, 1988; Gjerde, 1983). Most tasks used to assess depressive deficits contain components of both automatic and effortful processes. In this section, we analyze tasks with respect to degree of effortfulness, review evidence regarding depressives' performance on these tasks, and examine whether results of studies using the tasks support the conclusion that depression interferes with effortful processes. Studies of intellectual functioning, problem solving, general learning, effortful encoding (i.e., organization and clustering, semantic encoding), reading, and speed of performing will be reviewed. Within each of these subsections, studies are divided according to whether subjects were depressed patients or whether subjects were classified as depressed on the basis of psychological tests.⁶ Depressed patients are presumed to be more severely depressed than nonclinical subjects who exhibit depressive symptoms on psychological tests. Interference in performance appears to be consistently demonstrated when the subjects are depressed patients but not always demonstrated when the subjects are not patients. Studies in which normal subjects received a transient negative-mood induction have not been included in this section. Tables 2 through 7 summarize the relevant results of studies in each of the six effortful processing areas.

Intellectual Functioning

Various subscales of intelligence tests seem to tap combinations of automatic and effortful processes. However, to our knowledge, no previous attempt has been made to categorize the subtests of the Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955) according to whether each is relatively automatic or effortful. On the basis of reasoning rather than on hard evidence, we attempted to analyze selected subscales according to the degree of effortfulness. We categorized a subscale if there appeared to be a basis for arguing that it was primarily automatic or effortful and if there were several studies reporting results on that particular subscale.

The Vocabulary, Picture Completion, and Information subscales of the WAIS (Wechsler, 1955) primarily involve retrieval of information encoded before the depressive episode, a relatively automatic process (see Semantic Encoding). Vocabulary appears to be the most automated of the three because it essentially entails the automatic activation of the meaning of words. Picture Completion involves cued recall and seems to be more automated than Information, which entails free recall. These subscales are also among the "hold" tests (Golden, 1979) that are thought to be relatively impervious to deterioration with aging. This is consistent with Hasher and Zacks's (1979) formulation that automatic versus effortful operations do not deteriorate with age. In contrast, Block Design is a "don't hold" test. The latter subscale, along with Comprehension, involves the relatively effortful operations of search, imagery, organization, and problem solving (see Problem Solving). Several researchers examined the association between depression and performance on the WAIS or other intelligence measures (Table 2).

Clinical samples. The preponderance of studies with depressed patients suggest a negative relationship between depression and global intellectual functioning (e.g., intelligence quotient [IQ], verbal IQ, performance IQ; Andreasen, 1976; D. C. Clark et al., 1985; Payne, 1961, 1973; Staton, Wilson, & Brumback, 1981). However, one study (Weckowicz, Tam, & Bay, 1978) failed to find depressive deficits on intelligence measures. A possible explanation for the null findings is that the latter study (Weckowicz et al., 1978) used nondepressed psychiatric patients as the control group. Psychiatric patients may have suffered from deterioration in intellectual functioning for reasons other than depression (see *Is Interference in Effortful Processing Unique to Depression?*). Furthermore, deficits on general intelligence measures may be small, because intelligence tests appear to combine subscales with both automatic and effortful operations. Thus, null findings in the Weckowicz et al. (1978) study may be attributable to a less than optimal control group obscuring relatively small depressed–nondepressed differences.

An examination of the performance of depressed patients on the basis of our tentative categorization of WAIS subscales generally supports this argument. Several studies demonstrated depressive deficits on the effortful Block Design and Comprehension subscales but not on the most automatic Vocabulary sub-

⁶ In some subsections, we are not aware of relevant studies in both categories. Thus, for example, the section on Effortful Encoding—Organization and Clustering contains only studies of depressed patients.

Table 2
Effortful processes in Depression: Intellectual Functioning

Study	Subject	Measure of depression	Task	Result
Clinical samples				
Andreasen (1976)	Major depressives tested at admission & discharge	RDC	Shipley-Hartford, Raven Standard Progressive Matrices	Nonsignificant tendency for improvement from admission to discharge
Callagan (1952)	Depressed patients	Rating by psychiatrists	5 verbal & performance subtests of Wechsler-Bellevue	Increases in IQ after clinical improvement
D. C. Clark et al. (1985)	In- and outpatient major depressives, manic-disordered, schizoaffectives, & intermittent depressives	SADS, RDC	Shipley-Institute of Living Scale, IQ estimate	D < NC
Davidson (1939)	Manic-depressed patients	Not reported	Stanford-Binet Intelligence Scale	Increases in scores with clinical improvement
Fisher (1949)	Veterans whose primary symptom vs. diagnosis was clinical depression	Feeling & Attitude Scale	Wechsler-Bellevue	Increases in IQ after clinical improvement
Friedman (1964)	Depressed inpatients; average age, 58 years	Independent diagnoses by trained raters	WAIS I & PC subtests	D = NC
Granick (1963)	Psychotic depressed inpatients (mean age, 57 years)	Diagnosis by 2 psychiatrists	WAIS I subtest Thorndike-Gallup Vocabulary Test	D = NC
Hart, Kwentus, Taylor, & Harkins (1987)	Major depressed patients	<i>DSM-III</i> , Hamilton	WAIS I & BD subtests	D < NC on BD, D = NC on I
Robertson & Taylor (1985)	Bipolar, unipolar, & reactive depressed prisoners	Hospital case notes & interview	WAIS V, PC, & BD subtests	D < NC on PC & BD but not on V
Staton, Wilson, & Brumback (1981)	6- to 13-year-old major depressives	<i>DSM-III</i> , CDRS, CDI, symptom questionnaire	WISC-R	Performance improved on FSIQ, VIQ, PIQ, C, & BD but not on V, I, or PC with remission of melancholic depression
Stromgren (1977)	Endogenously depressed inpatients	Specially designed symptom rating scale	WMS	MQ increased from first to last ECT treatment
Weckowicz, Tam, Mason, & Bay (1978)	Depressed inpatients	BDI, psychiatrists' diagnosis per Canadian adaptation of <i>DSM-II</i>	Quick Test, WAIS	D = nondepressed psychiatric controls
Zung, Rogers, & Krugman (1968)	Moderate & marked depressed inpatients	SDS	ITPA	Increases in IQ after clinical improvement
Nonclinical samples				
Brumback, Jackoway, & Weinberg (1980)	Prepubertal children with school problems & depression	Experimenter criteria based on parent & school reports	WISC or WPPSI	No difference between depressed & nondepressed children with school problems
Kaslow (1981)	1st, 4th, & 8th graders	Self-report	WISC-R BD, C, & V	Depressed 1st & 4th graders impaired on BD & C, but not V, relative to NC; no relationship between depression & performance of 8th graders
Lefkowitz & Tesiny (1980)	4th & 5th grade public school children	Self-rating, teacher rating, PNID	Figure drawing IQ	Negative relationship between depression and intellectual functioning
Tesiny, Lefkowitz, & Gordon (1980)	4th & 5th grade public school children	PNID	Goodenough-Harris Drawing Test	Negative relationship between depression and intellectual functioning

Note. BD = Block Design; BDI = Beck Depression Inventory; C = Comprehension; CDI = Children's Depression Inventory; CDRS = Children's Depression Rating Scale; D = depressives; *DSM-III* = *Diagnostic and Statistical Manual of Mental Disorders*, third edition; ECT = electroconvulsive therapy; FSIQ = Full Scale Intelligence Quotient; I = Information; IQ = intelligence quotient; ITPA = Illinois Test of Psycholinguistic Abilities; MQ = mental quotient; NC = normal controls; PC = Picture Completion; PIQ = performance intelligence quotient; PNID = Peer Nomination Inventory of Depression; R = revised; RDC = Research Diagnostic Criteria; SADS = Schedule for Affective Disorders and Schizophrenia; SDS = Self-Rating Depression Scale; V = Vocabulary; VIQ = verbal intelligence quotient; WAIS = Wechsler Adult Intelligence Scale; WISC = Wechsler Intelligence Scale for Children; WMS = Wechsler Memory Scale; WPPSI = Wechsler Preschool & Primary Scale of Intelligence.

scale (Hart, Kwentus, Taylor, & Harkins, 1987; Robertson & Taylor, 1985; Staton et al., 1981; see also Granick, 1963). Although the evidence is not as strong when we consider the performance of depressed patients on the relatively automatic Picture Completion and Information subscales, most studies still tend to support our hypothesis. The majority of studies (Friedman, 1964; Granick, 1963; Hart, Kwentus, Taylor, & Harkins, 1987; Staton et al., 1981) found no differences between depressed and nondepressed patients on the presumably automatic Picture Completion and Information subscales, but at least one study (Robertson & Taylor, 1985) of the performance of depressives on the Picture Completion subscale found evidence contradictory to our argument.

Finally, several authors reported that depressed patients' IQ scores increase with clinical improvement and decrease with clinical deterioration (Callagan, 1952; Davidson, 1939; Fisher, 1949; Stromgren, 1977; Zung, Rogers, & Krugman, 1968), suggesting that the severity of symptoms influences the degree of impairment in intellectual functioning.

Nonclinical samples. Two studies showed that children classified as depressed by psychometric criteria were impaired relative to controls on general intelligence measures (Lefkowitz & Tesiny, 1980; Tesiny, Lefkowitz, & Gordon, 1980). Brumback, Jackoway, and Weinberg (1980) failed to find depressive deficits on IQ tests; however, the control group consisted of children with school problems. Kaslow (1981) found that impairment on the effortful Block Design and Completion subscales was related to self-reported depression by first and fourth graders but not by eighth graders.

Summary. Studies of global intellectual functioning among depressed patients provide consistent support, with only one exception, for the conclusion that depression interferes with effortful processes. The evidence for this conclusion would be stronger if there were hard data to support our proposed categorization of WAIS subtests. Students, who are presumably less depressed than patients, have not consistently demonstrated impaired functioning on intelligence measures. Taken together, these results and findings from studies of patients who improved clinically provide reasonable evidence that the degree of interference in intellectual functioning depends on the severity of depression.

Problem Solving

Problem-solving tasks involve primarily effortful processes (Shiffrin, 1976). Although the specific tasks vary widely, from solving anagrams to solving interpersonal problems, all involve effortful subskills such as controlled search (Anderson, 1980) and decision making (Bootzin, Loftus, & Zajonc, 1983). The tasks meet all of Hasher and Zacks's (1979) criteria for effortful processing. They occur under intentional learning conditions (e.g., Davies, 1970), improve with instruction and practice (Ward, 1937), interfere with other operations, require attention, and show developmental trends (Flavell, 1977). A number of studies assessed the relationship between depression and problem solving (Table 3).

Clinical samples. Several studies demonstrated deficient problem-solving skills in depressed patients. Specifically, clinical depression has been associated with deficits on anagrams

(Price, Tryon, & Raps, 1978; but see Gotlib & Asarnow, 1979), series-completion and proverb-interpretation tasks (Braff & Beck, 1974), the Halstead Category Test (Savard, Rey, & Post, 1980; although an earlier study on the same sample failed to uncover significant differences; Rey, Savard, Silber, Buchsbaum, & Post, 1979; Staton et al., 1981), a multiple-classification matrix-completion task (Cole & Zarit, 1984), and the Shipley-Hartford Abstraction Test (Andreasen, 1976). Moreover, Braff and Beck (1974) reported that the degree of problem-solving deficits was correlated with the severity of depression.

Nonclinical samples. Although the findings have been mixed (e.g., Wollert & Buchwald, 1979), most studies also demonstrated that mild depression interferes with problem solving. Students with milder depressive symptoms have sometimes shown (Fisher-Beckfield & McFall, 1982; Kaslow, Tanenbaum, Abramson, Peterson, & Seligman, 1983; Miller & Seligman, 1975; Mullins, Siegel, & Hodges, 1985) and sometimes not shown (Mullins et al., 1985) deficits in solving anagrams, making analogies, and solving interpersonal problems. Zarantonello, Slaymaker, Johnson, and Petzel (1984) found that anxiety, but not depression, was related to anagram performance.

The degree of interference in problem solving appears to be related to the degree of effortfulness of the task. Depressed college students showed less efficient problem-solving skills than nondepressed students, particularly on more difficult tasks (D. J. G. Dobson & Dobson, 1981); and depressed students showed deficits in problem solving when asked to generate their own hypotheses but not when the hypotheses were generated for them (Abramson, Alloy, & Rosoff, 1981).

Summary. There is substantial evidence that moderate to severe depression, such as that found in patient samples, interferes with problem solving. Mild depression, as found in non-help-seeking students classified as depressed on questionnaires, may interfere with problem solving, depending on the nature of the problem-solving task. Taken together, these findings and results of the Braff and Beck (1974) study suggest that the degree of interference in problem solving is directly related to the severity of depression.

General Learning

Experimental paradigms used to study learning involve primarily effortful subskills including rehearsal, organization, clustering, and transfer of information from short-term store to long-term store (Schneider & Shiffrin, 1977). However, there are variations in the attentional requirements of different learning tasks. For example, subjects may be asked to recall or to recognize items that have been memorized. Thus, learning tasks appear to be essentially effortful in nature, with some learning tasks falling further along the continuum toward highly effortful processes than others. The literature abounds with reports of depressed patients' performance on general learning tasks (see Table 4).

Clinical samples. Numerous studies demonstrated that depressed patients are impaired on general learning tasks. Depression has been associated with memory deficits on word-learning tests (Cole & Zarit, 1984; Coughlan & Hollows, 1984; Cronholm & Ottosson, 1961; Friedman, 1964; Henry, Wein-

Table 3
Effortful Processing in Depression: Problem Solving

Study	Subjects	Measure of depression	Task	Result
Clinical samples				
Andreasen (1976)	Major depressives tested at admission & discharge	RDC	Shibley-Hartford Abstraction Test, Raven Standard Progressive Matrices	Nonsignificant tendency for improved performance after clinical improvement
Braff & Beck (1974)	Depressed inpatients	BDI	Shibley Abstraction Test, Gorham Proverbs Test	On abstraction NC > D > schizophrenics, and degree of deficit correlated with severity of depression
Cole & Zarit (1984)	Depressed medical inpatients	RDC	Multiple classification matrix completion	D < community controls
Gotlib & Asarnow (1979)	Student outpatients	BDI, (STAI)	Anagrams	Anxiety, but not depression, related to performance
Gotlib & Asarnow (1979)	Student outpatients	BDI	MEPS	Negative correlation between depression & performance
Price, Tryon, & Raps (1978)	Depressed psychiatric & medical inpatients	BDI-SF	Anagrams	D & medical patients deficient
Rey, Savard, Silber, Buchsbaum, & Post (1979)	Hospitalized unipolar & bipolar depressives	<i>DSM-III</i> , Bunney & Hamburg scale, nondirective interview	Halstead Category Test	High interview-rated depressive disturbance not related to performance
Savard, Rey, & Post (1980)	Hospitalized unipolar & bipolar depressives	<i>DSM-III</i> , Bunney & Hamburg scale	Halstead Category Test	D made more errors than controls
Staton, Wilson, & Brumback (1981)	6- to 13-year-old major depressives	<i>DSM-III</i> , symptom questionnaire, CDRS, CDI	Halstead Category Test	Remission of melancholic depression associated with improved performance
Nonclinical samples				
Abramson, Alloy, & Rosoff (1981)	Students	BDI, MAACL	Judge potential control over light onset under self- or experimenter-generated hypothesis conditions	D deficient when generating own hypotheses
Dobson & Dobson (1981)	Students	BDI	Determine rule given positive & negative stimulus pattern exemplars	D deficient on more difficult tasks
Fisher-Beckfield & McFall (1982)	Students	BDI, self-report of tendency to experience frequent depression	PICS	D < ND; no relationship between frequency of depression & performance
Kaslow, Tanenbaum, Abramson, Peterson, & Seligman (1983)	9- to 11-year-old schoolchildren	CDI	Block Design, anagrams	Moderate correlation between performance & depression
Miller & Seligman (1975)	Students	BDI	Anagrams	ND exposed to helplessness induction = mild D
Mullins, Siegel, & Hodges (1985)	9- to 12-year-old schoolchildren	Children's depression scale	Social MEPS, thinking test (optional)	Depression related to deficits in impersonal, but not interpersonal, problem solving
Mullins, Siegel, & Hodges (1985)	9- to 12-year-old schoolchildren	Self-report	Anagrams	Higher levels of depression associated with lower performance.
Wollert & Buchwald (1979)	Students	MMPI-D	Analogies test	Negative correlation between depression & performance of females but not males
Zarantonello, Slaymaker, Johnson, & Petzel (1984)	Students	BDI (STAI A-Trait Scale)	Anagrams	Anxiety, but not depression, related to performance

Note. BDI = Beck Depression Inventory; CDI = Children's Depression Inventory; CDRS = Children's Depression Rating Scale; D = depressives; MMPI-D = Depression Scale of the Minnesota Multiphasic Personality Inventory; *DSM-III* = *Diagnostic and Statistical Manual of Mental Disorders, third edition*; MAACL = Multiple Affect Adjective Check List; MEPS = Means-Ends Problem Solving Procedure; NC = normal controls; ND = nondepressives; PICS = Problem Inventory for College Students; RDC = Research Diagnostic Criteria; SF = Short Form; STAI = State-Trait Anxiety Inventory.

Table 4
Effortful Processing in Depression: General Learning Tasks for Clinical Samples

Study	Subjects	Measure of depression	Task	Result
Breslow, Kocsis, & Belkin (1980)	Hospitalized major depressives	RDC, Hamilton	WMS	D deficient in verbal learning
Calev & Erwin (1985)	Hospitalized unipolar (endogenous & reactive) depressives	Diagnosis by at least 2 psychiatrists	Verbal recognition and recall	D < NC; D better at recognition than recall
Cawley, Post, & Whitehead (1973)	Geriatric (older than 60 years) inpatient depressives	Rating on 3- or 5-point scale, admissions conference	SLT, Mill Hill Vocabulary Scale	Clinical improvement associated with improved performance
Cohen, Weingartner, Smallberg, Pickar, & Murphy (1982)	Inpatients with major depression	RDC, SADS, Hamilton, Bunney-Hamburg, BDI	Recall of nonsense syllables	D < NC; degree of depression negatively related to performance
Cole & Zarit (1984)	Hospitalized depressives, average age 63 years	RDC, BDI	Word recognition	D < healthy subjects, D = physically ill
Coughlan & Hollows (1984)	In patient and day patient depressives	Judgment of their psychiatrists	Story recall, list learning, forced-choice word recognition	D < NC only on list recall
Cronholm & Ottosson (1961)	Endogenously depressed inpatients	Experimenter-devised symptom rating scale	Twenty Figure Test, Thirty Word Pair Test, Thirty Personal Data Test	D < surgical patient controls; clinical improvement after ECT associated with improved learning
Davis & Unruh (1980)	Nonpsychotic depressed outpatients	BDI-SF	Recognition & recall tasks	D = ND
Friedman (1964)	Depressed inpatients; average age, 58 years	3 independent diagnoses by trained raters	Easy & hard associates, Graham-Kendall designs—memory error score on 4 designs	D < matched controls
Golinkoff & Sweeney (1989)	Depressed inpatients	SADS, <i>DSM-III</i> , Hamilton	Word recall & recognition, frequency judgments	D & personality disordered < NC on recall & recognition; D = NC on frequency judgments
Gruzelier, Seymour, Wilson, Jolley, & Hirsch (1988)	Patients with affective psychosis	<i>DSM-III</i>	Spatial & nonspatial associate learning tests	D & schizophrenics < NC
Hart, Kwentus, Hamer, & Taylor (1987)	Depressed outpatients (most referred for possible dementia; average age, 70)	<i>DSM-III</i> , psychiatrist & neuropsychologist agree on diagnosis, Hamilton	Reminded and unreminded recall of high- & low-imagery words	D < controls on unreminded, but not reminded, words
Hart, Kwentus, Taylor, & Harkins (1987)	Major depressives, normal EEGs	<i>DSM-III</i> , Diagnostic Interview Schedule, Hamilton	WMS	D < NC
Hemsi, Whitehead, & Post (1968)	Depressed inpatients referred for ECT	Hamilton	SLT	Nonsignificant tendency for improvement with clinical improvement 2 weeks after ECT
Henry, Weingartner, & Murphy (1973)	Hospitalized unipolar depressives & bipolar patient depressives	Bunney-Hamburg ward rating scale	Serial learning task, free, recall task	D impaired on serial learning compared with their own performance when less depressed; only more severely depressed unipolar patients impaired on free recall

Table 4 (continued)

Study	Subjects	Measure of depression	Task	Result
Post (1966)	Elderly depressives	Diagnosis by psychiatrist on basis of check list of symptoms	SLT	Performance correlated with clinical progress and tended to be related to severity D deficient
Rapaport (1945)	Neurotic & psychotic depressed inpatients, not manic-depressives	Psychiatrist decision, discussed with psychologist, on basis of case material	Immediate recall on Babcock Test	
Robertson & Taylor (1985)	Male prisoners	Hospital case notes & interview	Visual retention test	D < NC
Roy-Byrne, Weingartner, Bierer, Thompson, & Post (1986; Procedure 2)	Hospitalized unipolar & bipolar major depressives	RDC, Bunney-Hamburg	Word learning	D impaired on free recall but not recognition
Stromgren (1977)	Endogenously depressed inpatients	Specially designed symptom rating scale	WMS	Degree of depression correlated with degree of impairment; degree of clinical improvement correlated with degree of improved performance
Walton, White, Black, & Young (1959)	Neurotic & psychotic depressed patients	Not reported	MW-LT	D scored in the normal range though generally lower than other non-brain-damaged psychiatric patients
Williams, Little, Scates, & Blockman (1987)	Major depressives hospitalized at least once	DSM-III diagnosis based on interview by patient's psychiatrist; BDI	Delayed free recall, delayed cued recall, short story recall, WMS	D < ND on free recall, logical memory, & memory quotient of the WMS
Wolfe, Granholm, Butters, Saunders, & Janowsky (1987)	Hospitalized unipolar & bipolar depressives	DSM-III criteria for major affective disorder based on SADS or structured clinical interview	Word learning	D impaired on word recall & recognition; bipolar & Huntington's disease patients more impaired than unipolar patients
Zung, Rogers, & Krugman (1968)	Moderate & marked depressed inpatients	SDS	Benton Revised Visual Retention Test, WMS	D < NC on Benton, D deficient on WMS

Note. BDI = Beck Depression Inventory; D = depressives; DSM-III = *Diagnostic and Statistical Manual of Mental Disorders, third edition*; ECT = electroconvulsive therapy; EEG = electroencephalogram; MWLT = Modified Word Learning Test; NC = normal controls; ND = nondepressives; RDC = Research Diagnostic Criteria; SADS = Schedule for Affective Disorders and Schizophrenia; SDS = Self-Rating Depression Scale; SF = Short Form; SLT = Synonym Learning Test; WMS = Wechsler Memory Scale.

gartner & Murphy, 1973; Walton, White, Black & Young, 1959), the Wechsler Memory Scale (WMS; Breslow, Kocsis, & Belkin, 1980; Hart, Kwentus, Taylor, & Harkins, 1987; Stromgren, 1977; Wechsler, 1945; Williams, Little, Scates, & Blockman, 1987; Zung et al., 1968), the Immediate Reproduction subscale of the WMS (Rapaport, 1945), recall of nonsense syllables (Cohen, Weingartner, Smallberg, Pickar & Murphy, 1982), visual retention tests (Friedman, 1964; Robertson & Taylor, 1985; Zung et al., 1968), spatial and nonspatial associate learning tests (Gruzelier, Seymour, Wilson, Jolley, & Hirsch, 1988), and the Synonym Learning Test (Cawley, Post, & Whitehead, 1973; Hemi, Whitehead, & Post, 1968; nonsignificant tendency). One study indicated that performance on a word-learning task

tended to be inversely related to severity of depression (F. Post, 1966).

Free recall is thought to be more effortful than recognition and is more likely to result in depressive deficits. Several studies (Calev & Erwin, 1985; Hart, Kwentus, Hamer, & Taylor, 1987; Roy-Byrne, Weingartner, Bierer, Thompson, & Post, 1986; Williams et al., 1987) found that depressed patients showed deficits relative to normal controls when freely recalling words but not under recognition, reminded recall, or cued-recall conditions. In two other studies (Golinkoff & Sweeney, 1989; Wolfe, Granholm, Butters, Saunders, & Janowsky, 1987), hospitalized depressives were impaired relative to normal controls on both recognition and recall tasks. Davis and Unruh (1980) failed to

find recognition or recall learning deficits in depressed clinic patients; however, subjects had to be only mildly depressed to meet the criteria for depression.

Summary: There is strong evidence that depressed patients show performance deficits on general learning tasks. Also, although there are some contradictory findings, several studies indicate that the degree of interference by depression depends on the degree of effortfulness of the specific learning measure. One study suggests that mild depression may not be sufficient to interfere with performance on learning tasks.

Effortful Encoding

Studies of encoding processes, including organization, clustering, and semantic encoding (Hasher & Zacks, 1979; Tyler, Hertel, McCallum, & Ellis, 1979), provide more fine-grained analyses of the specific subskills involved in recognition, recall, and problem solving (Table 5).

Organization and clustering. Organization and clustering are considered to be primarily effortful processes requiring considerable cognitive capacity (Hasher & Zacks, 1979). Several researchers addressed the relationship between depression and performance on tasks involving various degrees of organization or structure.

Clinical samples. In general, moderately depressed patients have shown deficits when tasks called for the imposition of organization or structure but not when tasks already provided organization or structure. Hospitalized patients who were at least moderately depressed remembered less than normals when words were unrelated (a relatively effortful task) but not when words were related (Weingartner, 1986, Experiment 1, Protocols 3 and 4). Similarly, depressed patients recalled appreciably fewer words under conditions in which list structure was removed or not immediately apparent, but they did not differ from controls in recall of word lists that were highly organized (Weingartner, Cohen, Murphy, Martello, & Gerdt, 1981, Experiment 3). Finally, depressed patients showed greater memory deficit for unstructured than structured material but only when word lists of medium and high levels of structure were compared. However, the opposite pattern held true when word lists of low and medium levels of structure were compared (Watts, Dalgleish, Bourke, & Healy, 1990).

One study suggests that severely depressed patients are unable to use syntactic structure or semantic cues even when such organization is provided in the stimulus materials. Levy and Maxwell (1968) found that the recall of severe depressives, schizophrenics, and controls was equivalent when no contextual relationships existed in the lists to be remembered. However, depressed and schizophrenic subjects, compared with controls, did not benefit from increased contextual constraint.

Some studies suggested that depressed patients may impose organization during learning but may not take advantage of that organization at recall. Russell and Beekhuis (1976) found that acute psychotic depressives, schizophrenics, and normal subjects did not differ in initial categorization when sorting nouns; however, patients' recall and clustering at recall were inferior to that of normal controls. In one study (Weingartner et al., 1981, Experiment 2), moderately depressed inpatients, as opposed to controls, imposed more organization during the

learning phase of the experiment when instructed to sort random words into categories. Despite this, patients recalled fewer random words than controls recalled but the same number of related words. In another study, depressed patients clustered related words less at recall when the words were presented in a random arrangement (Weingartner et al., 1981, Experiment 3). Similarly, Calev and Erwin (1985) found that hospitalized depressed patients clustered items less than normals clustered items at recall.

Summary: Taken together, organization and clustering studies provide fairly consistent but limited evidence suggesting that interference in these subskills occurs depending on the severity of depression and on the degree of effortfulness of the task. Moderately depressed patients (e.g., Weingartner, 1986, Experiment 1, Protocols 3 and 4; Weingartner et al., 1981, Experiments 2 and 3) seem to manifest deficits when tasks call for the imposition of organization or structure but not when tasks provide organization or structure. The reasons for this remain unclear. Some studies suggested that depressives, as opposed to nondepressives, initially impose as much or more structure. It may be that moderately depressed patients are unable to both impose structure (Weingartner, Cohen, Bunney, Ebert, & Kaye, 1982) and encode it deeply. One study (Levy & Maxwell, 1968) indicated that severe depressives may not even be able to perceive or take advantage of structure that is imposed by others.

Semantic encoding. The encoding of semantic material compared with nonsemantic material is thought to require greater cognitive capacity (Tyler et al., 1979) or attention (Gjerde, 1983) and is therefore more effortful in nature. Semantic encoding is also more likely to require "deeper" processing or elaborative rehearsal (Craik & Lockhart, 1972). In addition, elaborative rehearsal appears to be an effortful process (Hasher & Zacks, 1979). Several studies documented associations between depression and deficits in semantic encoding.

Clinical samples. Research indicates that depressed patients exhibit deficits when recalling semantically processed material. In a typical study, depressives and controls produced either a semantically related (e.g., window) or an acoustically related (e.g., mouse) response to each stimulus word (e.g., house). Depressed patients exhibited deficits relative to normals when recalling semantically, but not acoustically, processed words (Weingartner et al., 1981, Experiment 1; see Weingartner, 1986, Experiment 1, Protocols 1 and 2 for similar results). Depressed patients also performed more poorly than normal controls when recalling noun pairs after making comparative judgments about them (Roy-Byrne et al., 1986, Procedure 1). Encoding deficits in depressed patients may be compensated for by providing subjects with their own associates as retrieval cues (Weingartner, 1986, Experiment 2).

Nonclinical samples. In one study, subjects classified as depressed by psychometric criteria showed impairment in semantic encoding. Hasher and Zacks (1979, Experiment 4) presented depressed and nondepressed students with words for study. The subsequent recognition test consisted of target words, semantic and acoustic associates of the targets, and words unrelated to the targets. Depressed subjects chose fewer incorrect semantic associates than did nondepressed subjects, suggesting less semantic processing of the targets by depressives.

Table 5
Effortful Encoding Processes in Depression

Study	Subjects	Measure of depression	Task	Result
Organization				
Clinical samples				
Calev & Erwin (1985)	Hospitalized unipolar depressives	Diagnosis by at least 2 psychiatrists	Free recall	D clustered less than NC
Levy & Maxwell (1968)	Severe inpatient depressives, schizophrenics, & nonpsychotic controls	Patients considered severely depressed enough to need ECT	Recall word lists with no contextual constraint or complete sentences	Overall recall of controls better than patients; controls better able to benefit from contextual constraint
Russell & Beekhuis (1976)	Acute psychotic depressives, schizophrenics, & controls	Clinical files; consultation with hospital medical staff	Sort & recall nouns from conceptual groups	No difference in initial categorization; patients' recall & clustering at recall inferior to normals
Watts, Dalglish, Bourke, & Healy (1990)	Patients with major depression	RDC, Hamilton, clinical interview	Recall word lists of high, medium, & low structure	D < NC more for lists of medium vs. high structure; D < NC more for lists of medium vs. low structure
Weingartner (1986; Experiment 1, Protocols 3 & 4)	Inpatients at least moderately depressed	RDC, Bunney-Hamburg, Hamilton	Organize & recall unrelated and related words	D < NC only when words unrelated
Weingartner, Cohen, Murphy, Martello, & Gerdt (1981; Experiment 2)	Moderately depressed inpatients with unipolar major depression	RDC, Hamilton	Sort & recall related or random words	No difference in grouping or recall of related words; D vs. controls imposed more organization on random words & recalled fewer of them
Weingartner, Cohen, Murphy, Martello, & Gerdt (1981; Experiment 3)	Inpatients with major depression	RDC	Recall of highly organized & randomly arranged word lists	D < NC only when words randomly arranged
Semantic encoding				
Clinical samples				
Roy-Byrne, Weingartner, Bierer, Thompson, & Post (1986; Procedure 1)	Hospitalized unipolar & bipolar major depressives	RDC, Bunney-Hamburg	Make comparative judgments of noun pairs and recall pairs later; tell which judgment made	D impaired only on free recall
Weingartner (1986; Experiment 1, Protocols 1 & 2)	Inpatients at least moderately depressed	RDC, Bunney-Hamburg, Hamilton	Produce semantic or acoustic associate to words; freely recall	D < controls only in semantic condition
Weingartner (1986; Experiment 2)	Inpatients at least moderately depressed	RDC, Bunney-Hamburg, Hamilton	Produce semantic or acoustic associate to words; freely recall or cued recall given own associate as cue	D < NC only on free recall
Weingartner, Cohen, Murphy, Martello, & Gerdt (1981; Experiment 1)	Moderately depressed inpatients with unipolar major depression	RDC, Hamilton	Produce semantic or acoustic associates to concrete words; recall 24 hr later	D < NC only in semantic condition
Nonclinical samples				
Hasher & Zacks (1979; Experiment 4)	Students	BDI	Word recognition among distractors including semantic associates, acoustic associates, & unrelated words	No difference in total errors; D vs. ND chose fewer incorrect semantic associates

Note. BDI = Beck Depression Inventory; D = depressives; ECT = electroconvulsive therapy; NC = normal controls; RDC = Research Diagnostic Criteria.

Summary: Semantic encoding is presumably more effortful than acoustic encoding. Although the number of studies is limited, existing research has consistently demonstrated that depressed individuals are deficient in recalling words encoded semantically versus acoustically during the depressive episode. As yet, there is no evidence from these studies that interference in semantic encoding depends on the severity of depression.

Unanswered questions remain regarding the reason for semantic encoding deficits. First, is it that depressives cannot or do not engage in extensive semantic encoding? It may be that depression reduces available cognitive capacity so that depressives are unable to engage in semantic processing, which requires attentional resources. Alternatively, available cognitive capacity may not be reduced in depressed individuals. Instead, deficits may occur because depressives do not rehearse semantic associates as often as nondepressives do. For example, Hasher and Zacks (1979) argued that both associatively and acoustically related words were automatically activated on initial list presentation in their experiment. They attributed depressives' reduced choice of semantic distracters in the recognition test to rehearsal of fewer distracters or, alternatively, to less active rehearsal of distracters. This last explanation suggests that depressives may use available attentional resources to engage in a less effective, qualitatively different type of rehearsal. Specifically, depressives may engage in fewer elaborative processes or more "shallow processing."

Reading

For fluent readers, word recognition is an automatic process, whereas reading comprehension is effortful in nature (LaBerge, 1973; LaBerge & Samuels, 1974; Stanovich, 1980). A number of studies examined the relationship between depression and reading (Table 6).

Clinical samples. Depressed patients have not shown deficits on word-recognition tests (Robertson & Taylor, 1985; Staton et al., 1981).

Nonclinical samples. Depression in children was not related to reading performance on the Wide Range Achievement Test (Brumbach et al., 1980; Jastak & Jastak, 1965), a test of word recognition. However, Goldstein and Dundon (1987; Goldstein & Paul, 1983) found an association between depression and reading performance on the Woodcock Reading Mastery Test (Woodcock, 1973). The Woodcock Reading Mastery Test includes a measure of reading comprehension. One study (Henderson, 1987) found that fifth graders' depression was not related to Woodcock Word Identification or Word Attack scores but was related to overall comprehension scores.

Summary: The limited number of existing studies consistently demonstrates that depressive deficits occur on tests of reading comprehension (presumed to be relatively effortful) but do not occur on tests of word recognition (presumed to be relatively automatic). No evidence yet exists to indicate that this relationship depends on severity of depression.

The question arises as to whether depressed children have difficulty with reading because emotional problems have kept them from attending school or paying attention, and hence learning to read, or whether current depression interferes with their previous level of attained proficiency. The Goldstein and

Paul (1983) study involved learning-disabled subjects, some of whom were also socioemotionally disturbed. Goldstein and Paul (1983) observed the highest correlation between depression and reading deficits in the socioemotionally disturbed group. Henderson (1987), in contrast, excluded developmentally delayed, learning-disabled, and/or disturbed children in his study. Taken together, this suggests both that emotional problems interfere with learning to read and that current depression interferes with reading performance.

Speed of Performing

Tasks typically used to measure cognitive and motor speed require the attention of the subject and are neither innate nor highly practiced. Thus, these tasks are essentially effortful in nature. Numerous studies evaluated speed of performing in depressed individuals (Table 7).

Clinical samples. Research with depressed patients has generally demonstrated that slow rates of performance as indexed by the Digit Symbol subscale of the WAIS (Wechsler, 1955) and similar tests are an indication of depression and of severity of psychopathology in general regardless of a patient's diagnostic category (Cole & Zarit, 1984; Fisher, 1949; Friedman, 1964; Hart, Kwentus, Wade, & Hamer, 1987; Payne & Hewlett, 1960; Staton et al., 1981). In contrast, Beck, Feshbach, and Legg (1962) found that Digit Symbol subscale scores were not significantly related to psychiatrists' ratings of depth of depression or to BDI severity scores. However, scores were related to severity of psychiatric illness without regard to nosological group.

Additional studies with depressed patients demonstrated that psychomotor retardation on measures other than the Digit Symbol subscale may be an index of depression (Friedman, 1964; Hall & Stride, 1954; Hemsli et al., 1968; Payne & Hewlett, 1960; Shakow & Huston, 1936; Shapiro & Nelson, 1955; Weckowicz, Nutter, Cruise, & Yonge, 1972; Weckowicz, Tam, Bay, Collier, & Beelen, 1981; Weckowicz et al., 1978; see Miller, 1975, for a review).

Some studies showed (Payne & Hewlett, 1960; Robertson & Taylor, 1985; Staton et al., 1981) and some did not show (Gur, 1979, Experiment 2; Loeb, Beck, & Diggory, 1971) that cognitive speed is impaired in depressed patients.

Nonclinical samples. Few studies exist of speed of performance in nonclinical samples. Mildly depressed college students were slower than controls on a digit symbol test (Berndt & Berndt, 1980). Similarly, children who endorsed more depressive symptoms had longer latencies and more errors on the Matching Familiar Figures Test (Schwartz, Friedman, Lindsay, & Narrol, 1982).

Summary: Motor and cognitive speed tasks are presumably effortful. Taken together, numerous studies, with only one exception, provide consistent evidence that depression interferes with motor speed and that the degree of interference is related to the severity of depression. It is unclear whether deficits in motor speed are unique to depression or characteristic of psychopathology in general. The evidence is mixed as to whether depression interferes with cognitive speed. Williams et al. (1988) suggested that psychomotor retardation occurs in all depressed patients, whereas cognitive retardation occurs only in

Table 6
Effortful Processes in Depression: Reading

Study	Subjects	Measure of depression	Task	Result
Clinical samples				
Robertson & Taylor (1985)	Unipolar, bipolar, & reactive depressed male prisoners	Hospital case notes & interview	Schonell Graded Word Reading Test	No depressive deficits
Staton, Wilson, & Brumback (1981)	6- to 13-year-old major depressives	DSM-III symptom questionnaire, CDRS, CDI	WRAT-reading	Remission of depression not associated with improved performance
Nonclinical samples				
Brumback, Jackway, & Weinberg (1980)	Prepubertal children with school problems & depression	Experimenter criteria based on parent & school reports	WRAT-reading	No relationship between depression & performance
Goldstein & Dundon (1987)	LD/SED depressives	CDI	Woodcock Reading Mastery test	Degree of depression related to reading performance
Henderson (1987)	5th-grade students	CDI	Woodcock Reading Mastery test	Depression inversely related to comprehension, but not related to word identification or word attack

Note. CDI = Children's Depression Inventory; CDRS = Children's Depression Rating Scale; DSM-III = *Diagnostic and Statistical Manual of Mental Disorders, third edition*; LD/SED = learning disabled/socioemotionally disturbed; WRAT = Wide Range Achievement Test.

endogenous depressives (see Cornell, Suarez, & Berent, 1984, for support of this hypothesis).

Hypothetical Causal Mechanisms

How does depression interfere with effortful processing of neutral material? In this section, we discuss reduced cognitive capacity and narrowing of attention to focus on task-irrelevant or specifically depression-relevant thoughts as possible mechanisms for interference in effortful processes by depression. We do not view these causal hypotheses as mutually exclusive. Hence, we also discuss a third hypothesis termed the capacity-reduced, negative-focus hypothesis, which integrates components of each of the other hypotheses. After discussing the hypotheses, we review the limited evidence related to testing them.

Cognitive Capacity-Reduction Hypothesis

According to the cognitive capacity-reduction hypothesis, total cognitive capacity is reduced (but not eliminated) in depressed individuals, resulting in fewer attentional resources for performing effortful tasks. The degree of capacity reduction, and hence the degree of interference in effortful processes, is thought to be positively related to the severity of depression.

The notion that depression might constrain capacity was first introduced by Hasher and Zacks (1979). They pointed out that available data on loss of memory and efficiency in depression are compatible with the hypothesis that these deficits are due to a reduction in cognitive capacity among depressed individuals. Hasher and Zacks proposed that states that are typically thought to influence cognitive capacity such as depression

and arousal, affect effortful processes that require attention but do not affect automatic processes. Similarly, Schneider, Dumais, and Shiffrin (1984) stated that "any physiological or psychological effects that *reduce capacity* [italics added] should primarily affect the performance of control processes and have only a minor effect on automatic processing" (p. 15). The capacity-reduction hypothesis was later refined to propose that the degree of reduction in cognitive capacity is directly proportional to the severity of depression (Hasher, Rose, et al., 1985; Hasher, Zacks, Rose, & Doren, 1985; Mayer & Bower, 1985).

Why would depression reduce total cognitive capacity? First, biological mechanisms have been implicated (Roy-Byrne et al., 1986; Schneider et al., 1984). Roy-Byrne et al. (1986) suggested that depression may selectively impair effortful (capacity-demanding) processes as opposed to automatic processes by interfering with the effects of the neurotransmitter dopamine.⁷ Simi-

⁷ Roy-Byrne et al. (1986) presented circumstantial evidence in support of their hypothesis. Dopaminergic dysfunction has been implicated in the physiology of depression (Post, Cutler, Jimerson, & Bunney, 1981). Furthermore, some antidepressant drugs may affect the dopaminergic system (Fibiger & Phillips, 1981; Halaris, Belendiuk, & Freedman, 1975; Jimerson & Post, 1984). Dopamine is one of the catecholamines; and in one study (Reus, Silberman, Post, & Weingartner, 1979), catecholamine agonists (activators) improved performance on free recall (presumably a more effortful process) but not on cued recall (presumably a less effortful process). Parkinson's disease and depression appear to impair effortful, but not automatic, processes (Weingartner, Burns, Diebel, & LeWitt, 1984), and Parkinson's disease is thought to result from insufficient dopamine. Furthermore, Parkinsonian-like symptoms may be relieved by L-dopa, a precursor to dopamine. Finally, one study (Henry et al., 1973) found that administration of L-dopa during depression improved free recall. Interestingly, L-dopa

larly, Brewin (1989) stated that acute stress may diminish neural activity in anatomical structures serving conscious (effortful) processing and transfer control to nonconscious processes.

Second, reduced cognitive capacity and impaired performance on effortful tasks in depression may result from either low or high arousal. This is suggested by the Yerkes-Dodson law (1908), which states that performance is a U-shaped function of arousal. Furthermore, Kahneman (1973) assumed that momentary capacity varies as a function of arousal. According to Kahneman, the effects of low and high arousal on performance are due to different mechanisms. The failure of the under-aroused subject is attributable to insufficient motivation. If we assume that low arousal is a characteristic of depression (Henry et al., 1973), then reductions in functional cognitive capacity in depression may result from decreased arousal, leading to decreased effort invested in a task. However, notice that this is a motivational hypothesis (see Overview). It does not explain why available cognitive capacity is reduced. Instead, it accounts for the amount of capacity that is actually being used at the moment.

If we assume that high arousal is a characteristic of depression and follow Kahneman's (1973) line of reasoning, then depression should narrow attentional focus. Kahneman explained that high arousal restricts the range of cues among which attention may be divided and also disrupts control of selective attention. Similarly, Mandler (1975) suggested that arousal narrows attention when internal autonomic signals and thoughts about the conditions that generated those signals occupy cognitive capacity.

Narrowing of Attentional Focus Hypothesis

According to the narrowing of attentional focus hypothesis, total cognitive capacity is not reduced in depressed individuals. The two forms of the hypothesis state that depressives primarily use their attentional resources to focus on (a) task-irrelevant thoughts or (b) specifically depression-relevant thoughts. As a consequence, fewer attentional resources are available for task performance, resulting in depressive deficits in effortful processes.

The process-product distinction (e.g., Ingram & Wisnicki, 1991) becomes important in clarifying this hypothesis. Note that the hypothesis states that the *products* (i.e., the task-irrelevant or specifically depression-relevant thoughts) of depressives' cognitive processes take up cognitive capacity. We later argue that depressives appear to *process* self-relevant content (which for depressives is presumably negative content) automatically and without interference to cognitive functioning. To best explain what at first may seem like a contradiction, we refer back to the example of "a thought just popped into my mind." Paradoxically, thoughts (the product) that are produced (a process) without interference may be highly likely, once generated, to take up capacity.

Note also that numerous studies demonstrated that depres-

sives selectively process depression-relevant information (see Effortful Learning of Negative Mood Congruent Material). This is not in question. However, the narrowing of attentional focus hypothesis states that depressives' selective processing of depression-relevant material is the cause of reductions in attentional resources available for task performance.

Several theorists (Baddeley, 1972; Cailaway & Dembo, 1958; Easterbrook, 1959) proposed that emotional states produce a narrowing of attention. The concept of cognitive interference in depression was used as early as 1960, when Payne and Hewlett hypothesized that depressives are distracted by their negative thoughts and worries. Payne and Hewlett seemed to imply that attentional resources are used by internal thoughts, not leaving enough available cognitive capacity to perform tasks well. More recently, Ingram (1984b; Ingram & Wisnicki, 1991) argued that depressives' available processing capacity is occupied by depression-related cognitions. Contemporary theories that emphasize the predominance of negative thinking in depressed individuals are consistent with the narrowing of attentional focus hypothesis, although many do not address the issue of cognitive resources directly. Beck (1967, 1991), for example, suggested that depression develops when negative schemata (i.e., memory structures) "preempt" more adaptive schemata. Pyszczynski and Greenberg (1987) proposed that self-regulatory perseveration and a self-focusing style on the part of depressed individuals may contribute to difficulty concentrating on current tasks. Rehm (1977) proposed that depressed individuals selectively monitor negative events. Lewinsohn's model (Lewinsohn, Hoberman, Teri, & Hautzinger, 1985) suggests that self-focused attention produces negative alterations in cognition.

Why would attention narrow when one is depressed? Several reasons (including high arousal as described previously) have been suggested in the literature. Most cognitive psychologists (e.g., Hasher & Zacks, 1979; Shiffrin & Schneider, 1977) explain effortful and automatic processing in terms of network theory (e.g., Bower, 1981). Ingram's (1984b) information-processing model of depression, which is also based on network theory, suggests a possible mechanism for the narrowing of attention in depression. According to Ingram and Wisnicki (1991):

Certain cognitive associative networks are linked to the affective structures responsible for the initiation of each emotion. When the structure for sadness or depression is activated . . . depression-linked networks are then activated and become operational in the individual's cognitive functioning. The activation of these networks has several effects: available processing capacity is occupied with the recycling of depression-related conditions [*sic*], associated cognitive networks are energized through spreading activation processes, and cognitive processes associated with these networks (e.g., . . . processing of information) are negatively affected. (p. 189)

Other authors attributed cognitive interference in depression to impaired inhibitory processes, allowing too much information into working memory. Kuhl (1984), for example, proposed that depressed mood states are maintained when unfulfillable intentions claim working-memory capacity that is needed for processing new fulfillable intentions. Similarly, Hasher and Zacks (1988) criticized earlier capacity-reduction frameworks and proposed that inefficient inhibitory processes that nor-

did not improve depression ratings. In contrast, lithium carbonate and imipramine did not improve free recall but did improve depression ratings.

mally limit access to working memory by "nongoal path" information account for cognitive deficits in the elderly. Hasher and Zacks and others (e.g., Hertel & Rude, 1991) suggested that the framework might be extended to understanding memory breakdowns in the emotionally ill. Hasher and Zacks's formulation is compatible with our explanation that thoughts produced without interference may be very likely to enter working memory and reduce available cognitive capacity. Alternatively, depressed individuals may be cognitively inflexible and have difficulty switching their attention to focus on the task.

Capacity-Reduced, Negative-Focus Hypothesis

The capacity-reduced, negative-focus hypothesis combines aspects of both of the other hypotheses. According to this hypothesis, cognitive capacity is reduced in depressives, and depressives primarily use the attentional resources that remain to focus on depression-relevant thoughts.

In 1988, H. C. Ellis and Ashbrook identified and incorporated both capacity-reduction and narrowing of attentional focus hypotheses into their resource allocation model. H. C. Ellis (1991) emphasized that at least two possibilities can occur: (a) Some portion of depressives' total cognitive capacity can be preempted by thinking about their sad state, extratask processing (i.e., cognitive activities that are directed toward events other than the criterion task), and irrelevant-task processing (i.e., processing features of the task that are not related to the outcome measures set by the examiner); and (b) sad or depressed mood can quantitatively reduce cognitive capacity. Although Ellis and Ashbrook stated that both capacity reduction and narrowing of attentional focus can occur, the capacity-reduced, negative-focus hypothesis states that both processes do indeed occur, often resulting in a synergistic effect.

How would this work? A possible explanation of this hypothesis includes elements of explanations given for both the capacity-reduction and the narrowing of attentional focus hypotheses. Specifically, it may be that depression is associated with dysfunction in the dopaminergic system, resulting in selective impairment of effortful processes and that remaining cognitive capacity is primarily occupied by recycling task-irrelevant and specifically depression-relevant thoughts.

Evidence Relevant to Testing Hypothetical Causal Mechanisms

In this section, we suggest types of studies that could be used to test the causal mechanism hypotheses and review the limited evidence that exists relevant to these hypotheses. There are clearly not enough studies in this area.

One difficulty in testing the various hypothetical causal mechanisms is that there has been a failure to develop satisfactory measures of available cognitive capacity. The secondary task procedure may be the best available method of capacity measurement (Hasher & Zacks, 1988). Using this procedure, subjects are asked to perform a primary task in conjunction with a secondary task such as responding to a probe signal. The slower the response to the probe signal, the greater the cognitive capacity presumably being expended on the primary task.

The probe-signal paradigm might be extended to test the

various causal hypotheses. In the typical secondary task procedure, the probe signal is neutral (e.g., a tone). Suppose that instead the probe signal was either a negative, a neutral, or a positive word. If the narrowing of attention to focus on depression-relevant thoughts hypothesis is true, depressives should be primed to respond faster to a negative word probe than to a neutral or positive word probe. Also according to this hypothesis, the total cognitive capacity of depressives is equal to the total cognitive capacity of nondepressives. Hence, depressives' total latency of response to probe words (i.e., latency of response to negative plus neutral plus positive probe words) should be equal to nondepressives' total latency of response to probe words. From the first two predictions, we derive a third prediction: Depressives' latency to nonnegative (i.e., neutral plus positive) probe words must be slower than nondepressives' latency to nonnegative probe words. This line of reasoning can be extended to make predictions regarding the other hypotheses. To our knowledge, no experiments have been performed using this "word-probe-signal" paradigm.

We are aware of only two studies that use a secondary task procedure relevant to testing the causal mechanism hypotheses. Ingram's (1984a) study was conducted with subjects who had each been given a mood-induction procedure. Results of the study support the narrowing of attention to focus on depression-relevant thoughts hypothesis. Subjects in the experiment processed unfavorable and favorable feedback while performing the secondary task of responding to a neutral probe signal. As predicted by the hypothesis, the total latency of response to the probe signal (i.e., latency of response to the probe signal while processing unfavorable plus favorable feedback) was the same for negative-mood subjects as for subjects in each of the other mood conditions. Also consistent with the hypothesis, negative-mood subjects, as opposed to neutral- or positive-mood subjects, responded more slowly to the probe signal when processing unfavorable feedback.

In another study (Hertel & Rude, 1991; see also Strack, Blaney, Ganellen, & Coyne, 1985), subjects decided whether words sensibly completed corresponding sentence frames while responding to a secondary probe signal. The extent to which subjects were required to focus their attention on the target words was varied. Depressed subjects relative to nondepressed subjects recalled fewer words in the unfocused-attention condition, but not in the focused-attention condition. H. C. Ellis et al. (1984, Experiment 3) conducted a similar experiment, but they did not include a focused-attention condition. Ellis et al. found that depressed-mood, as opposed to neutral-mood, subjects recalled fewer words from difficult-to-complete sentences. They concluded that the depressed state appears to be associated with decreased semantic processing and decreased cognitive capacity allocated to tasks. Ellis et al.'s experiment is frequently cited to support the cognitive capacity-reduction hypothesis. However, the results of Hertel and Rude's (1991) study demonstrated that when depressed subjects were required to focus their attention, they did have sufficient cognitive capacity to perform the primary task. Thus, results are more consistent with the narrowing of attentional focus hypothesis. H. C. Ellis (1991) pointed out that results are not contrary to H. C. Ellis and Ashbrook's (1988) resource allocation model. Interestingly, depressed subjects' latency of response to the probe signal in

Table 7
Effortful Processing in Depression: Psychomotor Retardation

Study	Subjects	Measure of depression	Task	Result
Clinical samples				
Beck, Feshbach, & Legg (1962)	Psychiatric patients in different nosological categories	Psychiatrists' ratings of depth of depression; BDI	Wechsler Digit Symbol subscale	Performance not related to depth or severity of depression but related to severity of illness
Cole & Zarit (1984)	Moderately to severely depressed inpatients (average age, 63 years)	RDC, BDI	Wechsler Digit Symbol subscale	D < healthy subjects; D = physically ill
Cornell, Suarez, & Berent (1984)	Inpatients with major or minor depression	RDC, SADS, DACL, Hamilton	Reaction time tasks of varying difficulty	Performance decreased as a function of increased task difficulty & level of depression
Fisher (1949)	Veterans whose primary symptom (vs. diagnosis) was clinical depression judged suitable for ECT	Feeling & Attitude Scale	Wechsler-Bellevue Digit Symbol subscale	Speed increased with improved clinical states
Friedman (1964)	Depressed inpatients (average age, 58 years)	Independent diagnoses by trained raters	Wechsler Digit Symbol subscale, tapping test, reaction time test	D < C on Digit Symbol and last trial of reaction time; D = C on tapping test
Gur (1979; Experiment 2)	Short-term inpatient depressives with history of previous depression	Diagnosis by treatment team based on exam, observation, history, psychological tests	Detect difference between altered pictures	Schizophrenics, but not D, slower than C
Hall & Stride (1954)	Endogenous & reactive depressed inpatients		Reaction time tasks	Decreased reaction time for D clinically improved; NC > neurotics > D > schizophrenics
Hart, Kwentus, Wade, & Hamer (1987)	Outpatients with major depression	<i>DSM-III</i>	Wechsler Digit Symbol subscale	D < C
Hemsi, Whitehead, & Post (1968)	Depressed inpatients referred for ECT	Hamilton	Digit copying test	Speed improved with clinical improvement
Loeb, Beck, & Diggory (1971)	Depressed clinic outpatients & matched controls	BDI, psychiatrist's rating of depth of depression	Card sorting	D = C
Payne & Hewlett (1960)	Endogenous depressed inpatients	Identification by doctor	Nufferno speed tests, writing speed, Babcock-Levy Substitution Test, USES Manual & Finger Dexterity Tests, Three Squares Test	D < schizophrenics < neurotics < NC; except schizophrenics slowest on Three Squares Test
Robertson & Taylor (1985)	Unipolar & bipolar psychotic depressed male prisoners	Hospital case notes & interview	Identity & match letter or figure	D < NC
Shakow & Huston (1936)	Male manic-depressive inpatients	Diagnosis by psychiatrists & psychiatric staff	Speed of tapping	Manic-depressives slower than normals but faster than schizophrenics
Shapiro & Nelson (1955)	Female patients	Agreement of at least 2 psychiatrists	Error-free speed tests including portions of the Babcock Mental Efficiency Test & Nufferno	Speed increasingly slow in normals, neurotics, acute schizophrenics, manic-depressives, & chronic schizophrenics
Staton, Wilson, & Brumback (1981)	6- to 13-year-old major depressives	<i>DSM-III</i> , CDRS, CDI, symptom questionnaire	Matching Familiar Figures Test, WISC-R Coding subscale	Remission of melancholic depression associated with increased speed

Table 7 (continued)

Study	Subjects	Measure of depression	Task	Result
Clinical samples (continued)				
Weckowicz, Nutter, Cruise, & Yonge (1972)	Depressed patients	BDI	Simple reaction time test	D < matched controls
Weckowicz, Tam, Bay, Collier, & Beelen (1981)	Endogenous & reactive unipolar depressed inpatients	DSM-II (Canadian version), BDI, LPD	Psychomotor speed test	D deficient on 4 of 5 tests
Weckowicz, Tam, Mason, & Bay (1978)	Depressed inpatients	BDI, psychiatrist's diagnosis per Canadian adaptation of DSM-II	10 speed tests	D < psychiatric C
Nonclinical samples				
Berndt & Berndt (1980)	Students	MDI, BDI	Wechslerlike test, writing speed	D < C
Schwartz, Friedman, Lindsay & Narrol (1982)	Children	Endorsement of depressive symptoms on self-report measure	Matching Familiar Figures Test	Depression associated with longer latencies & more errors

Note. BDI = Beck Depression Inventory; C = controls; CDI = Children's Depression Inventory; CDRS = Children's Depression Rating Scale; D = depressives; DACL = Depression Adjective Checklist; DSM-III = *Diagnostic and Statistical Manual of Mental Disorders, third edition*; ECT = electroconvulsive therapy; LPD = Levine-Pilowsky Depression Questionnaire; MDI = Multiscore Depression Inventory; RDC = Research Diagnostic Criteria; SADS = Schedule for Affective Disorders and Schizophrenia; USES = United States Employment Service; WISC-R = Wechsler Intelligence Scale for Children-Revised.

the focused condition of the experiment was longer than that of nondepressed subjects. This could mean that depressives, relative to nondepressives, were expending more attentional resources on the primary task; or it could mean that depressives were expending more attentional resources on the primary task plus depression-relevant thoughts, resulting in a slower response to the probe signal. The word-probe-signal paradigm suggested previously could be used to test these hypotheses.

Studies of the "distraction effect" are consistent with both the narrowing of attention to focus on depression-relevant thoughts hypothesis and with the decreased-motivation form of the capacity-reduction hypothesis. Research suggests that distraction leads to improvement in depressives' performance on motor speed tasks (see Miller, 1975; Williams et al., 1988, for reviews). In a typical study, Foulds (1952) administered subjects a maze test under standard and distraction conditions. While performing on the distraction form of the maze, subjects repeated numbers after an experimenter. Distraction significantly improved depressives' speed of maze completion (but also increased errors). A distracter presented by the experimenter may use less cognitive capacity than the depressive's own negative thoughts, which are connected to a large associative network of memories, worries, and feelings. Alternatively, the results of distraction studies are consistent with the decreased-motivation form of the capacity-reduction hypothesis. Results of distraction studies may be explained by assuming that depression is characterized by low arousal. Distraction may increase arousal and thereby increase the effort that depressed subjects invest in the task.

Analogous predictions can be made regarding studies in which subjects have been asked to remember positive, neutral, and negative words. To view these studies as tests of the causal

mechanism hypotheses, it must be assumed that the extent of recognition or recall is an indication of the cognitive capacity expended on the task. All of the hypotheses can account for the consistent finding that depressed subjects, relative to nondepressed subjects, remember more negative words. However, findings in some studies (e.g., Balin, 1984; Dunbar & Lishman, 1984) that depressed and nondepressed subjects remember the same number of words overall tend to support the narrowing of attention to focus on depression-relevant thoughts hypothesis.

Studies in which performance deficits characteristic of depressives are simulated or induced among nondepressed subjects also indirectly support the narrowing of attention to focus on depressive-relevant thoughts hypothesis. These studies indicate that performance deficits similar to those found in depressives can occur as the result of interference by task-irrelevant thoughts. Deficits typical of those found in depressives were produced in normal subjects by adding a secondary task (Krames & McDonald, 1985). In addition, inducing increased self-reflection after failure contributed to subsequent performance deficits (Kuhl, 1981; Strack et al., 1985).

Summary

Studies that provide evidence relevant to the causal mechanism hypotheses tend to support the narrowing of attention to focus on depression-relevant thoughts hypothesis. However, results of some of these studies are not necessarily contradictory to the capacity-reduction or capacity-reduced, negative-focus hypotheses. Future research is needed that directly tests each of these causal mechanism hypotheses and that directly pits each hypothesis against the other.

Is Interference in Effortful Processing Unique to Depression?

Effortful processes appear to be impaired in depression. However, is interference in effortful processing associated only with depression or with psychopathology in general? It is important to establish specificity for several reasons. First, answering questions regarding specificity has implications for ascertaining why depression interferes with effortful processes. For example, if deficits in effortful processing were characteristic of psychopathology in general, then this would tend to support the capacity-reduction hypothesis more than the narrowing of attention to focus on depression-relevant thoughts hypothesis. Furthermore, a great deal of research has been conducted regarding the relationships among automatic and effortful processing and various mental disorders. It is not clear that these conceptual approaches are meaningful in any real sense unless they are specific to the disorder (Ingram, 1990). Finally, a comparison of automatic and effortful processes in various disorders may help to identify appropriate control groups for future research on cognitive processes in depression (Garber & Hollon, 1991).

We now address the degree to which interference in effortful processes is unique to depression or characteristic of psychopathology in general. Studies of effortful and automatic processes in patients with anxiety, schizophrenia, and progressive senile dementia of the Alzheimer's type (SDAT) are reviewed.

Anxiety

Depression and anxiety frequently occur together (e.g., Alloy, Kelly, Mineka, & Clements, 1990), so discovering information-processing differences between them is of particular theoretical interest. Research on cognitive processes in anxiety has primarily been conducted with nonclinical samples (see Eysenck, 1982; Williams et al., 1988, for reviews). Anxious subjects appear to show an automatic-attention response (Shiffrin & Schneider, 1977) to threat-related stimuli (e.g., MacLeod, Mathews, & Tata, 1986; Mathews & MacLeod, 1986; Mogg, Mathews, & Weinman, 1987). Williams et al. contended that a similar automatic-attention response appears to be less associated with depression. It is certainly true that less research (see Sanz & Vázquez, 1992, for review) has been conducted on automatic attentional biases in depression, but whether a similar effect occurs for depressives is still in question. Studies that failed to demonstrate the effect for depressives (e.g., Hill & Dutton, 1989; MacLeod et al., 1986) have often used stimulus materials that appear to have been more anxiety relevant than depression relevant. Williams et al. further suggested that automatic processes in depressives are not negatively biased. However, our review of the existing evidence indicates that depressed individuals automatically process self-relevant content and that, for depressives, content is negatively biased (see Automatic Processing in Depression).

With regard to the effects of anxiety on effortful processing, Eysenck (1982) reviewed evidence and concluded that anxiety is associated with decreased cognitive capacity as a result of worry but with increased effort (in the motivational sense), resulting in anxious people having fewer undeployed attentional re-

sources. Anxiety is often associated with poor performance on hard (and presumably more effortful) tasks and better performance on easy (and presumably less effortful) tasks (see also Kahneman, 1973). Increased effort and better performance on easy tasks are seldom associated with depression. Mood-congruent memory effects have seldom been demonstrated for anxious subjects (Williams et al., 1988) but have consistently been demonstrated for depressed subjects.

Schizophrenia

To our knowledge, there has been no systematic comparison of the types of deficits shown in depression and schizophrenia. However, it appears that schizophrenia interferes with both automatic and effortful processes, whereas depression interferes only with effortful processes. Even some preattentive processes, which are automatic in most people, may be damaged in schizophrenics. For example, schizophrenics seem slower to begin internal cognitive processing of stimuli (Braff & Geyer, 1989; Braff, Saccuzzo, & Geyer, 1991).

There may or may not be differences between schizophrenia and depression regarding the way in which deficits in effortful processes occur. Gjerde (1983) postulated that decreases in effortful processing by schizophrenics reflect high levels of arousal characteristic of the disorder. Nuechterlein and Dawson (1984) suggested that dysfunctions in effortful processing in schizophrenics could result from several factors. First, total cognitive capacity may be reduced. Next, the control function that allocates processing capacity may not respond appropriately to task demands. Third, more processing capacity may be devoted to task-irrelevant external or internal stimuli (e.g., Harvey, Winters, Weintraub, & Neale, 1981; Oltmanns & Neale, 1975). These are generally the arguments made for deficits in effortful processing shown by depressives as well. Some authors (Liberman et al., 1984; Patterson, 1987) suggested that deficits in the initial automatic stages of processing overload the schizophrenic's cognitive system. This requires them to use attentional resources normally available for effortful processes to perform processes that are typically automatic. As a result, decrements in effortful processing occur.

A final difference between depression and schizophrenia is that decrements in effortful processing have been found in people at risk for schizophrenia and in remitted schizophrenics as well as in those who are actively schizophrenic (Nuechterlein, 1986; Nuechterlein & Dawson, 1984), whereas no studies demonstrated decrements in effortful processing in depression-prone individuals or in those who have remitted from depression.

SDAT

Several studies compared cognitive impairments in SDAT and depression (e.g., Abas, Sahakian, & Levy, 1990; Emery & Breslau, 1989). Overall, SDAT patients appear to be impaired on automatic (e.g., frequency judgment, semantic retrieval), relatively automatic (e.g., recognition memory, recall of reminded items, organization, and recall of highly related items), and effortful (e.g., free recall, motor speed) processes, whereas depressed patients appear to be impaired only on effortful pro-

cesses (Grafman, Weingartner, Lawlor, & Mellow, 1990; Hart, Kwentus, Hamer, & Taylor, 1987; Weingartner, 1986, Experiments 4 and 5; Weingartner, Grafman, Kaye, & Martin, 1983; Weingartner & Silberman, 1982).

Summary

Research regarding the effects of specific psychiatric disorders on automatic and effortful processes indicates that depression is unique in that it interferes with effortful processes but leaves automatic processes intact. In contrast, anxious subjects may perform better than normals on easy effortful tasks. Anxious subjects also have not shown mood-congruent memory effects. Schizophrenics and SDAT patients, compared with depressed patients, seem to be impaired on both automatic and effortful tasks, although the mechanism for interference in effortful processing may be different in the two disorders. Deficits in effortful processing have been found in individuals at risk for schizophrenia and in remitted schizophrenics. In addition, no such effects have been demonstrated as yet for depression-prone individuals.

Effortful Learning of Negative Mood-Congruent Material

Depression appears to interfere with effortful processing of neutrally valenced material. In contrast, numerous studies (e.g., Buchwald, 1977; De Monbreun & Craighead, 1977; Kuiper & Derry, 1982; Wener & Rehm, 1975; see Blaney, 1986, for a review; see Matt, Vázquez, & Campbell, 1992, for a meta-analysis) of effortful processing of valenced material indicate that depressed individuals selectively process negative information. In these studies, the experimenters presented subjects with a series of successes and failures; positive and negative feedback; or positive, neutral, and negative words, which were rated for pleasantness. The subject's task was to recall (or recognize) the positive and negative material that had just been presented. In general, depressed subjects, as opposed to controls, overrecalled negative rather than positive material.

Our formulation could account for these results in a manner similar to Bower's (1981) explanation for mood-congruent memory effects. The task in the experiments we described was to recall "events" (e.g., a success experience, presentation of a negative word). This task entails more than simply processing the content of the negative and positive material. It also entails remembering which valenced material was just presented on this particular occasion. Activation of the meaning of depressive self-referent words appears to be highly automated in depressed individuals (see Activation of Self-Referent Content). Activation of negative, as opposed to positive, self-relevant content may occur rapidly in depressed subjects, spread to recently presented negative event material (e.g., a failure experience, negative feedback, presentation of a negative word), and make the negative event more accessible when the subject is remembering which valenced material was just presented.

Automatic Processing in Depression

Automatic Processes Maintained in Depression

There is fairly good evidence that depression interferes only minimally with automatic processes. Few studies directly as-

sess automatic processing in depression. However, those studies that do exist indicate that processes that are automatic for people in general remain essentially intact in depressed individuals (Table 8). Frequency judgments and the meaning of self-referent words (presumably of depressive content) appear to be processed automatically by depressives. One study found no differences in spatial location performance as a function of mood.

In reviewing work on automatic processing, we use various criteria to evaluate whether results support our conclusion. If it has been well demonstrated that a cognitive process (e.g., frequency encoding) is automatic, then findings indicating that the process is performed equally well by depressed and nondepressed individuals are considered sufficient evidence to support our generalization. Alternatively, if a process has not been demonstrated to be automatic for people in general, we attempt to show that the process (e.g., activation of self-referent, and presumably depressive, content) meets the three definitional criteria for an automatic operation (see Table 1) in depressed individuals. If a process has not been demonstrated to be automatic in normal samples, then studies finding performance to be equivalent in normal and depressed groups will only be considered indirect evidence in support of our conclusion. Because there are few studies of automatic processing in depression, we consider studies of clinical and nonclinical samples together.

Frequency Encoding

A large body of evidence suggests that frequency of occurrence is encoded automatically by normals (see Hasher & Zacks, 1984, for a review). Furthermore, judgments of frequency have been shown to be equivalent in depressed individuals and nondepressed controls. In a typical study, Hasher and Zacks (1979, Experiment 3) showed subjects slides of common objects from one to three times and told them that they would be asked to recall the slides later. Both depressed and nondepressed subjects correctly estimated the frequency with which the objects had occurred (see also Golinkoff & Sweeney, 1989; Roy-Byrne et al., 1986, Procedure 2; Weingartner, 1986, Experiment 4). Thus, frequency judgments appear to be made automatically by depressed as well as nondepressed individuals.

Spatial Location Encoding

The encoding of spatial location information is one of the operations that Hasher and Zacks (1979) considered to be automatic. However, several studies (e.g., Naveh-Benjamin, 1988; Waddell & Rogoff, 1987) cast doubt on whether spatial location encoding is a fully automatic process. With regard to depressed samples, Cooper and Marshall (1985) found no differences in spatial location judgments as a function of induced depressed and neutral mood. However, ironically, their study is also one that questions the degree to which the encoding of spatial location is an automatic process. Specifically, they found that the performance of subjects in an intentional learning condition was far superior to that of subjects in an incidental learning condition (but see N. R. Ellis & Rickard, 1989).

Table 8
Automatic Processing in Depression

Study	Subjects	Measure of depression	Task	Criteria ^a	Result
Frequency encoding					
Hasher & Zacks (1979; Experiment 3)	Community adults	BDI	Judge actual & imagined frequencies of common objects	Task well documented to be automatic ^b	D & ND correctly estimated actual frequencies and were equally likely to confuse imagined with actual frequencies
Spatial location					
Cooper & Marshall (1985)	Students given mood induction	Writing speed, DACL	Recall spatial location of geometric figures (intentional & incidental learning conditions)	Evidence supporting & opposing task as being automatic	No difference in spatial location recall depending on mood; recall superior in intentional vs. incidental learning condition
Activation of self-relevant content					
Bargh & Tota (1988)	Students	BDI	Latency of self- vs. other-judgments in memory load or no-load condition	2	D self-judgments of depressive vs. nondepressive adjectives less affected by memory load
Dixom & Lear (1962)	Endogenous & reactive depressed inpatients	Independent assessment by at least 2 psychiatrists	Judge difference in visual threshold while subliminally presenting emotional or neutral words	1, 3	Visual threshold increased for D presented depressive words but not for NC presented emotional words
Gotlib & McCann (1984; Experiment 1)	Students	BDI	Emotional Stroop task	3	D showed longer response latencies to naming colors of depressive vs. neutral or manic words DM = NM = EM
Gotlib & McCann (1984; Experiment 2) MacDonald & Kuiper (1985)	Students given mood induction Clinically depressed patients, nondepressed patients, & student controls	MAACL BDI, diagnosis of unipolar depression in case files	Emotional Stroop task Self-judgments of depressive self-relevant vs. schema-incongruent adjectives under memory load or no-load condition	3 Indirect evidence	D processed self-relevant vs. schema-incongruent adjectives more quickly; no effects of load
Segal, Hood, Shaw, & Higgins (1988)	Unipolar depressed patients, anxiety disorder outpatients, & normal controls	SADS-L, RDC	Stroop task; target word a self-descriptive adjective primed by a related or an unrelated word	3	D chose more negative words as self-relevant; response latencies longer for all subjects when target primed by a related word

Table 8 (continued)

Study	Subjects	Measure of depression	Task	Criteria ^a	Result
Activation of self-relevant content (continued)					
Wenzlaff, Wegner, & Roper (1988; Experiment 1)	Students	BDI-SF	Written stream-of-consciousness report; half of subjects instructed to stop thinking of an imagined incident	3	During third interval of thought stopping, number of intrusive thoughts was higher for D than ND
Williams & Nulty (1986)	Female volunteers	BDI-SF	Emotional Stroop task	3	Higher depression associated with interference in color naming of negative vs. neutral words

Note. BDI = Beck Depression Inventory; D = depressives; DACL = Depression Adjective Check List; DM = depressed mood subjects; E = external; EM = elated mood subjects; I = internal; MAACL = Multiple Affect Adjective Checklist; NC = normal controls; ND = nondepressives; NM = neutral-mood subjects; RDC = Research Diagnostic Criteria; SADS-L = Schedule for Affective Disorders and Schizophrenia-Lifetime; SF = Short Form.

^a Criteria of automaticity tested in this experiment; see Table 1 and Definitions of Automatic and Effortful Processes section.

^b No explicit criterion of automaticity is tested in this experiment. However, studies with nondepressed subjects have evaluated whether the task is automatic.

Activation of Self-Referent Content

Both direct and indirect evidence supports the notion that the meaning of self-referent words (presumably of depressive content) is automatically activated by people who are currently depressed. The meaning of words is retrieved automatically by normal individuals (e.g., Conrad, 1974; Hasher & Zacks, 1979; LaBerge & Samuels, 1974; Posner & Snyder, 1975; Warren, 1972, 1974). Words in well-practiced categories, and specifically self-relevant words, are also highly automated in normal individuals (e.g., Bargh, 1982, 1984; Uleman, Winborne, Winter, & Shechter, 1986). If the continuum of automatic processes is maintained in depressed individuals, it is expected that the meaning of words in general will be automatically retrieved by depressives and that the meaning of self-relevant words (presumably of depressive content) will be automatically retrieved most rapidly. Several researchers conducted studies that are relevant to testing whether self-referent content is automatically activated according to various criteria of automatic processing (see Table 1).

Dixom and Lear (1962) found that depressed inpatients processed depressive content self-relevant words without attention or conscious awareness and without intention or control: the first and third criteria of automaticity. Experimenters measured the point at which a test patch of varying brightness was judged to be equal in brightness to the constantly illuminated background of the left eye while presenting neutral or emotional words subliminally to the right eye. For depressed patients, the emotional words were those determined in an interview to be critical to their pathology. For normals, "cancer," "TB," and "VD" were the emotional words. Depressed, but not normal, subjects showed an increase in visual thresholds after

presentation of emotional words. Emotional words for both depressed and normal subjects contained an emotional component, but only the words presented to depressed subjects were assumed to be self-relevant. The fact that words that were not of depressive content did not produce a tendency for threshold change suggests that the depressive content or self-relevant aspect of the words rather than their emotional component may be critical to automaticity.⁸

Bargh and Tota (1988) showed that depressed college students processed depressive-content self-referent constructs in parallel without interfering with other cognitive operations: the second criterion of automatic processing. Subjects' cognitive capacity was varied by giving half the subjects a six-digit number to keep in short-term memory and the other subjects no memory load, while subjects made "describes you?" or "describes the average person?" judgments about a set of trait adjectives. Depressed subjects' self-referent judgments of depressive-content adjectives (e.g., guilty) were less affected by memory load than were their judgments of nondepressive-content adjectives, indicating relatively automatic processing of the depressive words. Nondepressed subjects showed evidence for processing nondepressive-content, self-rated adjectives automatically. For both depressed and nondepressed subjects, memory load affected judgment times for other-relevant depressive adjectives but did not affect judgment times for other-relevant nondepressive adjectives. This latter finding seems to indicate that both depressed and nondepressed individuals habitually view others as nondepressed.

⁸ The Dixom and Lear (1962) study is not strong because stimuli presented to normal subjects differed in so many ways (e.g., negativity, presumed self-relevance).

Studies using variations of the Stroop paradigm demonstrate that depressives process negative self-descriptors (Segal, Hood, Shaw, & Higgins, 1988; Williams & Nulty, 1986) including depressive symptom words (Gotlib & Cane, 1987) without intention. In a typical study (Williams & Nulty, 1986), high depression was found to be associated with interference in color naming of negative compared with neutral words on the Stroop task.

Gotlib and McCann (1984) also used a variation of the Stroop task to provide direct and indirect evidence that depressive-content, self-relevant constructs are processed automatically by depressed individuals. Depressed subjects showed longer response latencies to naming the colors of depressive content than neutral- or manic-content words. The experimental procedures discouraged subjects from intentionally processing the content of these words, thus supporting the third criterion of automaticity. In a second experiment, Gotlib and McCann found that induction of depressed and elated mood was not sufficient to produce the response-latency effects found in the first experiment. Thus, the results of the first experiment were not attributable to transient mood.

A study by MacDonald and Kuiper (1985) provided indirect evidence for the relative automaticity of processing depressive-content self-relevant words in depressives by demonstrating that depressive-content schema-congruent adjectives were processed more quickly by depressives than schema-incongruent adjectives. Clinically depressed, normal, and nondepressed psychiatric controls rated depressive and nondepressive content adjectives on their self-descriptiveness. Half the subjects also had to remember six digits during each rating trial. Both clinical depressives and nondepressed psychiatric controls processed self-schema-congruent content more quickly than incongruent content. MacDonald and Kuiper (1985) reported also that there were no interactions among memory load, depression status, and adjective content. They contended that this supported their hypothesis that depressive schema-congruent content is processed automatically. However, the null interaction shows only that there is no difference in the attentional requirements of making the judgments as a function of depression status, adjective content, and referent factors. Either all judgment types are automatic, or they are all nonautomatic and equally effortful (Bargh & Tota, 1988). Consequently, the MacDonald and Kuiper experiment does not provide evidence relevant to the second criterion of automatic processing, namely, that the processing does not stress the capacity limitations of the system.

One study indicates that self-relevant depressive content in general, and not simply the meaning of self-relevant depressive words, may be retrieved automatically by depressed people. Wenzlaff, Wegner, and Roper (1988, Experiment 1) demonstrated that depressed people have difficulty suppressing thoughts of negative material and, compared with nondepressed individuals, have less control of such thoughts: the third criterion of automaticity. Wenzlaff et al. asked depressed and nondepressed college students to imagine themselves in either positive or negative situations. Subjects then made a written stream-of-consciousness report, and half were instructed to stop thinking about the imagined incident. In the third 3-min interval measured, the number of intrusive thoughts was higher

for depressed subjects than for nondepressed subjects when incident-related material was negative.⁹

Does Beck's Concept of Automatic Thoughts Fit Empirical Criteria for Automaticity?

In discussing Beck's concept of automatic thoughts in depression, the distinction between process and product (e.g., Ingram & Wisnicki, 1991) is important. Failure to make this distinction has been a source of confusion in the literature (e.g., Daigleish & Watts, 1990). Beck discussed the content of automatic thoughts (the product; e.g., Beck, 1967, 1976) as well as the process by which these thoughts are generated. It is not clear that automatic thoughts as described by Beck are processed automatically according to criteria set forth by cognitive psychologists.

Beck's clinically derived notions about depressive automatic thoughts predated work in cognitive psychology; however, many of his ideas parallel the definitional criteria for automatic processing developed by automatic and effortful processing theorists (e.g., Hasher & Zacks, 1979; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977). Beck distinguished between two types of thinking: higher level or secondary process thinking, involving judgment, weighing of the evidence, and consideration of alternative explanations, and lower level or primary process cognition, which tends to be relatively rapid and does not seem to involve any complicated logical processes. Lower level thoughts are automatic and arise as if by reflex without any apparent antecedent, reflection, or careful reasoning. They have an involuntary quality and occur even when the person resolves not to have them, preempting more rational responses. This is a direct parallel to the third criterion of automatic processing that automatic processes occur without intention. Beck argued that people experiencing mild disturbances may not be aware of their automatic thoughts, even though they are available to consciousness. This is similar to the first criterion of automatic processes, namely, that they take place without attention or conscious awareness. The second theoretically agreed on criterion of automatic processes, that they occur in parallel without interfering with other operations, is also implied by Beck's notion that people are not always aware of their automatic thoughts. When people are unaware of these thoughts, the unconscious thoughts must be taking place simultaneously with the conscious thoughts and behaviors that they are aware of and that the unconscious thoughts may be influencing.

⁹ H. C. Ellis and Ashbrook (1988) and Brewin (1989) suggested that the recall of personally relevant information (e.g., autobiographical information) requires few attentional resources. They cited several studies that show no effect of depression on recall of personally relevant material. Although it has been demonstrated that the meaning of self-relevant trait words is automatically processed (Bargh, 1982), it has not been demonstrated that self-relevant information in general is automatically recalled. Thus, the finding that this process is maintained in depressed individuals only suggests the possibility of automaticity and is only considered indirect evidence for our hypothesis that automatic processes remain intact in depressives. Whether recall of personally relevant information is automatic remains to be demonstrated.

According to Beck (1976), even when depressives are unaware of negative automatic thoughts, the thoughts can still influence their affect and behavior. Even when the person concludes that they are invalid, the thoughts continue to occur until he or she recovers from depression. Similarly, cognitive psychologists are in agreement that automatic thoughts are difficult to suppress or ignore. Furthermore, we have argued that initially unconscious automatic thoughts may later become conscious, interfere with other thoughts, and use processing resources (see Definitions of Automatic and Effortful Processes and Narrowing of Attentional Focus Hypothesis). Beck suggested that automatic responses have a perseverative quality in that the depressed person is prone to interpret the multiplicity and complexity of life situations in terms of a few stereotypical ideas. The discrete, shorthand, telegraphic style of automatic thoughts and their perseverative nature, both described by Beck, are compatible with the notion that highly practiced responses, and more specifically automatic responses, tend to be stereotyped and lack complexity.

Automatic thoughts as described by Beck (1967, 1976; Beck, Rush, Shaw, & Emery, 1979) are distinguished both by the way in which they are processed and by their content. Beck's description of the content of automatic thoughts (i.e., negative views of the self, world, and future) is consistent with evidence indicating that the meaning of self-relevant words (presumably of depressive content) is processed automatically (see Activation of Self-Referent Content).

Are Attributional Inferences Processed Automatically?

More research may have been conducted on attributions than on any other cognitive variable in the depression literature. According to Abramson and her colleagues (Abramson, Alloy, & Metalsky, 1988; Abramson, Metalsky, and Alloy, 1988, 1989), the kinds of attributions people make for negative life events and the degree of importance they attach to these events can increase the likelihood of developing an expectation of hopelessness and, thus, depressive symptoms.

Some cognitive psychologists suggested that attributions and other inferences are made automatically by everyone in the process of comprehending the world (Heider, 1958; Kintsch, 1974; Reder, 1979). Only a handful of studies (Bassili & Smith, 1986; Light & Anderson, 1983; Smith & Miller, 1979, 1983; Winter & Uleman, 1984) attempted to address this issue, however. Although the authors of these studies concluded that attributions seem to be made spontaneously, interpretation of the results is ambiguous (Higgins & Bargh, 1987). Research in social psychology indicates that people are more likely to make spontaneous attributions for negative events than for positive events (Pittman & Pittman, 1980; Pyszczynski & Greenberg, 1981; Swann, Stephenson, & Pittman, 1981; Walster, 1966; Wong & Weiner, 1981), but it is usually thought that these attributions are made in an effortful manner. It may be that attributions are sometimes made automatically and sometimes effortfully. Depressed individuals should be more likely to make attributions automatically for negative events because they have experienced negative outcomes in their lives frequently (Brown & Harris, 1978; Hirschfeld & Cross, 1982; Lloyd, 1980a, 1980b;

Paykel, 1982), and thus attributions for negative events should be well practiced.

One study (Hartlage, 1990; Hartlage & Alloy, 1992) examined whether depressed or depression-prone individuals, as opposed to people in general, sometimes automatically make internal attributions for negative life events or external attributions for positive life events. The experimental task was a modification and extension of a semantic priming paradigm frequently used by cognitive psychologists to assess automatic processes (Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Neely, 1977). This paradigm involves assessing the extent to which presentation of a prime automatically activates concepts that facilitate responding to a target.¹⁰

Hartlage (1990, Hartlage & Alloy, 1992) had subjects decide whether a target cause (e.g., "stupid") was an internal or external cause as rapidly as possible. The concern was the extent to which the presentation of a life event (e.g., "fired from job") as the prime facilitated (i.e., speeded up) this causal judgment. If subjects make causal inferences automatically, presentation of the prime event would be expected to automatically activate attributions normally connected to that event. If the target cause is similar to the previously activated attribution and the interval between prime and target is short, less additional activation is needed for the causal judgment about the target to be made. Responding to a target cause that has received some activation as the result of the presentation of a prime that elicits a congruent attribution should be faster than responding to that same target cause when it is preceded by a prime that elicits an incongruent attribution.

Hartlage (1990; Hartlage & Alloy, 1992) designed the experiment so that all three criteria of automatic processing (see Table 1) were tested. The interval between prime and target presentation (360 ms) was too short for subjects to effortfully attend and make an attribution in response to the prime event (Neely, 1977). Thus, inference processes took place without subjects' attention: the first criterion of automaticity. Second, inferential processes did not stress the cognitive capacity limitations of subjects. This was demonstrated by comparing the speed of subjects' judgments under conditions in which their memory was loaded (e.g., with digits to remember) and not loaded. Loading the subjects' memory should have no effect on attributional inference processes if they are automatic. Finally, the inference processes took place without subject intention. This was accomplished by giving subjects instructions that led them to believe that making attributional inferences was not the experimental task. Results indicated that cognitively depression-prone subjects made internal attributions for negative events and external attributions for positive events automatically. There was no evidence to support the hypothesis that people in general make attributions automatically. The latter finding sug-

¹⁰ Neely (1977), for example, presented category labels (e.g., bird) as primes. He found that, when the target was an exemplar of the prime category (e.g., robin), the subject made decisions about whether the target was a word or nonword faster than when the target was not from the prime category. Facilitation was thought to occur because activation automatically spread from category labels to their associated exemplars.

gests that making depressive-content attributions for negative events may be automated only in depression-prone people.

The Hartlage (1990, Hartlage & Alloy, 1992) study, in and of itself, provides good support for the hypothesis that depression-prone people sometimes automatically make maladaptive attributions for positive events. However, no study is definitive. Much more research is obviously needed in this area.

Negative Automatic Cognitions and Current Depression Versus Depression Proneness

Why would depression, an often temporary condition, be expected to affect content that is automated? If automatic thoughts are highly practiced, would they not exist as well-learned responses in the repertoires of individuals whether or not they are currently depressed? In this section, we discuss whether negative automatic cognitions appear to be associated with current depression or with depression proneness. For purposes of our discussion, we define depression proneness as cognitive vulnerability to depression.

Automatic negative thoughts and attributional inferences may be associated with the depressed state. Most studies support an association among negative attributions, beliefs, and current depressive symptoms (see Blaney, 1977; Coyne & Gotlib, 1983; Peterson & Seligman, 1984; Sweeney, Anderson, & Bailey, 1986 for reviews). If depressed people maintain negative cognitions for long periods of time during the depressed state (e.g., Beck, 1967), they are in effect "practicing" these cognitions while they are depressed. Thus, these negative thoughts and attributions would be more highly practiced and more likely to be made automatically by such individuals whenever they are currently depressed. Along these lines, Shiffrin and Schneider (1977) defined automatic processes as sequences of nodes that nearly always become active in response to a particular input configuration, where the inputs include the general situational context. Furthermore, Shiffrin and Schneider's contextual hypothesis suggests that the activation threshold of an automatic sequence can be lowered by information that is associatively related to the nodes making up the automatic sequence. A depressive-mood state may be the general situational context that is part of the input configuration activating automatic negative cognitive sequences. Furthermore, depressive mood may be associatively related to a negative automatic sequence and thus lower its activation threshold.

Alternatively, negative automatic thoughts may be associated with cognitive vulnerability to depression rather than current depression per se. Beck (1967, 1976) referred to depression-prone rather than currently depressed people when hypothesizing the existence of embedded negative attitudes. Beck posited that depression-prone people have negative self-schemata represented in memory that contain highly practiced depressogenic automatic thoughts. The hopelessness theory also hypothesizes that a particular cognitive style, a negative attributional style, is a contributory cause of depression.¹¹ People who are depression prone by virtue of their negative attributional styles or self-schemata are most likely to have made internal, stable, and global attributions for negative life events frequently and to have had negative thoughts regarding those events often. Thus, these attributions and beliefs are more likely to have been highly

practiced by such cognitively depression-prone individuals and, therefore, to become automatic.

To date, almost no research has been performed on the possible relationships between automatic processes and vulnerability to depression. However, the few studies that exist suggest that automatic negative thoughts may be more closely related to depression proneness than to current depression. Williams and Nulty (1986) found that interference in color naming of negative compared with neutral words on an emotional Stroop task was associated more with depression proneness, as indexed by depression levels determined 12 months earlier, than with current depression. Similarly, Hartlage (1990; Hartlage & Alloy, 1992) found that depressive automatic attributional inferences were more closely related to depression proneness than to current depression.

In what may be the first study using a physiological measure of central processing to demonstrate negative cognitive bias in depression, Blackburn and others (Blackburn, Roxborough, Muir, Glabus, & Blackwood, 1990) found that depressed subjects and recovered depressives had a smaller amplitude of P300 response to negatively toned words than positive words. A P300 response is an endogenous component of event-related potential that occurs at approximately 300 ms after the presentation of an unexpected stimulus. The amplitude of the P300 response is thought to reflect the strength of internal processing. Results suggest that depression-prone individuals have enduring cognitive structures such that they expect depressive stimuli in the environment.

Implications of Our Framework

In this section, we discuss implications of our conceptual framework for understanding depressive clinical features, treating depression, and conducting future research. Areas that seem particularly important to explore are highlighted. The implications discussed are merely suggestive. We leave it for future authors to further develop and empirically evaluate implications of our conceptual framework.

Understanding Depressive Clinical Features

Viewing depression from an automatic-effortful processing perspective may help to answer several questions regarding depressive clinical features: First, how does stress precipitate a depressive episode (e.g., Beck, 1967; Lloyd, 1980a, 1980b; Paykel, 1982); second, how do people become cognitively vulnerable to depression; and, third, why does depression persist?

Stress may engender high levels of arousal, narrow attention to focus on stress-related information (Mandler, 1975), restrict the number of cues among which attention may be divided (e.g., Easterbrook, 1959), disrupt the individual's control over what should be attended to (Kahneman, 1973), and bias memory

¹¹ Both Beck's model and the hopelessness theory recognize the heterogeneity of the depressive disorders (Abramson, Alloy, & Metalsky, 1988; Abramson, Metalsky, & Alloy, 1988, 1989; Alloy et al., 1988; Alloy, Clements, & Kolden, 1985). Other factors such as genetic predisposition, biochemical vulnerability, and interpersonal processes may also result in an individual being vulnerable to depression.

search toward more readily accessible sources of information (Eysenck, 1976). Some people, perhaps as the result of experiences extending over a number of years involving pain or loss (e.g., experiences with attachment figures in childhood; Brewin, 1989), may have a great deal of practice processing negative information and thus process negative content automatically with minimal attentional requirements. When stress narrows attentional focus (or alternatively reduces cognitive capacity) and interferes with effortful processing in these individuals, their remaining attentional resources may be sufficient only to allow automatic processing; and the content of what is processed automatically by these, now depression-prone, individuals is negative. Negative aspects of the stressful situation will be processed automatically. This will, in turn, prime recall of related negative experiences that were not initially remembered. The individuals recall more and more negative experiences with their accompanying negative emotional tone (Bower, 1981). Non-depression-prone people who are temporarily in a bad mood may switch from automatic to effortful processing (M. S. Clark & Isen, 1982) and short-circuit negative thoughts by counting their blessings, looking for the silver lining, and so on (Fiske & Taylor, 1984; Taylor, Lichtman, & Wood, 1984). However, when effortful processes are decreased by stress, individuals may be less able to counteract their negative thoughts through conscious strategies (Barber & DeRubeis, 1989). Depression-prone individuals who are temporarily in a bad mood and whose remaining attentional resources are decreased (by narrowing of focus or by decreased cognitive capacity) may also be unable to "get an ego boost" by taking credit for any good things that do happen to them (Hartlage, 1990). Taken together, these factors may precipitate a depressive episode. Furthermore, each time the negative content or attributions for life events are activated and positive information is excluded from processing, the negative information becomes more highly practiced and further automated. This may then increase the susceptibility of the depressed individual to future depression.

In addition, automatic and effortful processing theories may help to explain the perpetuation of depression. Coping with negative life events often requires problem solving, an effortful operation that is impaired among depressives. This impairment may contribute to a continuation of stress and, thus, to deficits in effortful processing. Also, even if depressives want and try to think about other things, automatically processed negative cognitions may continue to occur and be very difficult to suppress or ignore. Consistently, some authors (Sutherland, Newman, & Rachman, 1982; Wenzlaff et al., 1988) suggest that unwanted thoughts appear to be more difficult to remove during dysphoria. Finally, depressives may allocate available attentional resources to depression-relevant thoughts. Thus, depression may be maintained both by the relative dominance of automatically processed negative information and by depressives allocating attentional resources to depression-related thoughts.

Treating Depression

Our review suggests that depression may be characterized by automatic activation of negative self-referent content and by the use of available cognitive resources primarily to focus on nega-

tive information. Furthermore, we have proposed that allocation of available attentional capacity to selectively process negative information may result from priming by automatically processed negative content. In this section, we outline implications for treatment suggested by this framework.

Three general modes of intervention have been suggested in the literature (e.g., Barber & DeRubeis, 1989; Ingram & Hollon, 1986). First, automatically processed self-referent content could be changed from negative to positive. However, we would expect this to be extremely difficult, because learned automatic processes only develop through extensive practice (e.g., Shiffrin & Schneider, 1977). This may be why "working through" or "regular repetition of interpretations" (Weiner, 1975, p. 155) in insight-oriented therapy takes much longer than does the initial recognition of insights. Deficits in semantic encoding may also prevent new insights from being processed deeply. Given that repetition is required to change automatically processed content, methods should be developed for depressed individuals to more directly practice positive self-referent thoughts. At the same time, depressives could be taught thought-stopping techniques to prevent them from further practicing negative cognitions.

Second, negative self-referent content could be deactivated or positive content could be activated. This might be accomplished by reducing stress, which presumably activated the negative content. Depressed patients may need help with effortful operations including organization and problem solving to resolve stressful situations. Additionally, the current stressful situation is never identical to past situations that originally created the negative self-referent content. Hence, therapists may teach patients to discriminate current situations from past situations in which the automatically processed content was originally learned. For example, a depressed man who perceives others as rejecting him could be taught to discriminate cues indicating rejection from cues indicating that others are busy or preoccupied (Brewin, 1989). This should serve to deactivate the negative content. Finally, self-referent content, which is automatically processed, appears to be negative among depressives. Thus, if depressed individuals focus on others, negativity should be decreased (Ingram & Hollon, 1986).

Alternatively, patients can be helped to switch from automatic processing of content that is presumably negative to adaptive effortful processing. The change to adaptive effortful processing is not expected to be easy (although it may be easier than changing automatically processed content), because the processing resources of depressives may be depleted or occupied with negative thoughts. However, self-monitoring techniques, activity scheduling, assigning tasks of graded difficulty, and monitoring automatic thoughts may help (e.g., Ingram & Hollon, 1986; Wenzlaff et al., 1988; see K. S. Dobson, 1988; Hollon & Najavits, 1988, for reviews of cognitive therapy techniques).

Finally, research suggests that negative self-referent content will continue to be automatically activated during depression and will be difficult to suppress or ignore. Furthermore, these cognitions are likely to recur after recovery from depression if the individual encounters another stressful situation. This implies that depressed individuals should be taught compensatory skills that they can use to cope with negative thoughts when

these thoughts are activated (Barber & DeRubeis, 1989). Compensatory skills may include evaluating the validity of automatic thoughts, correcting cognitive distortions, and making adaptive reattributions (e.g., Ingram & Hollon, 1986). Furthermore, if depressives learn to recognize the involuntary aspect of their negative cognitions, they may be less apt to blame themselves for repeatedly thinking negative thoughts even though they believe that they should be able to stop doing so.

Future Research

We have suggested numerous hypotheses about how the effects of depression on automatic and effortful processes may help to explain depressive clinical features. Similarly, Williams et al. (1988) formulated an extensive theory about differences between cognitive processes in depression and anxiety that depends, in part, on studies regarding the effects of depression on automatic processes. Both our formulations and those of others have hinged on only a handful of studies regarding automatic processing in depression and regarding the mechanism by which depression interferes with effortful processes. Clearly, more work needs to be done in these areas.

Specifically, several studies demonstrated automatic-attention responses to threat-related stimuli in anxious subjects. Do depressives manifest similar attention responses to depression-relevant stimuli? Also, what is the causal mechanism by which depression interferes with effortful processes? Is cognitive capacity really reduced in depressives, and is cognitive capacity reallocated to task-irrelevant or depression-relevant stimuli?

Beck (1976) proposed that cognitive distortions and the process by which automatic thoughts are generated are characteristic of various psychopathologies but that the content of automatic thinking is idiosyncratic to the disorder. Empirical findings on automatic and effortful processing have also raised questions as to whether the effects of depression on cognitive capacity are unique or are consistent across psychopathologies and under conditions of arousal. Research is needed to determine the specificity of automatic and effortful processing mechanisms and of automatic thought content.

Beck (1967) theorized that the automatic thoughts of depressed individuals contain negative views of the self, world, and future. Research indicates that negative self-referent words are processed automatically by depressives, but are negative automatic thoughts as described by Beck and negative views of the world and future also highly automated in depressives? Abramson et al. (1978) associated a negative attributional style with depression. Are stable or global attributions for negative life events made automatically by depressives? What about constructs central to other theories of depression: Are they processed automatically?

Interference in effortful, but not automatic, processes may be attributable to current depression or to depression proneness. However, almost no studies of automatic processing to date have assessed depression proneness. Research is needed to determine whether automatic thoughts are associated with cognitive vulnerability to depression or with current depression.

Finally, several authors (e.g., Barber & DeRubeis, 1989; Ingram & Hollon, 1986) questioned whether cognitive therapy changes depressogenic content or whether negative content lays

dormant after depression remits. These researchers also pointed out the difficulties in assessing dormant schemata. Our model suggests that such questions may be answered through the use of paradigms designed to assess automaticity. We expect nondepressed people to have positive thought content if they are evaluated using methods designed to study effortful processing. However, cognitively depression-prone, as opposed to non-depression-prone, individuals should process negative rather than positive content automatically.

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