Impaired Systematic, Higher Order Strategies in Depression and Helplessness: Testing Implications of the Cognitive Exhaustion Model

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Cognitive exhaustion is explored as theoretical perspective in analyzing cognitive deficits observed as a result of learned helplessness and depression. According to this view, mild depression or uncontrollability does not reduce motivation to perform, but instead limits the resources available for systematic, higher order strategies of thinking. We report two lines of research. First, using category learning, we distinguish between tasks in which performance benefits from systematic and flexible strategies, and those that equally benefit from simpler fallback strategies. Helplessness-trained persons, compared to controls, are less likely to apply the former strategies. Second, we focus on mental model construction. After learning preliminary materials control participants demonstrated a generative way of thinking. They systematically applied logical rules to construct mental models, whereas depressed and helplessness-trained persons showed little evidence of such constructive activity. We discuss these findings in relation to other theories about cognitive deficits in depression and helplessness.

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Some years ago, three of helplessness theory's most prominent advocates wrote, "Many studies shed no light on why uncontrollable events disrupt a person's performance. That they have this effect was established early in the 1970s. Why they do so is still not clear in the 1990s." (Peterson, Maier, & Seligman, 1993, p. 117). The issue remains unresolved, and the statement valid. Examining results across the many studies in this area provides an important clue, however. Research from very different approaches, using a wide variety of paradigms, has demonstrated that disruption of depressed individuals' performance is not a ubiquitous phenomenon, but depends highly on the type of task (for an overview, see Kofka & Sedek, 1998). To make things more complicated, people suffering from depression, and performing normally on a given type of tasks, may show serious impairments in other, apparently very similar tasks (Smith, Tracy, & Murray, 1993). This variability in which tasks are affected by depression and helplessness affords an opportunity to specify the nature, and then perhaps the cause, of the impaired performance.

In this chapter we focus on a possible way of sharpening further hypotheses regarding the uncontrollability model of depression. We believe that many of the cognitive dysfunctions observed in uncontrollability states and in depression can be more generally described as dysfunctions in using higher order systematic strategies, requiring flexible, analytic, or integrative processing. These are seen as opposed to simpler strategies that may require more non-integrative piecemeal-oriented, or non-analytic, holistic styles of processing.

First, we outline some basic findings and controversies, centering around the assumption that uncontrollability and depression have similar effects on cognition. Second, we describe our own approach by introducing the model of cognitive exhaustion, originally proposed by Sedek and Kofka (1990). In illustrating this model, we present some recent findings, concentrating around two fields of application: category learning and mental model construction. In conclusion, we revisit the question of how helplessness states disrupt performance.

Approaching a Cognitive View of Helplessness

Early on, Seligman (1975) argued that the key symptoms of depression could be mapped into those seen in experimentally-induced control loss, which gave rise to the original formulation of the helplessness model of depression. In typical experiments (e.g., Hiroto & Seligman, 1975) subjects
were exposed to controllable or uncontrollable pretreatment, for example, they had to avoid an unpleasant tone or solve a concept-learning task. In the controllable version, there was contingency between the subject's responses and avoidance or concept identification success. However, in the uncontrollable version, there was no such contingency. Afterwards, subjects were tested using target tasks of varying content similarity to the pretreatment task to measure degrees of generalization in helplessness. Typically, performance decrements were found across target tasks, thereby demonstrating helplessness generalization. Additionally, after such treatments, participants showed symptoms that are germane to those seen in reactive depression. These are mood effects (e.g., feeling sad, despaired or discouraged), physiological effects (e.g., appetite loss or sleep disturbances), and most central for the present concern, cognitive effects (e.g., loss of interest or creativity, an experienced inability to think or reason effectively, and a lack of problem solving ability). (For an overview see Peterson et al., 1993.)

The primary understanding of why non-contingency of effort and outcome (i.e., uncontrollability) leads to these symptoms is described in the attributional reformulation of helplessness theory (Abramson, Seligman, & Teasdale, 1978). The person's explanation of why effort is failing is central to this approach. More recently, uncontrollability has become a fundamental concept in another, alternative view on depression, namely, the theory of cognitive exhaustion (Sedek & Kofta, 1990; Kofta & Sedek, 1998; Sedek, Kofta, & Tyszka, 1993). One argument in the development of this theory was the predominant role of singular life-events, such as death of an important person in life, or a lost job, as antecedents of depression (e.g., Healey & Williams, 1988; Lloyd, 1980).

The traditional helplessness-oriented view has difficulties explaining the central role of such exceptional experiences because, by definition, a singular event cannot induce an experience of action-outcome noncontingency. From the cognitive exhaustion perspective, however, it is assumed that the coping stage after negative life events can lead to an ongoing experience of uncontrollability. This is because such events are particularly conducive to rumination (Nolen-Hoeksema, 1991) or to counterfactual thinking, which is the attempt of mental undoing experienced facts, or simulating hypothetical alternative courses of action as compared to actuality. Counterfactual thinking is associated with feelings of self-blame and depression (Davis, Wortman, Silver, & Thompson, 1995; Niedenthal, Tangney, & Gavanski, 1994).
Ongoing engagement in hypothetical undoing of irrevocable events, however, not only is objectively useless and emotionally disruptive, but should also, according to our assumptions, constitute a kind of self-generated uncontrollability training. This is because such thinking would mean a prolonged investment of cognitive effort in unsuccessful problem-solving attempts, leading to an experience of control loss. This, in turn, should lead to cognitive exhaustion, a psychological state in which general-purpose cognitive resources are theorized to be diminished (Kofta & Sedek, 1998). Therefore, the general prediction is that when people are in this state, they will be less able to use more complex, systematic, or flexible strategies of processing, because such strategies consume more of a general-purpose resource. People in cognitive exhaustion states should show impaired performance in tasks that involve or would benefit from these types of strategies, whereas performance should not be impaired in tasks involving less resource-demanding strategies. Our use of the concept "resource" is in the sense of a unitary pool of attentional capacity (Baddeley, 1986; Cowan, 1995), which can serve to initiate and support different processing strategies of widely differing degrees of complexity (Engle, 1996).

Explaining the Deficits Observed in Reactive Depression

Limited Capacity

Some hold reduced attentional capacity responsible for cognitive deficits reported for depressed people and also claim that these impairments cannot be explained simply by motivational deficits (for recent reviews see: Ellis, Ottaway, Varner, Becker, & Moore, 1997; Gotlib, Roberts, & Gilboa, 1996). For clinical depression, Hartlage, Alloy, Vazquez, and Dykman (1993) summarize evidence suggesting that the most striking impairments are visible in tasks requiring considerable amounts of effortful processing (see also Weingartner, 1986; Weingartner, Cohen, Murphy, Martello, & Gerdt, 1981). Hasher and Zacks (1979) assume that the total amount of cognitive capacity is reduced in depressed individuals. This should be detrimental for cognitive strategies involving controlled, attention-guided processes, as opposed to simpler strategies involving more automatic processes. For the latter type of strategy no disadvantage is expected. Ellis and Ashbrook (1988) suggested that cognitive capacity is reduced in depression, partly because depressed people primarily allocate portions of their available attentional resources to depression-relevant thoughts (ruminative thinking) or irrelevant task processing (focusing on irrelevant features of the task).
These assumptions suggest a monotonic relation between the amount of resources that a task requires, and the amount of impairment observed in comparing depressed individuals to controls. This prediction, however, was not borne out. In a study on free recall of learned word lists, Channon, Baker, and Robertson (1993) had depressed and nondepressed subjects learn lists of nouns that were organized to different degrees. The number of words was identical in each of three conditions. In the first condition, the nouns were ordered by a small number of taxonomic categories. In the second condition, nouns from an equal number of categories were presented in a random sequence. In the third, the words all came from different categories. Operationalized in this way, the conditions decrease in degree of structure and thus require increasing amounts of controlled effort to organize them during learning. Inconsistent with the capacity view, the authors found the most striking depressive recall deficit to appear in the second condition, which was only of medium structure. Watts, Dalgleish, Bourke, and Healy (1990) used story material with different degrees of structure, and the same type of effect emerged.

Lack of Initiative

The non-monotonic relation between structure and performance casts doubt on a perspective solely oriented towards a capacity limitation in depression. Most notably, in the studies examining the influence of structure (Channon et al., 1993; Watts et al., 1990), the conditions showing the greatest deficits are those in which a controlled, systematic strategy is most promising for high performance. A systematic organization of a set of nouns from a small number of categories can be assumed to strain capacity less than doing the same with a set of completely unrelated nouns. Why is it, then, that depressed individuals do not profit from the structuring "opportunity" of the second condition (Channon et al., 1993)? Paula Hertel and coworkers (Hertel, 1997; Hertel & Hardin, 1990; see also Hertel & Meiser, this volume) argue for an explanation focusing on the issue of cognitive control and initiative. Just as in the experimental example above, the most useful processing strategy is not always obvious (e.g., as a clear task demand), or made explicit (e.g., as part of the instructions). In such cases, whether a subject employs that most useful strategy should depend on her or his own initiative to engage in this strategy. If this initiative is lacking, people should resort to other, substitute strategies. Hertel and Rude (1991), for example, found that depressed subjects showed impairments in a sentence-completion task, but only under the condition in which the exact point in time during a
trial to perform which sub-task, was left open to them. In another condition, where a fixed time structure was set up, depressives performed normally.

Focusing on initiative means a shift in emphasis from mere capacity to "capacity to control" issues. If depressed subjects are capable to perform on an equal level with nondepressed people, and if this can be achieved by substituting external guidance (i.e., instructions) for individual control, we are motivated to ask to what extent the deficit in depression lies in the initiation of a certain type of strategy, given a certain type of task.

The Present Perspective

The Induction of Experienced Uncontrollability

Before continuing the theoretical discourse, we describe the procedure used to induce an experimental state of experienced uncontrollability to illustrate our operationalization of this concept. We use a computerized version of the informational helplessness training first applied by Sedek and Kofa (1990). This consists of four sequences of eight trials each. In each sequence, a target concept has to be identified by the subject. Finding the target concept means isolating one critical dimension, and within that dimension, one out of two conceptual levels. The dimensions and their levels are: Size ["big" vs. "small"], shape ["triangle" vs. "circle"], surface ["plain" vs. "striped"], line position ["top" vs. "bottom"], case of letter in the middle of the figure ["r" vs. "R"] within a drawing presented in each trial. In addition to presentation of the drawing itself, either the word "YES" or the word "NO" appears right below the drawing, to indicate whether the target dimension has the correct value in the presented stimulus. The subject does not behaviorally respond to the stimulus in any way, but simply must consider the simultaneous presentation of stimulus and feedback information to determine which dimension and level is correct. Subjects are told that there is one definite solution so that cognitive effort is motivated.

In the controllable version of this task, the "YES"/"NO" cues are assigned to stimuli in a consistent, meaningful way, that is, "YES" appear under stimuli which express the target dimension value, and "NO" appear under stimuli which do not. Hence, the task is solvable. In the uncontrollable version, however, this assignment is such that for each value within each dimension, the simultaneous feedback cue is "YES" and "NO" for an equal number of times (see Figure 1). Hence, this version of the task is insoluble.
Note that by means of the simultaneous stimulus/feedback presentation, experienced controllability vs. uncontrollability is not a function of the subject's response being reinforced or not. Rather it is the result of successful vs. unsuccessful mental attempts at solving the problem, without overt responding.

**Uncontrollability Deficits Mirror Those in Depression**

Our studies show that people who have undergone the uncontrollable version of the task show affective reactions very similar to those observed in depression. These subjects' self reports reflect anxiety, anger, depression, unpleasant tension, discouragement, fatigue, and an inability to think (Sedek et al., 1993). After another stage of the experiment, control subjects reported a gradual decrease of uncertainty towards the moment of decision, whereas no such decline was observed for the uncontrollability group (Kohta & Sedek, 1998). Among objective cognitive symptoms, there were less focused (i.e., less uncertainty-reducing) preliminary choices by the uncontrollability-trained group in this experiment. In another study, a similar group also showed disadvantages in series completion and arithmetic tasks (Sosnowski, Krzywosz, Kohta, & Sedek, 1996). That the performance decline is generalizable across a variety of different task types speaks in favor of the interpretation of cognitive uncontrollability symptoms as related to a general executive resource. In the same vein, several studies on dual-task performance have shown decrements under experienced uncontrollability only for the dual-task and not for the single-task condition (McIntosh & Sedek, 1999). Thus, experienced uncontrollability tends to lead to effects similar to those observed in reactive depression. We do not equate, in an overall sense, depression and the experience of uncontrollability. However we suggest that uncontrollability may serve as a model for the cognitive subset within the set of depressive main symptoms.
Depression and Uncontrollability Do Not Reduce Motivation

However, uncontrollability does not, in general reduce motivation. On the contrary, there are classes of tasks in which even advantages in performance can be observed for depressed subjects. Edwards and Weary (1993) found that depressed subjects’ evaluative judgments about a target person use a relatively more effortful process than do control subjects. Depressed people’s person judgments were better predicted by their initial evaluation of the single traits from which the person description had been constructed, whereas in the control group, judgments were better predicted from the initial evaluation of the additionally provided category to which this person belonged. Gleich and Weary (1991) observed that, compared with nondepressed people, depressed subjects generated more inferences after viewing a video tape about an actor in an achievement situation, and their inferences were more abstract than those of the control group. (However, depressed subjects’ confidence in their inferences was lower.) In a study by Pittman and Pittman (1980), after an uncontrollability manipulation, subjects were more vigorous and prone to make attributions in a social perception task than were unmanipulated subjects. The enhanced activity and effort shown by depressed subjects in these studies are inconsistent with a motivational explanation of performance deficits in helplessness and depression. However, many such findings are in the context of social perception or attribution tasks, in which highly overlearned person or situation schemata may prevail and thereby limit the analytic, response generative effort needed in those tasks. At least in situations requiring relatively automatic processes, depressive states appear to enhance performance.

Basic Tenets of the Cognitive Exhaustion Idea

In terms of explaining the symptoms of cognitive deficit in uncontrollability states, our own research has elements in common with both the capacity- and control-oriented approaches discussed earlier. Germane to the capacity perspective, the results on dual-task performance hint at capacity limitations in working memory. In a state of cognitive exhaustion, effortful and controlled strategies of processing, most likely those that tax the central executive (Baddeley, 1996), seem to suffer. That is, such strategies may remain unsuccessful even in spite of vigorous trying. In making the distinction between different types of strategies being more or less susceptible to uncontrollability, cognitive exhaustion theory moves more in the direction of issues of control than mere capacity. It becomes then crucial
to understand, in a more general sense, under what conditions strategies of different complexity might be initiated and supported during task completion.

**Basic Predictions**

In terms of antecedents, we assume that experienced uncontrollability can stem from laboratory inductions as well as from unsuccessful coping processes, for example, ruminative or counterfactual thinking. The state of cognitive exhaustion is characterized by a preserved motivation to understand and think, but simultaneously by a reduced availability of resources deployable for the support of controlled, systematic, and flexible strategies. Such strategies play a role in a variety of everyday cognitive tasks, such as understanding a new concept in conversation, being creative, or getting oriented in new social situations. For example, understanding conversation or text implies an effortful "search after meaning" (Grässer, Singer, & Trabasso, 1994), in which knowledge-based inferences lead to an overall construction of what the discourse is about. Or, as another example, recent theories about the process of comprehension discuss an interplay between long-term knowledge and newly constructed, flexible representations of functional contexts or causal chains (Glenberg, Krueley, & Langston, 1994).

To examine the prediction that such more complex types of mental activity are selectively hampered in uncontrollability and depression states, we discuss empirical evidence from two main lines of inquiry. First, in two studies on category learning, we concentrate on flexible, controlled strategies by using an experimental situation comparing two types of tasks which are superficially similar, but which, in essence, profit from systematic strategies to different degrees. Second, in three studies on mental model construction we concentrate on generative thinking, conceptualized as the construction of an overall mental representation from a set of single information elements.

**Studies on Category Learning**

Smith, Tracy, and Murray (1993) compared depressed persons and controls in a series of studies on category learning. They examined the hypothesis that depressed people would use less sophisticated processing strategies. As predicted, depressed individuals were less likely to use analytic processing (i.e., processing stimuli in terms of their constituent properties), and more likely to use simpler fallback strategies (i.e., rigid or holistic strategies) in cognitive tasks.
In these studies, a series of multi-dimensional stimuli (in this case, sets of letters such as ABFG) was presented to the subjects, one stimulus after another. The subject had to assign each stimulus to one of two categories. After a response, the correct answer was revealed as feedback. Two versions of this method were used: First, criterial-attribute tasks (CA) are trials in which there is exactly one feature discriminating perfectly between both categories (in this case, e.g., the last letter). Such trials benefit most from systematic and flexible hypothesis testing. A rigid strategy, that is, perseverating on one given attribute, is likely to fail because the odds are that an undiagnostic feature would be selected. Moreover, holistic strategies, in which attention is divided across all features and global similarity is assessed, will also be less beneficial in this context, as only one feature is in fact diagnostic. Second, family- resemblance tasks (FR) are such that each stimulus has a certain degree of overall similarity to (that is, a certain number of features in common with the category prototype, e.g., each example would have three of the four prototypical letters). To solve this type of task, an analytic strategy may be applied, but other strategies, like holistic assessment or rigid perseveration, will be relatively successful, too. Smith et al. (1993) therefore predicted and found no performance differences between depressed and nondepressed in the FR task, but pronounced decrements by depressed subjects in the CA task. Moreover, they found overall performance in the FR condition to be worse than in the CA condition, which makes an explanation in terms of depressed subjects' lower motivation unlikely.

Generalization to Experienced Uncontrollability

In one of our experiments (McIntosh & Sedek, 1999), we tested a similar hypothesis as that of Smith et al. (1993) to see whether the proposed parallelism between reactive depression and induced helplessness states could be upheld in the realm of category learning. To this end, one FR and one CA task version were created using sets of letters. In each trial, subjects had to categorize a number of letter strings as belonging to class 1 or 2.

Subjects first were trained using the concept learning task described earlier, and were randomly assigned to uncontrollability vs. control conditions. Looking at the main experiment, there was better overall performance on the FR than on the CA task, and helplessness-trained participants performed worse than the controls.
Table 1
Stimulus Materials in the Category Learning Experiment, CA vs. FR Task

<table>
<thead>
<tr>
<th>Criterial Attribute</th>
<th>Family Resemblance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category a</td>
<td>Category b</td>
</tr>
<tr>
<td>Stimulus</td>
<td>Stimulus</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>O W A F</td>
<td>T I F A</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>O W Y S</td>
<td>C O S Y</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>U W Y F</td>
<td>T U F E</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>O T A S</td>
<td>W I S Y</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>O T Y F</td>
<td>C U F A</td>
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<tr>
<td>2</td>
<td>1</td>
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<tr>
<td>U T Y S</td>
<td>T U S A</td>
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<tr>
<td>2</td>
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<tr>
<td>U W A S</td>
<td>W O G Y</td>
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<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>U T A F</td>
<td>W O S E</td>
</tr>
</tbody>
</table>

Note. a Category 1: The last letter of nonsense word is "F"; Category 2: the last letter of nonsense word is "S".

b Category 1: mostly "T" as first letter, "U" as second letter, "F" as third letter and "A" as fourth letter; Category 2: mostly "W" as first letter, "O" as second letter, "S" as third letter and "Y" as fourth letter.

Figure 2. Category learning experiment: Interaction between uncontrollability and type of task (adapted from McIntosh & Sodck, 1999).
Consistent with predictions, there was an interaction between the two factors, showing significant decrements only among participants in helplessness states. We interpret this in a way analogous to Smith et al. (1993), and generalize their findings to induced uncontrollability. Systematic and flexible hypothesis testing, the strategy most useful for CA performance, seems to be impaired under uncontrollability; this is not the case for holistic or simpler, perseverating strategies. The additional observation of longer response times for uncontrollability-trained subjects in the CA task speak against an explanation in terms of a general, motivational deficit. In the latter case, relatively short response times should be expected as a result of giving up early.

Assessing the Role of Working Memory

The results so far support the assumption that the disruptive effects seen in depression and helplessness states are driven primarily by cognitive factors. In this context, it is crucial to assess more closely the role of working memory as the central device in thinking and problem solving. Rosen and Engle (1997) divided a sample of subjects into high- and low-working memory capacity, on the basis of the operations-word-span, an instrument designed to tap simultaneous storage and processing (Richardson, 1996). They found that high-span subjects performed better than low-span subjects at free exemplar retrieval from natural categories. The setting was then modified to include a concurrent workload by means of a secondary task, requiring participants to read aloud digits presented in intervals on a computer screen. Again, high-span subjects performed at a higher level than did low-span subjects. Notably, however, low-span subjects’ performance was not disrupted by the additional workload, whereas high-span subjects’ performance markedly decreased. This result is not compatible with a purely capacity-oriented approach, in which case a decrement among low-span subjects would have to be expected. Instead, the interpretation was that high-span subjects, when under a single-task condition, used a controlled, effortful search in their retrieval, which became severely disturbed under a dual-task condition. Low-span subjects, on the other hand, would use more automatic, less sophisticated and effortless processes in their search, on which the workload manipulation had no impact. From this perspective, resources in working memory, as reflected in the operations-word-span, would be equivalent to attentional resources that can be deployed to initiate and maintain processing strategies of very different complexity.

In the light of this analysis and our previous results, we (McIntosh & Sedek, 1999) hypothesized that by introducing a secondary workload when
using the CA type of task (which profits from controlled, systematic processes), one could examine the impact this workload would have on the assumed different strategies used by helplessness-trained and control persons. Specifically, control and helplessness-trained subjects worked on a CA categorization as described above, and half in each group had to press a key as quickly as possible upon hearing a tone (additional workload). In terms of accuracy, controls performed better than helplessness-trained participants. There were no accuracy effects related to additional workload, contrary to expectations. However, we did find longer response latencies in the helplessness-training group as compared to controls, but only when there was no additional workload.

![Graph showing response latencies](image)

Figure 3. Category learning experiment: Interaction between uncontrollability and workload (adapted from McIntosh & Sedek, 1999).

With additional workload, the performance of the control participants matched that of the experimental group. These data support the idea that in the simple categorization task, controls are able to use a more efficient, controlled strategy than helplessness-trained individuals. When a cognitive
load is imposed, however, this strategy is taken from the control subjects, and they are no longer able to perform as quickly (see Engle, 1996).

In sum, except the caveat in view of the accuracy data from the second reported study, both experiments on category learning point to cognitive factors in explaining helplessness deficits. Specifically, it seems that attentional resources might play an important role in initiating and controlling higher order, systematic processing strategies which are essential for successful problem solving in many areas. Subjects experiencing uncontrollability do not seem to apply such strategies, as compared with controls. We shall come back to this issue when suggesting some ideas why this could be the case.

Studies on Mental Model Construction

In another line of inquiry, we focused on the construction of mental models (Johnson-Laird, 1983, 1996). This is conceived as an on-line activity that requires a considerable amount of flexibility of thought, as well as higher order integrative and coordinative functions of working memory (Brewer, 1987; Greeno, 1989; von Hecker, 1997; Holland, Holyoak, Nisbett, & Thagard, 1986). According to cognitive exhaustion theory, subjects experiencing depression or uncontrollability should be impaired in successfully applying these kinds of more generative steps of processing. Once constructed, mental models are assumed to support the understanding and assimilation of further related information (Bransford, Barclay, & Franks, 1972; Garnham, 1997; see also Dutke, this volume). Constructive activity can also go beyond the information given because a mental model may contain, by implication, information that had never been explicitly learned (Mani & Johnson-Laird, 1982; see also Klauer, Meiser, & Naumer, this volume). To the extent they have difficulties in constructing mental models, depressed or helplessness-trained subjects should profit less from these features. Stated differently, our general research hypothesis was that at a basic level, where information has to be sampled and evaluated in a first attempt, there should be no decline in the performance of depressed or helplessness-trained persons, whereas at a more complex level, when it comes to further integrate piecemeal information into a coherent mental model, deficits should become apparent. We selected two experimental settings in which to study these predictions: (a) the construction of social clique models, and (b) the construction of linear arrays.
Social Clique Models

In referring to mental model theory, Hummert, Crockett, and Kemper (1990) have given the concept of a *clique* a more precise social cognitive meaning. Their basic idea was that to understand sets of pairwise sympathy relations, people engage in constructive activity to integrate them into so-called *clique models*. Cliques were formalized as maximal sets of people in which everybody likes everybody else, such that mutual positive sympathy would hold throughout. Between cliques, negative liking was assumed to hold throughout. Hummert et al. (1990) explained the process of clique construction as a stepwise integration of each single piece of sympathy information, for example, "A likes B", or "A dislikes B", into the overall representation of all pairwise relations learned so far.

Von Hecker (1997) conducted a series of studies showing that, during such a constructive process, people are sensitive to the relative diagnosticity among the relations with which they are presented. If some critical element is encountered that allows them to decide about the type of model under construction, (which was, under the instructions, helpful in finding the solution to the experimental task) subjects process this element with special care. Moreover, some essential features of the ensuing memory representation about the liking pattern in the group of people was found to be highly dependent on the type of that critical piece of information.

We used this setting (von Hecker & Sedek, 1999a, Exp. 2 and 3) in one study to compare controls to depressed subjects as classified by the Beck inventory (control group: BDI < 6; experimental group: BDI > 9), and, in another study, to compare controls which had undergone a solvable concept training task (see above) to an experimental group which had undergone the insoluble version of it. To illustrate the procedure, subjects were presented with a series of eight symmetric pairwise sympathy relations, which, taken together, would support a representation as exactly two or three cliques. Among this series of relations, there was always a subset of three relations, for instance, (1) "Monika and Karolina dislike each other", (2) "Karolina and Anna dislike each other", as "antecedent relations", and (3) "Monika and Anna like each other", as the "critical relation" (see Table 2). All eight relations were presented one after another in self-paced timing and in random order. The only restriction to order was that relation (3) be presented after (1) and (2).

To complete the set, three more positive liking relations were attached to Monika (with Renata), Karolina (with Patrycja), and Anna (with Agnieszka), and two more negatives were presented between Renata and Patrycja, and between Patrycja and Agnieszka (see Table 2 which shows one
possible sequence of presentation satisfying all these conditions). As can be seen from this example, the critical relation (3) is the most diagnostic of all eight relations because upon knowing the antecedents (1) and (2), positive liking between Monika and Anna is sufficient knowledge to establish an integrated model consisting of two cliques [Renata, Monika, Agnieszka, Anna], and [Patrycja, Karolina]. Conversely, had (3) been presented as a negative relation, the resulting model would consist of three cliques [Renata, Monika], [Patrycja, Karolina], and [Agnieszka; Anna]. Therefore, (3) is termed the critical relation. Its presentation position in the sequence was varied from fourth to seventh position across subsequent trials. In this manner, there were always some relations presented prior to (pre-critical), and some presented after the critical relation (post-critical). After learning, subjects were asked to group the six persons according to the perceived pattern of mutual liking.

Table 2
Example for Stimulus Materials Used in the Experiment on Social Clique Construction.

<table>
<thead>
<tr>
<th>Stimulus Relations (Temporal Sequence of Presentation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patrycja + Karolina</td>
</tr>
<tr>
<td>2. Monika - Karolina *</td>
</tr>
<tr>
<td>3. Renata + Monika</td>
</tr>
<tr>
<td>4. Karolina - Anna *</td>
</tr>
<tr>
<td>5. Agnieszka + Anna</td>
</tr>
<tr>
<td>6. Monika + Anna **</td>
</tr>
<tr>
<td>7. Renata - Patrycja</td>
</tr>
<tr>
<td>8. Patrycja - Agnieszka</td>
</tr>
</tbody>
</table>

Note. * antecedent relation; ** critical relation. The table shows a set of relations actually used, reflecting one possible presentation order (adapted from von Hecker & Sedek, 1999a).

We hypothesized that basic processes of information sampling and evaluation would be undisturbed in depressed and helplessness-trained participants, and this is essentially what we found. In line with previous results (von Hecker, 1997) we observed that both experimental groups devoted more study time to critical than non-critical relations, just as both control groups did. Furthermore, when given the opportunity to request additional information about previously shown relations, depressed and helplessness-trained subjects requested more, as did the controls, when presented with the critical relation as compared to the others. This makes sense under the assumption that the diagnostic value of this piece of
information was recognized; this in turn would instigate more need to corroborate previous knowledge. In all, these results show that subjects under depression and uncontrollability conditions were performing quite normally during the processing of single pieces of sequential information. In particular, all groups proved equally sensitive to diagnostic information.

Next, we analyzed post-critical study times. Having constructed the clique model with help of the critical relation, subjects should be able to smoothly accommodate all later information into the existing model which would lead to post-critical study times becoming shorter again. Here, we found a picture that clearly distinguished between experimental and control groups. In the latter groups, post-critical study times did in fact decrease again as compared to the critical relation. In contrast, for depressed and for helplessness-trained participants, post-critical study times remained at the level observed for the critical piece. Apparently, these subjects' processing of the critical relation did not help them to reduce their uncertainty about the type of clique model that would be adequate.

Table 3

<table>
<thead>
<tr>
<th>Study Time (ms)</th>
<th>Experiment 2</th>
<th></th>
<th>Experiment 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Depressed</td>
<td>Control</td>
<td>Trained</td>
</tr>
<tr>
<td>pre-critical relations</td>
<td>7927</td>
<td>7310</td>
<td>8704</td>
<td>10233</td>
</tr>
<tr>
<td>critical relation</td>
<td>12101</td>
<td>12211</td>
<td>13788</td>
<td>12119</td>
</tr>
<tr>
<td>post-critical relations</td>
<td>7772</td>
<td>12390</td>
<td>10451</td>
<td>13368</td>
</tr>
</tbody>
</table>

We also looked at the sorting solution created by our subjects after the study phase, tallying for each presented relation whether it was correctly represented in the sorted clique pattern. On this measure, we found both experimental groups to perform worse than the controls in overall solution quality. Notably, the critical relation itself was especially misrepresented in these groups, showing that in spite of their exerted effort during the study phase, depressed and helpless subjects were most uncertain about the relation most informative for the overall model. We might speculate that the pivotal element had become the most unstable one within their mental representation because (1) this element had been recognized as critical in determining the overall structure, while at the same time (2) this overall structure had remained unclear to them. To address the possibility of a general motivation
deficit explaining part of the results, we separately analyzed the "additional request" activity in view of the very last relation, that is, the eighth one in the sequence. As a general observation, this was the point in time when subjects in all three experiments did the bulk of their request activity. Thus, under the assumption of depressed and helpless subjects giving up earlier, we would expect lower numbers of requests, specifically at this point in time. In fact, however, we found the same amount of request activity in all groups of both studies.

To summarize, if we conceptualize the processing of pairwise liking information as guided by a higher order systematic strategy that watches for diagnostic elements and incorporates them step by step into an emerging online model, we conclude from these findings that although this strategy was followed by all our participants, the result of this strategy is severely impaired under depression or experienced uncontrollability.

Linear Orders

Our next aim was to explore possible alternative strategies that depressed subjects might use when faced with a task that involved constructive thinking. To do this, a well-known experimental paradigm seemed to offer a suitable avenue, namely, the mental construction of linear orders. The study of how linear orders are stored in memory has long been a topic of considerable interest in cognitive psychology (Potts, 1972, 1974; Smith & Foos, 1975; Moeser & Tarrant, 1977; Mynatt & Smith, 1977; Tsujimoto, Wilde, & Robertson, 1978; Pohl & Schumacher, 1991). One major finding in this area is the so-called distance effect. Upon learning a series of adjacent pairs like "John is taller than Paul", "Paul is taller than George", and "George is taller than Ringo", people will respond faster and more accurately to a query about the relation between John and Ringo, the pair of end-terms, as compared to, for example, Paul and George, the middle pair. Note that subjects had never learned about any of the more distant, non-adjacent relations. This effect has been taken to mean that subjects integrate all pairwise information into a unified episodic model from which they can easily "read off" the answer to a queried pair. Another obvious strategy, though, consists in simply storing piecemeal knowledge, that is, the adjacent pairs, during learning and then use those pairs to draw transitive inferences at the time of retrieval. In this case, no higher order, constructive processes need to take place. In terms of predictions, this latter strategy, propositional inference at the time of retrieval, would lead to decreasing accuracy and increasing response times as a function of pair distance. The linear order paradigm, therefore, seemed suitable to explore an alternative route of
processing that we hypothesize can become predominant under a depressed state.

Von Hecker and Sedeck (1999b) compared nondepressed to depressed participants in a task involving linear order construction as described above. Several trials in this experiment followed the same scheme: First, three relations were studied in a self-paced procedure, for example, "C > D", "A > B", and "B > C", in different sequential arrangements across trials. Immediately after learning, six test queries were prompted, referring not only to those relations just learned, but also to the relations that were valid by transitive inference, such as "A > C", "B > D" (pair distance of "two steps"), and "A > D" (pair distance of "three steps", or "end points"). We made sure to use relational signifiers such as "taller", "older", and the like which were clearly transitive by common-sense definition. Testing was done by prompting the subject with statements in either a correct (e.g., "A > D") or false format (e.g., "D > A"), and asking her or him for speeded verification.

First, study times in the learning stage were analyzed. We looked at different sequences of presentation to gain some insight into procedural aspects of array construction. So, for example, the sequence "A > B", "B > C should be easier to integrate into a linear array than the sequence "B > C", "A > B", because in the latter sequence, the second pair has to be transposed before the first to use the connecting element "B" for merging both relations (Mynatt & Smith, 1977). This should be reflected in shorter times studying the second relation in the latter sequence compared to the former. Also, in a sequence like "A > B", "C > D", the second pair should produce longer study times because of the unsuccessful search for a connecting element and the subsequent buffer storing of both relations as separate units (Mynatt & Smith, 1977). All these patterns could be found in both groups, control and depressed, in a closely parallel fashion. It appears, therefore, that both groups engage in very similar constructive steps. As a further prediction, "B > C" should be learned easier and studied shorter upon learning "A > B", "C > D" than upon learning "A > B", "C > D" because the sequential "gap" between B and C, where "B > C" would fit in, is more obvious in the first sequence than in the second. This is what we found in the nondepressed group. Depressed subjects, showed longer study times than controls overall, and for them there were no differences between both sequential conditions. Note however, that this differential result is especially plausible under the post-hoc assumption that a subject might attempt to form some "preliminary" linear array model (A, B, C, D) that waits for confirmation. Assuming that depressed subjects' constructive attempts are less successful than those of the nondepressed, one
would expect that they might not be able to profit from the "easier" arrangement of pairs in the first compared with the second sequence.

In the test stage we observed in the nondepressed group a constant high level of accuracy across pair distances ("adjacent" — "two-step" — "end points"). This is not an exact replication of the classical distance effect, which predicts an increase. Most probably, this result is a ceiling effect. It is, however, at least compatible with the idea of an effective retrieval from an integrated model, as queries on inferred relations (pair distances >1) were answered with no less accuracy than explicitly learned ones. On the other hand, in the depressed group there was a constant decline of accuracy values across pair distances.

Figure 4. Accuracy data from the linear order experiment (adapted from von Hecker & Sedek, 1999b).

This pattern is most compatible with a "propositional inference at retrieval" explanation, and it is clearly incompatible with the idea that depressed subjects retrieve from a mental model. In terms of response
latencies, this picture was nicely mirrored. For nondepressed controls, latencies decreased as a function of pair distance whereas they increased in the depressed group. This finding once more points to propositional reasoning as retrieval process in the latter group.

In sum, this study provided evidence showing almost indistinguishable processing between depressed and nondepressed individuals relating to basic constructive operations; further, it showed impairments among depressed subjects when it came to retrieval. Furthermore, propositional reasoning is a likely candidate for a process replacing the use of mental models in depression.
Conclusions

The similar impairments in performance of complex cognitive tasks experienced by depressed and helpless individuals have long intrigued psychologists. By understanding how and why exposure to uncontrollability leads to impaired performance, we may gain insight into the deficits endured by depressed people. Research based on cognitive exhaustion theory indicates that a primary problem is cognitive (Kofta & Sedek, 1998; Sedek & Kofta, 1990; Sedek et al., 1993). The presented research was aimed at better understanding the specific types of cognitive strategies applied by people in cognitive exhaustion states (due to depression or exposure to uncontrollability) in comparison to control participants. We tested the general prediction that the cognitive deficits in both depression and helplessness states might be characterized as dysfunctions in deploying higher order generative strategies, requiring analytic or integrative processing.

By characterizing the deficits seen in these states, our research narrows the field of possible explanations for the deficits. The findings reported in this chapter not only continue to question the motivational explanation for depression and helplessness deficits, but also further focus attention on the types of difficulties that will need to be explained.

Consistent with previous work on depression (e.g., Smith et al., 1993), we found repeatedly that depression and helplessness states affect higher order cognitive functions. In our category learning studies, helplessness-trained subjects were impaired in their use of flexible, analytical strategies. The second of these studies also suggests that this decrement relates to the central executive function of inhibition. In the studies on mental model construction, results were similar when we looked at later retrieval from memory. Helpless and depressed participants did not appear to construct effective and time-saving mental models to answer questions regarding social cliques. These groups were also less accurate and slower in answering questions of linear order. As before, this suggests that they do not make use of a higher-order mental model in responding. A common theme in these findings is that participants who have experienced helplessness or are depressed (and thus are in a state of cognitive exhaustion) do not use systematic, higher order cognitive processes, such as model generation and inhibition.

Is the absence of higher-order processes because helpless and depressed individuals do not try? Our data do not support such a motivationally-based explanation. In the dual-task and category learning studies (McIntosh & Sedek, 1999), helpless and control participants did not differ when mere
effort was all that was needed to perform well. They also did not differ when simpler, fall-back strategies were functional. In the studies of mental model construction (von Hecker & Sedek, 1999a), depressed and helpless participants tried to initiate very similar processes during input compared to those observed in the control groups. The diagnostic value of certain types of information were correctly distinguished, and basic constructive operations during sequential pair presentation were clearly undertaken in the depressed and uncontrollability groups, as well. Together, these data support our interpretation that cognitive performance problems of depressed and helpless individuals do not occur from a lack of effort.

Our findings also present problems for the cognitive initiative viewpoint (Hertel & Hardin, 1990; Hertel & Rude, 1991; Hertel, 1997). Note that in the experimental situation created by Hertel and Rude (1991), external guidance in the temporal structuring of the task was enough to remove depressed subjects' disadvantage. From our studies on mental model construction, two points can be made: (1) In these tasks, a clear temporal structure was inherent in the presentation mode (one relation separately after the other), but this did not remove the disadvantage. One could argue, however, that even so, the freely-paced study conditions for each relation gave participants enough freedom to let their minds wander and become distracted. (2) But more convincingly, the pattern of study times showed a similar allocation of time between depressed/uncontrollability-trained and control subjects, implying that the same basic constructive processes had been initiated in all groups. This implies that, at least in our set of tasks, initiative was not the primary problem in our depressed and helpless participants. Rather, it appears that in spite of their initiative and their attempts to follow a constructive strategy, such strategies were not further supported or maintained, or were in the end unsuccessful for other reasons.

The findings also are not compatible with a purely capacity-oriented view (Hasher & Zacks, 1979; Ellis & Ashbrook, 1988; Ellis et al., 1997). Following this view, one should have expected impairments in FR as well as CA type of categorizations (Smith et al., 1993) whereas we find them only in CA tasks. The observation that different types of strategies are differentially affected shifts the emphasis to issues of cognitive control in reasoning.

If depression and helplessness do not harm performance via deficits in motivation, capacity, or cognitive initiative, what could be the possible reasons? We believe the issues of cognitive control are key. The generation of mental models, inhibition of incorrect responses, and coordination between two tasks are all impaired in our depressed and helplessness trained participants. Each of these tasks involves controlled processing.
Within the area of working memory, the investigation of such processes increased dramatically during the 1990's. Recent conceptualizations of the functions of working memory describe not only storage but also simultaneous processing of information; the latter requires executive control (Baddeley, 1996). The difficulties demonstrated by helplessness-trained subjects are part of this concept of the central executive function of working memory (Baddeley, 1996; Baddeley & Logie, 1999; Miyake & Shah, 1999).

A study by Gilhooly, Logie, and Wynn (cited in Baddeley and Logie, 1999) suggests how deficits in working memory could affect mental model construction. They applied the idea that the syllogistic reasoning requires the formation of mental models. They also assumed that the formation of mental models place high demands on working memory. The participants were first intensively trained in syllogistic reasoning. Gilhooly et al. demonstrated that those subjects who had the best results in this training were especially prone to the disruptive effects of introducing a secondary task. Therefore, the deployment of executive functions of working memory (see also the similar idea of "simultaneous processing" function of working memory formulated by Just & Carpenter, 1992) may play an essential role in explaining the results concerning the difficulties with mental model generation among helpless and depressive individuals.

Additionally, the second study on category learning has shown that the CA task suffered from the secondary workload induced by the tone tracking. The CA task was assumed to profit from more flexible, analytic strategies which would be, in turn, more demanding in terms of executive functions of working memory.

One function in particular is salient in our findings: a lack of inhibition in the helpless participants. Inhibition has received much recent attention (Hasher & Zacks, 1988; Anderson & Neely, 1996; Engle, 1996). For example, Engle (1996) sees inhibition as an active process depending on attentional resources. He proposes this because differences between high-span and low-span subjects were only apparent when items were shared by different memory sets, thereby creating response competition or interference (Engle, 1996). Also, Rosen and Engle (1997) found low-spans to produce more repetitions than high-spans in a recall paradigm from natural categories in which it was asked for not repeating items. They interpret this by claiming more central-executive resources being deployable in the high-spans to inhibit the damaging effect of previous identical retrievals. We also find the idea attractive that those resources, which are diminished in a state of helplessness or depression, could be of a kind related to an active inhibition capacity.
There are several ways of modeling such an explanation, and we simply enumerate them here. Future research needs to examine the details of this proposal. A first idea could be to assume a "direct" effect of lacking inhibition, that is, irrelevant information, external thoughts, ruminations, and so on, interfere with task execution, from which higher-order, systematic strategies would presumably suffer more than simpler ones would. A second conceivable mechanism could be that higher-order strategies, because they are more complex and involve more elements of thought to be handled simultaneously, would internally create more opportunities than would simple strategies of arising interference which would then have to be blocked from the focal process of thought. And finally, a third possibility would be that a subject suffering from depression or uncontrollability, as soon as she or he experiences such interference, would also experience confusion, would therefore abandon the complex strategy altogether and resort to a simpler, reliable one. Our data from the linear order experiment would support this idea, showing that the depressed used propositional reasoning in the test stage. Engle too (1996, p. 113) has speculated about such a mechanism.

Although we find that depression and helplessness states result in deficits related to current conceptions of working memory and executive function, we do not believe that the effects of cognitive exhaustion are necessarily tied to these constructs. At present, that cognitive exhaustion results in deficits associated with working memory provides suggestions as to what types of cognitive outcomes and cognitive processes are affected by helplessness and depression. Component functions of the central executive include: (a) the capacity to coordinate performance on separate tasks; (b) the capacity to attend to one stimulus and inhibit the disrupting effect of others; (c) the capacity to hold and manipulate temporarily activated information from long term memory (Baddeley, 1996). Future work on cognitive exhaustion should determine the extent to which each of these are affected. However, note that the deficits in generation of mental models are not specifically mentioned, although such generative functions may - or may not - rely on executive functions. No matter how the discussion of the relation between working memory and varieties of controlled cognitive processing develops, however, the connection between cognitive exhaustion and controlled processing remains. Future work should both be informed by issues in working memory, and consider alternative routes to understanding the nature of cognitive exhaustion.

Another unexplored reason why initiated complex strategies could have remained unsuccessful on the side of depressed and helpless subjects, is their lowered confidence in their own inferences (Gleicher & Weary, 1991;
Peterson et al., 1993; Kofia & Sedek, 1998). To push this argument to its extreme, it could be that these subjects were able to perform all controlled, systematic steps in model construction, ending up with an integrated memory representation just as the control group. However, due to their lack of confidence, they would have mistrusted this inferential product at later retrieval. Consequently, in our study on linear order construction, they might have resorted to propositional reasoning as a more basic, secure avenue of responding.

And still another way of conceptualizing the influence of lowered confidence is in assuming that, although inferential construction is possible, the single steps taken do not appear as subjectively convincing enough or as sufficiently reducing uncertainty. As discussed above, in stepwise decision making, uncontrollability-trained subjects report about no decline in their subjective uncertainty (Kofia & Sedek, 1998). Moreover, our response data from the mental clique experiments point in the same direction. The post-critical study times, which reflect post-decisional ease in accommodating further nondiagnostic information, do not decline in depressed and helplessness-trained samples. These results speak strongly in favor of no decline in subjective uncertainty about which type of mental model to construct. It seems even more suggestive as there is a sharp increase in study time from pre-critical to critical in the impaired groups, indicating that the diagnosticity of the critical relation had obviously given rise to an increase in study time. Thus, an alternative explanation in terms of an overall elevation of uncertainty seems unlikely.

The work described here narrows the focus of questions of the nature of deficits experienced by individuals in helplessness and depression states. The significance of cognitive routes are supported, and our findings suggest that it is higher order, executive functions in particular that are affected. More research is needed to explore the reasons for and nature of these higher order deficits. While we must still agree with Peterson et al. (1993) that the issue why uncontrollability disrupts performance is unclear, we do believe that research focusing on the cognitive deficits holds significant promise.
References


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GENERATIVE MENTAL PROCESSES AND COGNITIVE RESOURCES

Integrative Research on Adaptation and Control

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