

Meditation, Restoration and the Management of Mental Fatigue

Stephen Kaplan
University of Michigan

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Correspondence regarding this article should be addressed to S. Kaplan, Department of Psychology, University of Michigan, Ann Arbor, MI 48109-1109. e-mail: skap@umich.edu

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Abstract

An analysis of the underlying similarities between the Eastern meditation tradition and attention restoration theory (ART) provides a basis for an expanded framework for studying directed attention. The focus of the analysis is the active role the individual can play in the preservation and recovery of the directed attention capacity. Two complementary strategies are presented which can help individuals more effectively manage their attentional resource. One strategy involves avoiding unnecessary costs in terms of expenditure of directed attention. The other involves enhancing the effect of restorative opportunities. Both strategies are hypothesized to be more effective if one gains generic knowledge, self knowledge and specific skills. The interplay between a more active form of mental involvement and the more passive approach of meditation appear to have far-reaching ramifications for managing directed attention.

Research on mental restoration has focused on the role of the environment, and especially the natural environment. Such settings have been shown to reduce both stress and directed attention fatigue (DAF) (Hartig & Evans, 1993). Far less emphasis, however, has been placed on the possibility of active participation by the individual in need of recovery. A major purpose of this paper is to explore the potential of this mostly neglected component of the restorative process.

The paper examines the role of attention in the restoration process both from the perspective of attention restoration theory (ART) and by exploring insights from the meditation tradition. The two perspectives are different in important ways, most notably in the active role that is played by the individual. At the same time, there are interesting common issues. In particular, I explore two ways to bring these frameworks together, namely preserving directed attention by avoiding costs (i.e., things that drain the attentional resource) and recovering attention through enhancement of the restorative process. These lead to a variety of tools and strategies that are available in the quest for restoration as well as a set of hypotheses concerning their expected impact on an individual's effectiveness.

The Complementarity of ART and Meditation

A Brief Overview of DAF and ART

This brief discussion of ART presents some key points that are important to the analysis of meditation in later sections. A more complete description of ART is available elsewhere (Kaplan & Kaplan, 1989; Kaplan, 1995).

The key concept of ART is directed attention, an attentional mechanism that is largely under intentional control.¹ Directed attention plays a central role in fighting off distraction and focussing on weak or ambiguous stimuli. It also makes it possible to sort the important from the unimportant among the vast quantities of stimuli an individual encounters on a daily basis. In his seminal discussion of attention, James (1892) contrasts voluntary attention (his expression for directed attention) with involuntary

attention, the kind of attention that is automatic rather than intentional. (Due to frequent misunderstanding of his terminology, in ART the term "fascination" is used instead.) While James was quite clear on the effortful characteristics of directed attention, he only hinted at its susceptibility to fatigue and its reliance on inhibition to achieve its effect. To update his analysis somewhat, ART views directed attention as a global inhibitory mechanism, such that fatigue from one task transfers to other tasks that subsequently require directed attention.

Directed attention allows one to be selective in what one focuses on both in thought and perception. Fatigue of this mechanism thus constitutes a substantial impairment in an individual's mental competence. For this reason restoration of fatigued directed attention is a matter of some urgency. Spending time in restorative environments, that is, in environments that facilitate recovery from directed attention fatigue (DAF) provides a means of restoring this vital capacity (Cimprich, 1993; Hartig, 1993; Hartig, Mang & Evans, 1991; Kaplan & Talbot, 1983; Tennesen & Cimprich, 1995).

A central feature of ART is its analysis of restoration in terms of four conceptual properties of a restorative environment. Strictly speaking these are properties of a person-environment interaction rather than of an environment per se. Nonetheless these properties can be useful for characterizing environments. In other words, for each of these properties one can identify environmental configurations that are likely to contribute to a restorative experience. The four hypothesized properties are:

Being away: Being distinct, either physically or conceptually, from the everyday environment.

Fascination: Containing patterns that hold one's attention effortlessly.

Extent: Having scope and coherence that allows one to remain engaged.

Compatibility: Fitting with and supporting what one wants or is inclined to do.

Thus in the context of ART, directed attention is seen as a precious and fragile resource. Its preservation requires not using it unnecessarily. Its recovery is aided by spending time in environments where competence is not contingent on its use. Each of the four properties of a restorative environment contributes to these goals.

Contribution of Meditation to Managing Directed Attention Capacity

One could hardly ignore the Eastern tradition of meditation² when considering the active role an individual can play in the restoration process. Many people meditate for reasons similar to those that lead others to pursue restorative experiences -- they seek a tranquil respite, an opportunity to regain composure and focus, a way to keep from being swept away by the distractions of the moment. And yet there are marked differences between the two approaches. Meditation is based on discipline, on a kind of mental training. While the result of meditation training might be a passive and accepting frame of mind, the process of getting there is far from passive. Considerable effort and even struggle are required before this state is achieved (Larkin, 1997). It requires practice, focus and skill. The individual plays a highly active role. By contrast, the restorative experience appears to require no training; in fact, the very exercise of discipline seems antithetical to rest and recovery. Meditation and restorative environment experience thus seem to be contrasting, perhaps even contradictory routes to the same goal. Is there any way to view the two approaches as compatible, or even complementary?

Meditation is a complex domain, with a great variety of approaches, techniques, and even goals (Goldstein, 1987; Mead, 1993; Smith, 1963). In its various forms it plays an important role in a number of distinct cultural traditions. This very diversity might seem to preclude the possibility of a common basis underlying the various forms and versions, to say nothing of searching for communality between meditation and restorative environment experience. Despite these rather substantial challenges, however, the potential benefit of tapping this rich and ancient body of intuition, knowledge and practice makes such a search worth the effort.

The analysis that follows represents a search for a common framework that underlies both ART and meditation. Thus the central issue could be framed as follows: What are the mandates or directives common to both perspectives that the individual is being called upon to carry out? Or more accurately, what is the individual asked *not to do*? While the emphasis on the negative may seem surprising, it is

entirely reasonable within a meditative framework. Meditation is rather like sculpture. One chips away everything that does not belong; what remains is meditation.

One of the striking aspects of many meditation techniques is the emphasis on the different and the distinctive. The ideal meditative environment is a special place reserved for the purpose and separated from reminders of one's everyday concerns. One is encouraged to cultivate a pattern of thought that is different from the usual, and whose content is also different. One may even adopt distinctive patterns and movements. All of these atypical patterns foster cognitive activity whose content contrasts with the content that typically occupies the mind. All of these factors suggest the first of two proposed mandates: Avoid calling on tired cognitive patterns.

In contrast to the simplicity of the first mandate, Mandate Two calls upon a broader range of meditation themes. To the untutored observer, several meditation techniques stand out as particularly striking. Among these are the mantra, observed motion and passive observation. Even a cursory examination of these techniques is instructive.

A distinctive feature of Hindu meditation is the mantra, a word or phrase that functions as an incantation. As one can readily demonstrate for oneself, the repeated mantra is remarkably effective at eliminating the "inner voice," the running dialog with oneself that so often occurs in quiet moments. In this way the focus on past and future events is greatly reduced.

Other meditation techniques pursue this quietness through the use of patterned or repetitive motions. Executed properly, these motions also serve to eliminate other content from the mind. Focusing on breathing, a Buddhist meditation technique, has a comparable effect. Closely parallel is the Zen emphasis on paying attention to the simple and often repetitive activities of daily life such as washing dishes or sweeping the floor.

Another frequently encountered technique involves permitting thoughts to run through one's head, but without intervening. One simply observes passively, permitting these thoughts to occur while refraining from any attempt to manage or direct them.

What is striking about these techniques is that each in a different way discourages active control of the thought process. In part this is achieved indirectly by fascination, such as fascination with slow, patterned movements.³ In taking over the mental process, fascination achieves control without effort.

Another way in which active control of the thought process is discouraged is by techniques that block or interfere with such active control. One either obliterates such activity with a mantra or encourages it to die on the vine by observing it rather than pursuing it. The many struggles that people often engage in, involving efforts to understand, to second guess or to plan, are precluded by these techniques. One might wonder why there is so much emphasis on banishing such internal dialogues. From the perspective of ART, the reason is clear. The mechanism that makes these internal problem solving efforts possible, the mechanism that is called upon repeatedly in doing "serious thinking," is directed attention. Avoiding directed mental activity is thus tantamount to avoiding the use of directed attention. Such attempts to direct the course of thought are effortful; meditation techniques appear to replace or eliminate such effort.

While these meditation tools are diverse, they have a common goal when considered from the perspective of ART. This leads us to the other proposed mandate that provides a common ground between meditation and restoration theory, which is to avoid the unnecessary use of directed attention, either through fascination or through elimination of effortful participation in thought.

The Two Mandates of Meditation from the Perspective of ART

In the context of meditation, the two mandates are accomplished by training and skill. In the context of restorative experiences, however, the goal of these mandates, if they are pertinent at all, must be achieved in a different way. Examination of the relation of ART to these mandates calls on a theoretical analysis of how the mind operates. Two concepts are central to this analysis: the *cognitive map* which is

the knowledge structure hypothesized to underlie much of mental functioning, and *inhibition* which plays a central role in keeping mental functioning organized and focused. The following discussion of these concepts and their mechanisms is likely to be too sketchy for some readers. They might wish to pursue more extensive treatments of cognitive maps (Kaplan, 1973; Kaplan & Kaplan, 1982; Lynch, 1970), directed attention (Kaplan, 1995), and regional inhibition (Kaplan, Sonntag & Chown, 1991; Milner, 1957). Other readers, by contrast, may find this discussion too heavy on mechanism. For them, skipping this section is quite safe, if they are comfortable with taking the following assertions on faith:

1. The cognitive map is an experience-based mental structure that helps guide behavior.
2. Complicated situations require multiple cognitive maps (or mental models).
3. Managing multiple models requires considerable (inhibitory) intervention by directed attention.
4. Inhibition also plays a central role in the management of cognitive clarity. Of particular importance here is regional inhibition, which is domain specific.
5. When regional inhibition fatigues a greater burden is placed on directed attention.

A key function of the mind is to guide what one does next. This process typically involves planning or at least anticipating what might happen. The mental equipment that makes this "lookahead" process (Samuel, 1963) possible can be viewed as a collection of cognitive maps. A cognitive map, in turn, is a mental structure built upon nodes representing "things" one has experienced in the world. ("Things" here is taken very broadly, and includes concepts as well as physical objects.) In a cognitive map these nodes or representations of things are interconnected, mirroring the way one experiences things in the world. In other words, life is not experienced as isolated events, but as one thing after another. These sequences are particularly important because they make it possible to anticipate things before they happen, and hence be better prepared. In the cognitive map the sequences one experiences are coded as paths or connections between the nodes. The result, then, is a network of interconnected nodes that corresponds to what-leads-to-what in one's experience.

This associative richness of the mind permits remarkable flexibility and subtlety, but also inherently creates a threat to clarity. Mental objects or concepts are likely to have participated in many sequences, and thus have a large number of paths or associations. Furthermore, it is likely that several representations will be active at once (the system capacity is approximately five [Cowan, 2001; Mandler, 1975]). Thus, if not controlled, the result would be a vast and diffuse spread of associative activity, only a small part of which would be pertinent to the task at hand.

A physiologically based theoretical account of how this might work is as follows: The needed control in these cases is provided by inhibition, which plays a "clean-up" role, eliminating the weaker and more diffuse activity. One mechanism which serves this function is called regional inhibition because its influence is restricted to a particular region or area of neocortex. It facilitates clarity and focus with respect to a specific domain or task, but it can only accomplish this for so long. In due course, the neurons responsible for the regional inhibition in a particular domain become fatigued.

While regional inhibition plays an important role in the maintenance of clarity, it is by no means the only inhibitory mechanism that does this. Directed attention, which depends on global as opposed to regional inhibition, is an alternative means of enhancing clarity. As long as the regional inhibition related to a content one is focusing on is rested and effective, there is less need for intervention through the use of directed attention. Conversely, when the neurons responsible for regional inhibition in a particular domain become fatigued, one must either change domains or increasingly depend upon directed attention. Thus it is postulated that protecting regional inhibition from fatigue will, in general, protect directed attention as well.

The same associative richness that challenges clarity becomes an even more pressing issue when one is dealing with a complex situation. In such cases different aspects of a situation lead one to think of different things, inclining different mental models to become active. To manage such situations one must recognize whether the partially activated mental model is pertinent to what is important at that moment. Furthermore, the cognitive map that is most important to the requirements at the moment needs to be protected from the competing alternatives. Directed attention plays a central role in accomplishing this goal. As James has pointed out (in his discussion of the will), the only way to protect a weak idea from potential interference is to inhibit everything else.⁴ Thus in a multiple model situation, global inhibition (the

output of the directed attention mechanism) is employed frequently.

Armed with an introduction (albeit sketchy) into some of the mechanisms assumed to underlie the workings of directed attention, we are in a better position to examine how the four requirements of a restorative experience relate to the two mandates of meditation.

Mandate 1: Avoid calling on tired cognitive patterns. This mandate seems closely related to the "being away" requirement of a restorative experience. While being away has been a part of ART from its inception, the hypothesized underlying mechanism has not previously been explicitly stated. Let us begin with a commonplace observation. Often when one has devoted considerable effort to some task, perhaps studying, one feels tired of it. The fatigue, however, need not get in the way when changing to a different content. It is not unusual to experience increased clarity and focus after such a shift. This improvement is the result of leaving a domain where the regional inhibition is fatigued in favor of a domain where the regional inhibition is relatively less fatigued. While there are admittedly vast differences in this phenomenon across people and content domains, the pattern is nonetheless quite common.

For many people the content domains that make up their round of everyday activities all lack rested regional inhibition. In other words, they function in the face of a persistent state of fatigue and reduced clarity. Understandably they yearn to "get away from it all." But Mandate 1 goes beyond "being away," in its usual sense. By engaging in tasks with too little variety, or spending too long on an activity before changing, one misses opportunities to rest regional inhibition within the context of one's everyday activities. In other words, there are opportunities for increased balance that do not require "getting away from it all." And since lack of balance ultimately, although indirectly, impacts directed attention capacity, such less dramatic adjustments can have important consequences.

Mandate 2: Avoid unnecessary effort. While Mandate One has ties to being away, Mandate Two is related to each of the other requirements of a restorative experience. The connection to "fascination" is the most straightforward of these. One way to spend time without using directed attention is by interacting with interesting things; this is what the fascination component of restorative experiences is about. It is thus hardly surprising that fascination is related to Mandate Two, as it has long been seen as a way to reduce the need to use directed attention.

The relation to the "extent" property of restorative experiences requires greater elaboration. At an intuitive level, extent is related to the distance to a boundary -- physical or conceptual. The magnitude of that distance and how it is filled are both critical to the sense of extent. In terms of the individual's mental state, a sense of extent is enhanced by the feeling that the "space" one is in has coherence and scope. These concepts may be easier to understand in terms of the cognitive map of the individual. In the context of a specific place or domain, the cognitive map reduces the need to be vigilant or observant as one can anticipate what might happen and know how to deal with it. Thus situations in which one can rely on more extensive cognitive maps demand less directed attention.

In a coherent environment things follow each other in a relatively sensible, predictable and orderly way. Coherent environments make a cognitive map easier to build and easier to use. But even in a coherent environment the boundary may come too soon. If the environment has insufficient scope one must relinquish one's currently running cognitive map and bring up a different one. This is true whether this deficiency is physical or conceptual. A garden in which one has many things to check out, care for, and wonder about can have vast scope even though it is physically small.

Extent thus calls on both scope and coherence. Insufficient scope terminates the experience; insufficient coherence makes it difficult to experience the setting as a unified entity. From the point of view of restoration, running a single cognitive map for an extended period of time is ideal.

Several other ways to rest directed attention by avoiding effort have interesting connections to the final restorative experience requirement, "compatibility." For example, one might avoid situations where there is (a) insufficient or inappropriate information, (b) inappropriate motivation, (c) the need to run multiple models, or (d) inadequate skill. These all describe situations where the compatibility requirement of restorative experiences is

negated. The present analysis highlights the intimate relationship between *incompatibility* and the expenditure of effort. This connection suggests that incompatible environments are costly in the sense that they require a high expenditure of directed attention.

Compatibility has been described in terms of various matches between person and environment. For example, whether one's intended actions are the same as what is required by that environment is an important kind of match; an environment that forces one to do what one doesn't want to, or that prevents one from doing what one intends, is a major source of incompatibility. Whether the information needed to carry out one's intended actions is readily available is another way in which an environment may or may not match one's needs and inclinations (Kaplan, 1983). This description highlights two potential sources of conflict between person and environment. One of these is informational; the other, reflecting the conflict between what one is obligated to do and what one wishes to do, is motivational.

Another way to cast this analysis of compatibility closely parallels the discussion of extent. It is based on the idea that behavior is guided by the mental model or models that one is running at that particular moment (Kaplan, 1992). In a highly compatible situation, where one acts directly and intuitively, a single mental model will suffice. If, however, what one is inclined to say is inappropriate to a situation, or if one has to check oneself constantly to be sure that what one is doing is acceptable, then one necessarily has to run more than one model at once, and the effort (and hence, directed attention cost) rises substantially. Behaving correctly in an unfamiliar situation as well as saying one thing and believing another are familiar examples of the multiple model situation. As we have seen, there is a basis in theory for believing that multiple models require considerable mental effort to manage.

There is also support from clinical practice. In a previous era, the distinguished French psychiatrist, Pierre Janet (1924) identified a group of individuals he characterized as low in "psychological energy." He advised them to marshal their limited resources with care. An example that suggests the cost of multiple models was his recommendation that they never talk with more than a single individual at a time. In more recent times clinical neurologists have identified another multiple model context, the Trail Making test, as a useful measure of attentional capacity and of executive functioning (Lezak, 1995). The test has a series of numbers and letters scattered in different locations on a page. The task is to draw a line from A to 1 to B to 2 to C, etc. The performance on this task is contrasted with the score on a similar task, but where what is to be connected are numbers alone. The greater the difference in performance on the two-model task relative to the simpler task, the more the attentional impairment.

A previously neglected aspect of compatibility is that of competence, a theme that arises frequently in Csikszentmihalyi's (1975) discussion of the flow concept. Clearly a major source of incompatibility exists if the action called for in the situation and the action one is motivated to carry out are the same, but this action exceeds what one is capable of doing.

Thus four distinct domains of incompatibility can be identified: information, motivation, multiple models and competence. All have in common that they require effort. Effort, in turn, is a hallmark of the use of directed attention (Posner & Snyder, 1975).⁵ Thus these domains link the present analysis, which views incompatibility as undermining the restorative process because it requires effort, to the mandate to avoid unnecessary effort.

As this analysis suggests, there are many opportunities for incompatibility. Some are unavoidable aspects of human existence; others could be reduced substantially by changes in the cultural or the physical environment. An environment in which unnecessary incompatibilities are eliminated, would be far less costly of directed attention, and could make the need for restorative environments somewhat less acute and more manageable.

Thus in contrast to Mandate 1, which concerns balance, Mandate 2 points to the properties of an environment that make it supportive. While my previous analysis of supportive environments focused on the role of compatibility (Kaplan, 1983), it seems appropriate to extend the concept to include fascination and extent, both of which also reduce the need for effort.

The two mandates are thus independent in terms of focus (balance vs. supportiveness) as well as mechanism (regional inhibition vs. fascination). They also differ in their implications for action. Mandate 1 points to the importance of task management to lower attentional costs. Mandate 2 points to the cost reducing potential of certain kinds of environments. Their very independence suggests that they would be particularly effective in combination. This conclusion is, of course, hardly surprising, since together they encompass the four properties hypothesized by ART to characterize restorative environments.

The fruits of the foregoing analysis are summarized in Table 1. Each mandate has distinct but complementary correlates in the realm of environment and in the inner world of meditation. The environmental correlates are the four properties of a restorative environment; the meditational correlates are a more effortful, but at the same time more portable means of achieving similar outcomes. Admittedly the use of effort might appear to be paradoxical in an approach that appears to foster mental restoration. However, the effort involved is reported to decrease substantially with practice (Larkin, 1997), so that it can be viewed as an acquisition cost rather than an enduring difference.

Table 1
Comparison of ART (Environmental) and Meditation (Person-based)
Approaches to the Management of Directed Attention

	Environmental	Person-based
Mandate I Avoid calling on tired cognitive patterns	Being away	Change tasks reasonably often and seek balance in one's activities.
Mandate II Avoid unnecessary effort	Fascination and aesthetics Extent Compatibility	Learn to recognize, seek, and create supportive environments.

The two mandates drawn from the examination of meditation thus appear to have strong links to the restorative properties of environments, suggesting some common underlying themes. Implicit in this analysis are two distinct, yet often overlapping, ways in which an individual can take an active role in reducing the level of DAF. One way is through enhancing the restoration process. Perhaps equally important, however, is the reduction of those costly encounters that lead to DAF in the first place. Following William James (1892), it is not difficult to imagine that talking with an unpleasant individual about boring matters at a noisy party would tax directed attention. But this example, vivid though it is, hardly scratches the surface in terms of the kinds of costly encounters that an individual would need to know about in order to avoid unnecessary losses of this precious resource. A major focus of this paper, therefore, is to explore what information an individual would need in order to take a more active role in both restoration and cost avoidance.

Cost Avoidance

While people tend to find the idea of mental fatigue intuitively meaningful, they often have little awareness of its manifestations or its time course. They are often cognizant of the various problems caused by a depleted directed attention capacity, but they tend to experience these problems as unrelated to each other. Further, they often hold beliefs from their culture that undervalue the role of rest and reflection. The range of knowledge and skill necessary for people to manage the attentional resource effectively is thus substantial.

Closer examination of the factors that influence directed attention leads to two complementary strategies. One of these, the focus of this section, concerns preservation of the attentional resource by avoiding or mitigating situations that are costly. The other strategy, discussed in the next section, concerns ways to enhance the benefits of restorative experiences. This strategy takes on increasing importance to the extent that the first strategy is not fully effective. While the strategies differ in important ways, they call for similar tools. The overarching hypothesis in both instances is that if the individual has the knowledge and skill necessary to recognize, anticipate, and manage potentially costly situations and to recognize, seek, and intensify restorative situations, there should be a gain in directed attention capacity.

Generic Knowledge and Cost Avoidance

Avoiding costs or conditions that drain directed attention is difficult if one cannot recognize such conditions. Given the great diversity of such conditions, no simple rule of thumb is likely to aid recognition.

Rather, some more abstract or generic knowledge seems called for. At the same time many of the individuals who need this information may not be interested in theory. Thus the challenge is to cast the material in a sufficiently concrete and memorable form such that it is understandable and useful to theoryphiles and theoryphobes alike.

Cost avoidance is closely related to avoiding incompatible environments. The comparison of the meditation perspective and the ART perspective pointed to a wide range of sources of incompatibility. These can conveniently be grouped into three categories, incompatibilities that undermine clarity, those that arise out of incompatible action, and finally, those where the task itself is the source of incompatibility.

Clarity Problems

The clarity concept has already been mentioned briefly in the context of the regional inhibition concept. While the discussion that follows fills in a bit more of the story, it is still highly simplified. Readers interested in greater detail should consult earlier treatments (Kaplan, 1978, 1991). Clarity is a state of mind in which mental activity is dominated by a relatively small (5 ± 2) number of active circuits that meet two criteria: the circuits are strongly active, and are related to each other and to the topic at hand. Clarity is a pleasurable mental state, best exemplified by an individual who has an insight in which all the pieces of a problem previously struggled with are finally falling into place. Another example would be of an individual who gradually comes to an understanding of a subject matter that has been studied, despite confusion, for some time.

A failure of clarity can result in ways that are seemingly quite different from each other. One form of unclarity is the result of a state of mind in which the mental activities, although few in number, related to each other, and strongly active, are so compact that they do not fully occupy channel capacity, and hence do not dominate the mental space. For example, an expert who once experienced clarity in practicing his/her craft may eventually come to experience boredom instead. At the other end of the spectrum, an individual first learning a body of material may have many weak and not-yet-related activities instead of a few strong ones. This creates an experience of confusion rather than of clarity.

As we have seen, clarity benefits from a favorable signal to noise ratio. Distractions, by definition, reduce that ratio. Lack of information, too, makes it harder to separate the relevant from the irrelevant. Both of these circumstances are endemic in a world characterized by so much information and so little structure.

Distraction makes it more difficult to obtain the information one needs to pursue one's purposes. A distracting environment is often characterized by stimuli that are fascinating, but irrelevant to one's purposes. As marketing has intensified the commercialization of the visual world, in some urban areas irrelevant fascination has become the norm. What was once called "information input overload" is probably more appropriately characterized as distraction that makes obtaining the information one needs a highly effortful activity.

Deficit of information. Situations in which one lacks adequate information to know what to look for, how to behave appropriately, or to achieve some other goal require intense attention to assess potentially useful cues.

Thought vs. Action

Sometimes the difficulty lies not in a lack of clarity, but in the complexity of managing behavior that is not an accurate reflection of one's inclinations. There can be various reasons for this.

Duty frequently refers to expected or required action that is different from what one would prefer to do. One does things that are unpleasant or difficult, but necessary. One tolerates boredom. One pushes on despite fatigue. In circumstances of this kind effort is required to persist in behavior that is in conflict with some underlying motivation.

Deception involves saying or doing one thing while thinking another. Multiple models are required, and the effort necessary to carry on such mental bookkeeping is considerable. Deception need not

involve guile. One can behave politely while trying to figure out how to get out of the situation as quickly as possible. One can act calmly while struggling to comprehend what is going on. Even trying to behave in a formally correct way while being confused about the appropriate rules in the situation may involve deception of a sort.

Task-generated Problems

Attempts to do something that is beyond one's ability or skill is an invitation for incompatibility. One may experience impaired focus, because one does not know what to look for. One may experience response incompatibility, especially if it is something one is expected or required to do. The difference between task difficulty and the other incompatibilities we have considered is that in this case the source of the problem is not extraneous but inherent to the task. The difficulty arises from a mismatch between the individual's competence and the requirements of the task. People resist getting into something they suspect may be beyond their competence, and understandably so.

Difficulty. A useful first step in alleviating such potential incompatibilities is to anticipate tasks or situations that would tax one's capacity and skill. In some cases anticipation can lead to avoiding the situations or at least give one time to acquire needed skill before they need to be faced. At other times the difficulty may be unavoidable, but anticipation can nonetheless be beneficial and lead to more adaptive responses. Such difficulties come in all too many variations. They include, for example, circumstances of prolonged uncertainty that may be associated with health or job or interpersonal matters; the experience of loss, whether of a valued individual, place, or even of an ability; and adapting to a new environment. In these situations it is helpful to have appropriate expectations with respect to the costs and the likely consequences.

Perhaps a note is in order as to why uncertainty, loss, and grief might be so costly of directed attention. As we have seen, a key role of the mind is to guide what one does next. The individual's collection of cognitive maps makes possible planning or at least anticipation of possible next steps. Experiencing a loss, whether it be of a loved one, a physical capability, a job or a special place, has important cognitive as well as affective consequences. Cognitive maps containing representations of the lost object cannot function as before. Three things happen when some formerly routine cognitive pattern is initiated after a loss. There is an experience of discrepancy, of mismatch, because it is no longer possible to carry out the old pattern in the old way. Pain is experienced due to the forceful reminder of the loss and its implications. And the map sequence is broken; it cannot be run smoothly to its terminus as was formerly the case. In the long run such disruptive cognitive events are adaptive, since they encourage the break-up of the old cognitive map structures and their reorganization. In the short run, however, such experiences are disorganizing, frustrating and sometimes paralyzing.

When one harbors a serious uncertainty (such as whether one will regain the ability to walk or whether one will receive a needed transplant in time), the cognitive state is similar to that of loss. Instead of possible futures one experiences discrepancy, pain and cognitive maps that are no longer functional.

In all of these cases, one cannot be confident that what was once assumed is now possible. Trying to think without running into painful reminders is extremely difficult — constant vigilance is required to keep from falling into old patterns that once provided comfort but now guarantee quite the opposite. In addition, the intolerance of others to listening to one's struggles (Pennebaker, 1992) leads to a classic dissimulation situation, where what one says and what one feels and thinks are in sharp conflict.

Danger presents a complex picture. Modest amounts of danger that test one's skills can be fascinating, as many mountain climbers can attest. On the other hand, uncontrollable, chronic danger can be exhausting. A situation perceived to be dangerous evokes a high level of vigilance toward potentially important signals. Since vigilance requires sustained attention, the costs in terms of effort can be considerable. There may also be additional need to behave in a cautious or constrained way; such inhibitory control of one's behavior is also costly. While brief experiences of this kind can be tiring, sustained effort in the presence of potential danger can be particularly costly. Consider the inner city dweller, for whom such costs can be ever present, and who is expected to function despite a chronic state of mental exhaustion (Obasanjo, 1998).

There is yet another kind of danger, quite different but still capable of evoking fear. This type of danger is characterized by fear of doing the wrong thing, of breaking something, of looking foolish. Struggling with a new piece of software can lead to such concerns, as can public speaking. Here competence limitations (perceived or actual) can play a key role.

This analysis of generic knowledge and its implications for cost management leads to Hypothesis One: Knowledge of the various sources of directed attention costs (clarity problems, thought vs. action conflicts, and task-generating problems) will help sustain directed attention capacity over the longer run.

Self Knowledge and Cost Avoidance

While generic knowledge is invaluable, it is not in itself a sufficient basis for effective cost reduction due to the substantial individual variation in these matters. What is a costly incompatibility for one person may be nothing more than a mild annoyance for another. Comparably, how quickly directed attention fatigue develops and how it is expressed have different patterns in different people. Actively exploring one's own characteristic ways of acting and reacting is an essential ingredient of self-knowledge. One needs to learn to recognize what drains one's directed attention. Easy as this may sound, such information is difficult to discern. Not only will the demands on directed attention differ with the circumstances, but DAF may only show up after a delay. Further, DAF is a cumulative deficit that may reflect a series of low level drains rather than one dramatic one. While the human mind is exceptionally efficient at associating discrete events that occur close to each other in time, important contingencies are likely to slip by unnoticed when characterized by gradualness and delays between cause and effect (Platt, 1973). It also may be difficult to detect patterns that fail to fit one's usual categories.

The Benefits of Mindfulness

A crucial element in cost management is being aware of what is going on, of being sensitive to that which is subtle and often overlooked. There is a special form of sensitivity, often called mindfulness (Benson & Klipper, 1976; de Silva, 1990; Kabat-Zinn, 1993; Miller, 1995), that could play a useful role here. This is well illustrated by Ram Dass's (1976) well known mandate to "be here now," which involves taking in what is present, appreciating what is. It is perception, uncontaminated by what was or what might be. When one is mindful, one is not engaged in worrying about the future or regretting the past. One is fully there. Such mindfulness can be a powerful tool. But this is not a tool that is acquired without effort. Both taking in situations and being aware of oneself require not only knowledge but practice as well. It is a kind of expertise, and as with any expertise, it takes time before it can be called upon with little or no effort.

Though probably not sufficient by itself, acquiring this expertise can provide an important source of information about what is costly in one's life. Given uncertain temporal relationships and the possibility of gradual, cumulative effects, a more systematic approach may be useful. Small personal experiments based on keeping records of potentially costly events and of one's perceived competence or effectiveness could provide a firmer basis for important insights. Such recording is likely to be most useful in the framework of a calendar since time lags between cause and effect add to the challenge of seeing recurring patterns.

There is an additional benefit of acquiring the skill of mindfulness. It offers a low-cost means of relating to the environment. This passive, accepting way of attending provides a restful alternative to the intensely analytic pattern frequently encountered in the western world.

A word about terminology: Mindfulness in the meditation context should not be confused with a quite different use of the same term by Langer and her colleagues. As is clear from Langer's (1989) book of the same name, her use of the concept involves the avoidance of automatic cognitive processing in the pursuit of more effective problem solving. This kind of mindfulness is active, highly goal oriented, and often effortful. Langer has noted (but not attempted to resolve) the substantial differences between these two uses of the term.

Intrinsic Motivation

There are many times when one faces a task one would rather not do. Forcing oneself to do something requires considerable inhibition and is thus costly. Bringing intrinsic motivation into one's life

and activities is a way to reduce such costs since it introduces a fascination component into the equation. This both makes the task more attractive and makes its more unpleasant aspects feel worthwhile. Admittedly, arranging one's life to increase the proportion of intrinsically interesting activities can be challenging. It violates the culturally-supported adage that "one can do anything one sets one's mind to do." Instead it emphasizes self-knowledge, both in the sense of knowing what one finds interesting and what one is good at. One way to maintain the presence of intrinsically interesting activities in one's life is by choice of occupation and activities that meet those criteria. A complementary strategy is to try to transform what one has to do into something that one is also interested in. Hallowell and Ratey (1994) mention this as a successful strategy for students with Attention Deficit Disorder (which in many ways parallels DAF).

The discussion of these ways in which costs can be reduced by self-knowledge and skill lead to the following hypotheses:

Hypothesis Two: Discovering what is personally costly (e.g., through record keeping and small experiments) can lead to a favorable shift in directed attention capacity.

Hypothesis Three: Acquiring and applying the skill of (meditational) mindfulness will help sustain directed attention capacity over the long run.

Hypothesis Four: An active strategy of incorporating intrinsic motivation in otherwise undesirable activities will help sustain directed attention capacity over the long run.

Restoration Enhancement

The focus in the previous section was on ways to sustain directed attention capacity by finding the costs or situations that lead to its decline. The focus in this section shifts to strengthening directed attention by identifying situations that have a restorative effect. It is striking that the same tools can apply despite the strong contrast in strategy; recognizing restorative situations also requires both knowledge and skill. While cost reduction is a relatively neglected area of DAF management, restoration is more widely studied and more frequently discussed. Even in the case of restoration, however, there is benefit to be gained from taking a fresh look; in particular, it is useful to explore ways in which the individual could take a more active role in the process.

Knowledge and Enhancing Restoration

Without placing a priority on restorative experiences, many restorative opportunities are likely to be missed. Even if one has such a priority, but is unable to recognize a restorative opportunity, the directed attention capacity is likely to suffer. For these reasons, generic knowledge can make a major contribution. Watching television provides a good example as many people consider this to be a useful and appropriate way of recovering from fatigue. Knowing what to look for in a restorative environment (and knowing that television is far from that [Canin, 1991]) is an important first step. Realizing the life-influencing impact of restorative experiences is also essential if one is to assign such activities the priorities they deserve.

Paradoxically, the effect of a restorative experience on mental activity often occurs unnoticed. Nature content, when present in the environment and taken in by the mind, can have its impact without the participant's awareness. While the beneficial effect of nature has the advantage of requiring minimal skill and mental effort, it is highly dependent on the environment as well as whether (and how) the individual is relating to that environment. That is, when the mental activity is resonant with what is in the environment, the restorative effect would be greater. Further, an environment that is not particularly attractive may nonetheless yield a substantial restorative effect when viewed by a person with pertinent experience and skill. The possibilities here are fascinating. Modest environments could have more impact, and perhaps even inclement weather could have beneficial effects with suitable instruction and experience.

Useful as it may be, intellectual understanding of this kind often carries little weight when one is tired and perhaps even impatient and irritable. This is one area in which concrete, personal experience seems to be essential. A deeply restorative experience can have a remarkable influence on one's outlook, one's effectiveness, and one's sense of who one is and what one can do. Further, having personally

experienced such a transformation, one is far more likely to put a priority on restorative opportunities in the future.

Research carried out in a wilderness context provides a vivid example. Participants in a wilderness program lasting between 7 and 10 days were asked to keep diaries for the first week after their return. A striking finding of this research was a deep concern shared by many participants. They found the wilderness experience to be deeply restorative (although they did not use this term). They were apparently unfamiliar with being in this state, since they felt it revealed aspects of their personalities that they had not known before, and that they valued highly. Having found their time in the wilderness so transforming, they were worried about how they could be sure to have such experiences again in the future. Their sense of discovery and the emotional impact that accompanied it may not have been possible without this first-hand experience (Kaplan & Kaplan, 1989).

Thus self-knowledge in this context concerns not only finding out what environments one finds particularly restorative, or even finding out what impact such environments have on one's effectiveness. It also concerns a deeper level of knowing, where the priority becomes less abstract and more urgent. This may well have been what happened to the participants in the Gagnon Thompson and Barton (1994) study, whose concern for the preservation of natural areas was more than hypothetical, and included the willingness to take concrete action.

This analysis leads to Hypothesis Five, which has two parts: (a) Individuals who have knowledge about what constitutes a restorative environment plus first-hand experience with the difference that restoration can make will be more likely to use the knowledge in organizing their lives, and (b) Those who do use this knowledge will enhance their effectiveness in recovering directed attention capacity.

Meditation and the Enhancement of Restoration

The Eastern meditation tradition plays a central role in the skills hypothesized as important to restoration enhancement. The skill one most readily associates with this tradition is, of course, meditation itself. As we have seen, meditation shares the goals of restoration, namely to foster tranquillity and allow the mind to rest and regain its capacity to focus. Both restorative experiences and meditation also seek to avoid incompatibilities. Meditation, however, approaches these goals in different ways than by seeking restorative settings. While the restorative experience is a means of recovering through avoiding mental effort, meditation is a discipline that requires mental effort. In one sense this is a minor difference, in that the effort involved is reported to decrease substantially with practice (Larkin, 1997).

In more important ways, however, this is a profound difference, since many individuals with sudden urgent need for restoration (due, for example, to the onset of a life-threatening illness; e.g., Cimprich, 1993) may have little capacity for the effort required to learn the skill. This is a disadvantage of meditation, at least in certain contexts. On the other hand, finding the right kind of environment to reduce mental fatigue may not be straightforward either. In this respect meditation is relatively undemanding. Interestingly, however, monasteries that focus on meditation tend to be situated in environments that are striking for their restorative qualities. The architecture in such settings, too, appears to be designed with its restorative potential in mind.

The possibility that an environment could facilitate meditation has fascinating implications. First, it suggests a continuum between the environmentally-based restorative experience of the mindless recreationist and the highly disciplined and internal meditation experience of the Zen practitioner. Intermediate points along this continuum, involving various combinations of environmental support and skill, could be useful in situations where neither superbly restorative environments nor great skill are available. Second, it suggests that, given an appropriate setting, even a relatively unskilled individual could do something approximating meditation with comparatively little mental effort. This appears to be a promising area for research. In this hypothesized trade-off among skill, effort and environment, the skill and perceived effort should be fairly simple to measure. One might also explore the effect of the sorts of variables uncovered in research on environmental preference, such as mystery and legibility (Kaplan & Kaplan, 1989).

Thus we have Hypothesis Six: Consider an individual with little meditation training attempting to meditate in an environment arranged to have only modest restorative properties. That individual would be

expected to experience more recovery of directed attention capacity than either the same person in the same environment, who is not attempting to meditate, or the same person trying to meditate in an environment that offers fewer restorative properties.

The practical benefits of research in this area are clear. Restorative environments may be inaccessible because of distance or inclement weather or the health status of the individual in need of restoration. Having an alternative as a supplement to a restorative environment experience, or even as a substitute when there is no other alternative, could substantially increase the availability of this important component of psychological health.

Meditation by individuals of limited skill in an even modestly restorative indoor environment thus represents a researchable and potentially useful middle ground. Another potentially fruitful middle ground depends upon providing the individual with techniques to increase receptivity to environmental patterns. Consider, for example, an individual in an environment with natural elements, such as a park in an urban area. While there is considerable evidence for the restorative effectiveness of natural stimuli, in order to have their full effect, they must be mirrored by the activity of corresponding structures in the mind. If, for example, while passing through a natural area, one is wholly engaged in an intense conversation with a companion, there would be little mental activity that is resonant with the setting, and presumably, considerably less restorative effect as well.

Although this approach to restoration enhancement seems straightforward, its implementation takes us into uncharted territory. In the absence of well-formulated proposals, some examples might be helpful. In *The Tracker*, Brown (1978) describes his training in how to see and interpret natural signs (such as animal tracks) by Stalking Wolf, the Native American grandfather of a friend. It turns out that the acquisition of this expertise, as with expertise in general (de Groot, 1965), is a process of learning to see. As one increases one's skill at knowing what to look for, an environment that might have been confusing – or even boring – becomes transformed into one rich in things to see, explore and think about. The book is engaging and inspiring; the exercises involved in this learning process, however, require considerable patience and discipline.

Frisbie's (1969), *It's a Wise Woodsman Who Knows What's Biting Him*, takes an approach that is both more light-hearted and more conceptual. He recommends that every nature outing be made more worthwhile by turning it into an expedition or adventure. Thus, for example, he suggests that even a neighborhood walk be converted into a hike by taking a backpack and a walking stick. His many examples focus on how to utilize the imagination to increase "red blood density," a concept that while tongue-in-cheek, nonetheless belongs in the same family as increasing directed attention capacity.

Leff (1984), in his *Playful Perception: Choosing How to Experience the World*, shows the potential effectiveness of cognitive sets (or what he later called "awareness patterns" [Leff & Nevin, 1994]). For enhancing a natural environment experience, Leff suggests the following examples (personal communication, 1997): "Imagine you have a camera with only a few frames of film left and your goal is to select the most interesting natural objects or scenes you can find around you (or the most soothing or inspiring scenes, etc.)," or "Consider how each item in your surroundings adds to your non-monetary 'wealth'," or "What would you select from your surroundings to keep in your own private landscape?" Similarly, one might have a goal of looking for roadside flowers while on a bike trip.

This leads to Hypothesis Seven: If ways can be found to increase an individual's resonant mental activity with respect to a potentially restorative environment, the restorative effectiveness of the experience will be greater than it would have been otherwise.

Conclusion

Playing an active role in preserving and renewing directed attention is enhanced by three kinds of knowledge. First, one must understand enough generic knowledge to think cogently about what might be happening and to recognize indications of one's condition. Second, one must be able to translate the knowledge one has to fit one's own situation. This requires a substantial degree of self knowledge. And

finally, one's effectiveness is likely to be further enhanced by acquiring such skills as mental resonance, mindfulness and meditation.

These three knowledge factors provide the basis of a coordinated approach to avoiding or mitigating incompatible environments. This is not, however, their only role. These same three factors can make an equally important contribution to restoration. In other words, the knowledge factors could contribute to both sides of the ledger: to reducing the loss of directed attention through management of costs and to increasing the reserve of directed attention through restoration enhancement. Table 2 provides a summary of these relationships.

Table 2
Kinds of Knowledge Necessary to Improve Directed Attention Capacity

Kind of Knowledge	Cost Avoidance	Restoration Enhancement
Generic knowledge	Clarity problems Thought vs. Action Task-generated problems	Knowing what is restorative.
Self-knowledge	Identifying what is costly.	What works in one's own case?
Skill	Avoiding what is costly. Drawing on intrinsic motivation.	Meditation per se and mental resonance as ways of making an environment have more impact.

Ultimately the key issue, as far as the state of mental fatigue and its recovery are concerned, is what happens in the mind. Something in the environment that is not taken in by the mind is unlikely to influence it. Meditation takes on this challenge directly by controlling mental content. It has the benefit of modest environmental requirements but the potential disadvantage of requiring effort in the very act of avoiding effortful thought. Attention restoration theory, by contrast, emphasizes the role of the environment. The synthesis of these two perspectives offers promise for managing cost and enhancing restoration, thus increasing the availability of this life-enhancing resource.

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Footnotes

¹ James's (1892) use of the expression "voluntary attention" for this mechanism suggests total intentional control; in certain contexts, however, the use of directed attention becomes habitual. In such cases the mechanism may be employed automatically and unconsciously, and may, therefore, be quite independent of intention.

² While Shapiro (1994) points out that meditation has been "an essential element of the esoteric aspect of all contemplative religions and spiritual traditions (p. 111), he also acknowledges that the vast preponderance of research on meditation has been done on individuals using Eastern meditation techniques. This is also characteristic of popular writing on meditation in Western culture. Thus the characteristically Eastern patterns tend to be the most familiar and best understood.

³ A frequently heard objection to this idea is based on the concern that focusing on body rhythms such as breathing or on slow patterned movements could be boring. This is a complex issue. First, it must be recognized that fascination is learnable (James, 1892), and that it likely is far easier to learn fascination to some things rather than others. Many have come to find the slow, highly patterned, feedback-sensitive breathing characteristic of Yoga thoroughly fascinating. Comparably, the slow, graceful and thoughtful movements of Tai Chi also hold fascination, both for the person practicing it and often even for the observer. Clearly there is much room for research here. An additional hypothesis worth exploring: younger people, who tend to value excitement, may be less disposed to find these things fascinating than do older people, for whom peace and mental calm can be enormously engaging experiences.

⁴ This description should not be taken too literally; there is no physiological basis for believing that a global mechanism can differentially inhibit the relevant and the irrelevant. However, early in the activation of a mental structure inhibition has a differential effect. It interferes far less with an activity that is gaining in strength than with an activity that is barely begun (Kaplan, Sonntag & Chown, 1991). In this way, through appropriate timing, a global mechanism can have a specific effect.

⁵ While individuals are often aware of the effort involved in utilizing directed attention, much directed attention occurs without conscious effort. This is particularly the case for activities in which directed attention and fascination are simultaneously active, as in writing software, or even in producing text about topics one finds interesting.