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THE RESTORATIVE BENEFITS OF NATURE: TOWARD AN INTEGRATIVE FRAMEWORK

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Abstract

Directed attention plays an important role in human information processing; its fatigue, in turn, has far-reaching consequences. Attention Restoration Theory provides an analysis of the kinds of experiences that lead to recovery from such fatigue. Natural environments turn out to be particularly rich in the characteristics necessary for restorative experiences. An integrative framework is proposed that places both directed attention and stress in the larger context of human–environment relationships.

Introduction

Evidence pointing to the psychological benefits of nature has accumulated at a remarkable rate in a relatively short period of time. Whether a theoretical understanding of these restorative influences has kept pace with the empirical work is, however, less clear. As Hartig and Evans (1993) have pointed out, theory in this area has been dominated by conflicting positions, one emphasizing stress reduction (Ulrich, 1983) and the other concerned with recovery of the capacity to focus attention (Kaplan & Talbot, 1983; Kaplan & Kaplan, 1989). While it might be argued that these positions are hopelessly far apart, Hartig and Evans hold out hope for a synthesis. The purpose of this paper is to propose a way in which such an integration might be achieved.

A synthesis requires first that there be something to synthesize. There must be entities or ideas distinct enough and useful enough to warrant synthesis. One piece of this is simple to achieve; there is no disagreement over the point that stress is a meaningful concept and that stress reduction is aided by natural environment experience. Ulrich *et al.* (1991), however, have questioned the usefulness of the attentional concept in this context, and have suggested that the performance deficits found in research on attentional fatigue can be understood simply as effects of stress.

Given these questions and alternative interpretation, it seems appropriate to begin by focusing on 'directed attention' and its role in the Attention Restoration Theory. Several studies that examine the relationship between the natural environment and restoration are then presented. This lays the groundwork for proposing an integrative framework which focuses on the causal matrix that connects stress and attention. Finally, the paper offers some directions for future research and concludes with a brief analysis of the merits of distinguishing between stress and attentional factors.

Directed attention

An important source for the attention constructs central to Attention Restoration Theory is the work of William James (1892). His 'voluntary attention' concept concerned the kind of attention that went 'against the grain', as it were. It was to be employed when something did not of itself attract attention, but when it was important to attend nonetheless. Thus James emphasized the centrality of effort in the employment of this kind of attention. Certainly the themes of 'voluntary' and 'effort' suggest the functioning of the will, a topic of considerable interest to James. And in fact, by turning to his discussion of will, it is possible to gain still further insight into his thinking on this issue. In exploring

how one can support a weak intention, such as a thought of something one ought to do but finds difficult, James indicated that the only hope was to inhibit all distractions. There was no way, he felt, to strengthen the weak intention itself. The only support one could provide required protecting it from competing thoughts.

While James did not explicitly relate his discussions of the will and of voluntary attention, it is evident that in both cases the central construct is that of focus, of supporting difficult mental activity in the face of potential distraction. Bringing these two Jamesean themes together yields a more general mechanism than either would be separately. It also suggests an interesting and far-reaching hypothesis about the operation of this mechanism, namely that it is inhibitory in nature. Although James did not use the term 'inhibition', a mechanism whose operation depends on the suppression of competing activity must exert an inhibitory influence.

An attentional mechanism that requires effort, that can be brought under voluntary control, and that depends upon inhibition for its operation offers substantial explanatory promise. James' writings suggested this juxtaposition about a century ago; it is remarkable that this potentially powerful theoretical tool has been ignored for so long.

Although James emphasized the role of effort in the voluntary attention concept, he did not address the possibility that this mechanism was susceptible to fatigue. While not having as well developed a concept of attention, the eminent landscape architect Frederick Law Olmsted not only understood the possibility that the capacity to focus might be fatigued, he also recognized the need for urban dwellers to recover this capacity in the context of nature. This was evident both in his approach to the design of parks, and, quite explicitly, in his writing as well (Olmsted, 1865).

More recently, clinical neurologists, working with brain-damaged patients, have identified a remarkably similar mechanism that they refer to as 'directed attention' (Mesulam, 1985). Interestingly, they relate deficits in directed attention to damage to the prefrontal cortex, a portion of the brain that has long been associated with an inhibitory role in mental functioning (Rothbart & Posner, 1985). Since the concern of clinical neurologists is with rehabilitation, their emphasis is less on specific information-processing capabilities than it is on the broader issue of getting along in the world. Thus they have been particularly concerned with the role of directed attention in 'executive functioning', the capability necessary to lead an organized and purposeful life (Lezak, 1982; Stuss & Benson, 1986).

While inspired by James' notion of voluntary attention for some time (e.g. Kaplan, 1973), we have shifted to calling this concept 'directed attention' as it avoids confusions others have had with James' terminology (Kaplan & Kaplan, 1989).

Directed attention fatigue and basic processes. Drawing together these various themes yields a mechanism with the following properties: it requires effort, plays a central role in achieving focus, is under voluntary control (at least some of the time), is susceptible to fatigue, and controls distraction through the use of inhibition. While the coherence and usefulness of this concept may not be immediately obvious, in fact it is quite familiar. What is familiar, however, is not the mechanism itself, but the state of mind that accompanies its fatigue. Any time one has worked intensely on a project and subsequently finds oneself mentally exhausted, one has experienced this unwelcome state. The typical state of mind of students at the end of a semester is a familiar example. In fact, even a thoroughly enjoyable project, if sufficiently intense and sufficiently prolonged, is likely to lead to this same outcome.

More formally, any prolonged mental effort leads to directed attention fatigue. It might seem peculiar that a mechanism so intimately involved with human effectiveness would be so susceptible to fatigue. Yet, in evolutionary perspective, this apparent limitation might have been quite reasonable. To be able to pay attention by choice to one particular thing for a long period of time would make one vulnerable to surprises. Being vigilant, being alert to one's surroundings may have been far more important than the capacity for long and intense concentration. Further, much of what was important to the evolving human—wild animals, danger, caves, blood, to name a few examples—was (and still is) innately fascinating and thus does not require directed attention. It is only in the modern world that the split between the important and the interesting has become extreme. All too often the modern human must exert effort to do the important while resisting distraction from the interesting. Thus the problem of fatigue of directed attention may well be of comparatively recent vintage.

The importance of directed attention. One might wonder just how important directed attention fatigue is. Granted that scholars who need to concentrate for long periods of time might be disadvan-

taged by this limitation. But there remains the question of how significant the fatigue of directed attention would be for people in general. It may seem unlikely that a deficiency one has never even heard of before could play a major role in human thought and human effectiveness. Nonetheless there are theoretical grounds for suspecting that directed attention fatigue can, and often does, have devastating impacts.

Selection. The capacity to solve problems is often viewed as the crowning achievement of the human mind. Even a cursory look at problem-solving reveals the central role of attention. Consider a mature individual approaching a problem. Such an individual has available a remarkable array of capabilities; there is considerable stored knowledge, along with a multiplicity of perceptual possibilities and a vast repertoire of possible actions. Much as these are powerful resources, most of them are irrelevant to the solution of any particular problem. The very richness of possibilities presents a daunting challenge. Solving a problem requires a focus on the tiny portion of one's repertoire that is pertinent to the problem at hand. It is essential to select appropriately from among the knowledge, the possible percepts, and the potential actions. Ironically, the larger the store of possibilities, the more essential is the capacity for selection. In his chapter on Reasoning (where he treated material closely akin to what we would now call problem-solving), James (1892) both emphasized the significance of selection and illustrated it in the same passage: 'To me now, writing these words, emphasis and selection seem to be the essence of the human mind. In other chapters other qualities have seemed, and will again seem, more important parts of psychology' (p. 223).

In routine behavior much of the selectivity comes from associative connections; one looks for the crucial stimulus or performs the suitable action because that solution has become habitual. But in problem-solving, where well-learned connections are often not available, some other means of selectivity is essential. This is precisely the role that has traditionally been assigned to attention (Moray, 1987). In problem-solving, where routine, associatively-based attention can not be counted on, an attentional capacity under voluntary control is particularly important.

Inhibition and affect. Just as following one's well-learned patterns is often inappropriate to the solving of problems, following the uncensored dictates of one's affective system can be equally maladaptive. As Pennebaker (1991) has pointed out, there are many times when inhibiting one's impulses and inclinations is essential. There are times one must inhibit the inclination to flee, or to act without thinking, or to act in socially unacceptable ways. Carrying out actions that are unpleasant but necessary also requires considerable inhibition. Indeed, this function is so basic that Pennebaker has characterized inhibition as 'the linchpin of health', because, like the linchpin of a wagon, it is what holds everything together. An inhibitory capacity that is under voluntary control is thus an indispensable mechanism for behaving appropriately.

Fragility. Directed attention is not, in itself, more important to problem-solving than knowledge or perception or action. Likewise, it is not necessarily the most important component of the system necessary to generate appropriate behavior. But unlike these components, it is fragile. It is susceptible to fatigue, and as such is more likely to be deficient than are the other components. It is, in other words, often the weak link in the chain. And for this reason it may well be a critical resource in problem-solving and in human effectiveness in general.

As one might expect of a mechanism with such pivotal roles, it is central to the smooth and effective operation of basic information processing functions. And as is so often the case with psychological mechanisms, its importance is most readily observed by the consequences of its absence:

Perception. Lacking effective directed attention, an individual becomes highly distractible, resulting in impaired perception of material that is not inherently engrossing.

Thought. Directed attention is necessary for stepping back from the situation one is facing, for pausing to get a larger picture of what is going on. Thus without the aid of directed attention, it is difficult to deal with situations in which the appropriate action is not immediately obvious. It is also hard to plan and to follow a plan. This leaves the individual caught up in the demands of the immediate situation, unable to transcend momentary pressures and temptations.

Action. Inhibition is essential to delay and reflection. Lacking this capability an individual behaves in a less adaptive and appropriate fashion. Without the patience and endurance necessary to carry out difficult or unpleasant tasks, behavior becomes more oriented to the short term. Social

behavior, which also depends upon inhibition, becomes less appropriate. There is also a greater inclination to be impulsive, to take unnecessary risks, and to act in an impatient and hasty manner.

Feeling. Irritability is a hallmark of a person who cannot draw on directed attention. There is an interesting contrast here to stress, which is characterized by anxiety. Anxiety often leads to seeking to be with others; irritability tends to have the opposite effect. Thus it is not surprising that there is evidence suggesting that under these conditions people are far less likely to be willing to help one another (Sherrod & Downs, 1974; Cohen & Spacapan, 1978).

Directed attention is, thus, a key ingredient in human effectiveness. The fatigue of directed attention is similarly a key ingredient in ineffectiveness and human error. Unfortunately, even momentary lapses in directed attention, at critical times, can have dire consequences. Airplane pilots, ship captains and operators of nuclear or chemical plants provide vivid examples, since for each of these roles, at least one major accident has occurred under conditions when directed attention would be predicted to be at a low ebb (Moore-Ede, 1993). In fact, a study of airline crashes when equipment was not at fault found in every instance that there were disruptions of sleep schedules for key personnel (Wolfe, 1992). As the work of Broadbent *et al.* (1982) suggests, a state of mental fatigue may well be at fault in a large percent of those cases in which accidents are attributed to 'human error'.

The Restorative Experience

The restoration of effectiveness is at the mercy of recovery from directed attention fatigue. Sleep provides one approach to recovery. While useful, it is insufficient. Certainly for serious cases of directed attention fatigue, insomnia is likely to set in long before full recovery has taken place. In order to rest directed attention, it is necessary to find some other basis for maintaining one's focus. What is needed is an alternative mode of attending that would render the use of directed attention temporarily unnecessary.

Fortunately there is a way to meet these requirements and, also fortunately, it is widely available. This notion too, like the directed attention concept, derives from James' perceptive analysis of attentional processes. In his discussion, James contrasted voluntary and involuntary attention. The latter is a form of attention that requires no effort. Although James does not deal with this explicitly, it seems reasonable to assume that both types of attention are similar in being inhibitory and in having their effect through suppression of competition. And to venture clearly beyond James' analysis, involuntary attention, requiring no effort, is likely to be resistant to fatigue. Further, while the individual is in involuntary mode, directed attention should be able to rest. Since James' terminology has been confusing for many people and the circumstances that call on the effortless attention are intrinsically compelling, we have substituted the term 'fascination' for 'involuntary attention' (Kaplan, 1995).

There are many sources and types of fascination. Some of these derive from process. For instance, otherwise normal individuals have been reported to rouse themselves out of bed at an early hour in hopes of catching a glimpse of a small, feathered animal whose identity is uncertain. Likewise many are addicted to books in which the identification of the guilty party is difficult but not impossible to predict, and generally is not resolved until the end, even though far more efficient ways to transmit the same information are surely available. Predicting despite uncertainty as practised by gamblers provides another example of process fascination.

Fascination can also come from content. As previously noted, wild animals and caves are among the many contents that do not require directed attention. In some cases extremes of size lend to the fascination of objects or settings. Fascination can also derive from extremes along a 'soft-hard' dimension. Thus, there is the 'hard' fascination of watching auto racing and 'soft' fascination of walking in a natural setting. Soft fascination—characteristic of certain natural settings—has a special advantage in terms of providing an opportunity for reflection, which can further enhance the benefits of recovering from directed attention fatigue (Kaplan, 1993). We have used the concept of 'Restorative experiences' or 'Restorative environments' to refer to such opportunities for reducing the fatigue of directed attention (Kaplan & Kaplan, 1989).

Fascination is thus a central component of a restorative experience. That is not to say, however, that the presence of fascination guarantees that directed attention can rest. Fascination is a necessary, but not sufficient basis for recovering directed attention. It is evident that some researchers have failed to understand that fascination, although important, is but one component of the model.[1] We have, in fact, proposed three additional components

that are integral to our analysis of what makes an environment restorative (Kaplan & Talbot, 1983).

(1) Being away, at least in principle, frees one from mental activity that requires directed attention support to keep going. In fact, people often use 'getting away' as a shorthand for going to a restorative place. But continuing to struggle with the old thoughts in a new setting is unlikely to be restorative. Clearly being away involves a conceptual rather than a physical transformation. A new or different environment, while potentially helpful, is not essential. A change in the direction of one's gaze, or even an old environment viewed in a new way can provide the necessary conceptual shift.

(2) The environment must have extent. It must, in other words, be rich enough and coherent enough so that it constitutes a whole other world. An endless stream of stimuli both fascinating and different from the usual would not qualify as a restorative environment for two reasons. First, lacking extent, it does not qualify as an environment, but merely an unrelated collection of impressions. And second, a restorative environment must be of sufficient scope to engage the mind. It must provide enough to see, experience, and think about so that it takes up a substantial portion of the available room in one's head.

(3) There should be compatibility between the environment and one's purposes and inclinations. In other words, the setting must fit what one is trying to do and what one would like to do.

Compatibility is a two-way street. On the one hand, a compatible environment is one where one's purposes fit what the environment demands. At the same time the environment must provide the information needed to meet one's purposes. Thus in a compatible environment one carries out one's activities smoothly and without struggle. There is no need to second guess or to keep a close eye on one's own behavior. What one does comfortably and naturally is what is appropriate to the setting (Kaplan, 1983).

The relationship of compatibility to one's purposes has several interesting implications. First, one's purposes generally are more readily achieved when one has prompt and useful feedback from the environment. An environment that is compatible will thus be a responsive environment. Second, different people's purposes vary widely. If one's purpose is to be frightened by a horror movie, a snake might be a compatible as well as a fascinating stimulus. Likewise, members of a snake-oriented religious sect might find snakes both fascinating and compatible. For a great many humans, of course, a snake would fail the compatibility criterion. Third, carrying out purposes often involves solving the problems one meets along the way. As we have seen, solving problems involves exercising selectivity, a key function of directed attention. An ambiguous or distracting environment raises many irrelevant possibilities, placing more demand on directed attention. A compatible environment requires less selectivity and hence less directed attention.

A note on cognition

It may be appropriate at this point to address a central misunderstanding of the role of information processing in restoration. Ulrich *et al.* (1991) argue that the compatibility concept is based on cognition, and that cognition is too slow a process to play a role in restoration. There is no doubt that if one defines cognition as conscious, language-based, and dependent upon reasoning, then it will in fact be a relatively slow process. Ulrich *et al.* seem to adhere to such a limited view of cognition.

By contrast, those who consider perception to be a cognitive process—among them James (1892), Bruner (1957), Attneave (1962), Shepard (1975), Hebb (1980), and Margolis (1987)—make none of these assumptions. And perception is, of course, a very rapid process. Another example of rapid cognition is the implicit prediction that people continuously make about what will happen next in the environment (Macphail, 1987). This process is generally unconscious and typically surfaces only when it is falsified by subsequent events. Thus, in an example Hebb has used, one is not aware of making a prediction when picking up a coffee cup at the breakfast table. Should it, however, turn out to contain cold beer, one is suddenly vividly aware of having made a contrary prediction.

Another example is the inference of three dimensions, made from a two dimensional array on the retina. This process is likewise fast and unconscious. There is also no doubt, terminology aside, that rapid, unconscious human information processing occurs in many forms and at many levels of the system.

Nature and the Restorative Environment

An important theme of this paper, namely, the role of the natural environment in human effectiveness, has not been forgotten. We have talked about the significant role that directed attention plays as a component of effectiveness and about the need to

reduce the fatigue of directed attention in order to restore effectiveness. We can turn now to the question of how nature relates to restoration. One approach to this issue is to consider the ways in which natural settings are particularly likely to meet each of the four requirements for a restorative environment. The second approach will be to look to the empirical literature to see what evidence is available.

Revisiting the components of restorative environments

Being away. Natural settings are often the preferred destinations for extended restorative opportunities. The seaside, the mountains, lakes, streams, forests, and meadows are all idyllic places for 'getting away'. Yet for many people in the urban context, the opportunity for getting away to such destinations is not an option. However, the sense of being away does not require that the setting be distant. Natural environments that are easily accessible thus offer an important resource for resting one's directed attention.

Fascination. Nature is certainly well-endowed with fascinating objects, as well as offering many processes that people find engrossing. Many of the fascinations afforded by the natural setting qualify as 'soft' fascinations: clouds, sunsets, snow patterns, the motion of the leaves in the breeze—these readily hold the attention, but in an undramatic fashion. Attending to these patterns is effortless, and they leave ample opportunity for thinking about other things.

Extent. In the distant wilderness, extent comes easily. But extent need not entail large tracts of land. Even a relatively small area can provide a sense of extent. Trails and paths can be designed so that small areas seem much larger. Miniaturization provides another device for providing a feeling of being in a whole different world, though the area is in itself not extensive. Japanese gardens sometimes combine both of these devices in giving the sense of scope as well as connectedness. Extent also functions at a more conceptual level. For example, settings that include historic artifacts can promote a sense of being connected to past eras and past environments and thus to a larger world.

Compatibility. The natural environment is experienced as particularly high in compatibility. It is as if there were a special resonance between the natural setting and human inclinations. For many people, functioning in the natural setting seems to require less effort than functioning in more 'civilized' settings, even though they have much greater familiarity with the latter (Cawte, 1967; Sacks, 1987).

It is interesting to consider the many patterns of relating to the natural setting. There is the predator role (such as hunting and fishing), the locomotion role (hiking, boating), the domestication of the wild role (gardening, caring for pets), the observation of other animals (bird watching, visiting zoos), survival skills (fire building, constructing shelter), and so on. People often approach natural areas with the purposes that these patterns readily fulfill already in mind, thus increasing compatibility.

A nearby, highly accessible natural environment cannot provide the context for all of these goals and purposes. Yet even such a setting is likely to be supportive of the inclinations of those who seek a respite there. Consider the factory worker, racing off during the lunch period, fighting traffic and distractions, in search of a spot in the shade of a tree for a peaceful break. If the peaceful effects were to be worn off totally by the time the return trip is made at the end of the hour, would this ritual be repeated again the next day?

Attention restoration theory and natural environments: empirical findings

Olmsted (1865) was particularly sensitive to the role of 'natural scenery' in restoration: it 'employs the mind without fatigue and yet exercises it; tranquilizes it and yet enlivens it; and thus, through the influence of the mind over the body, gives the effect of refreshing rest and reinvigoration to the whole system' (p. 22). His inspiration, as well as the insights of others with intimate knowledge of the natural setting, were most influential in the development of national parks and in numerous other conservation efforts (Nash, 1968). These early writings relied on personal experience and literary talent. Thoreau's perceptiveness and foresight are perhaps even more appreciated today than in his own time (Anderson, 1968; Stern, 1970).

While such writings have great power and provide deep inspiration for some, scientific evidence is more compelling for others. The empirical literature on nature benefits has been growing steadily (Altman & Wohlwill, 1983; Kaplan & Kaplan, 1989; Francis & Hester, 1990; Relf, 1992). Several studies have addressed the role of nature scenes in holding

attention and interest (e.g. Ulrich, 1979, 1981; as cited by Ulrich & Parsons, 1992).

There are four studies that speak directly to the relation between restorative experiences and information-processing effectiveness, a crucial issue in establishing the distinct role of directed attention. What is particularly striking about these studies is how parallel the results are, despite wide variation in setting and procedure. Several of these studies are clinical- or field-oriented, an important type of research for a theory that is intended to make a difference beyond the laboratory. Such studies bring with them their own set of challenges and limitations of experimental control. The consistency of findings both with respect to each other and with respect to laboratory research is thus particularly useful in establishing the construct validation of the concept.

In the first study, Hartig *et al.* (1991) compared wilderness vacationers with urban vacationers and a non-vacationing control group. Only individuals with backpacking experience and who were engaged in regular physical fitness regimens were included in the study. Following their trip, the wilderness group showed a significant improvement in proof-reading performance, a task that is highly demanding of directed attention. By contrast, the other two groups showed a pre-test-to-post-test decline. Interestingly, the wilderness groups had the lowest overall happiness score at the post-test. At a 3-week follow-up, however, they showed the highest levels of overall happiness.

In the second study, also reported by Hartig *et al.* (1991), participants were randomly assigned to one of three conditions. Those in the 'natural environment' and 'urban environment' conditions drove to field sites where they completed attentionally fatiguing tasks before walking for 40 minutes in the respective setting. Those in the passive relaxation condition completed the same set of tasks before spending a comparable period listening to soft music and reading magazines. The pre-treatment manipulation was intended to ensure attentional fatigue; a check on this manipulation was also included. Hartig *et al.* reported that in this more controlled study, as in the initial quasi-experimental one, those in the nature-setting condition performed better on the proof-reading task. The second study also included self-report evaluations of the 40-minute experience in terms of being away, fascination, coherence (an aspect of extent), and compatibility. These were summarized in a 'perceived restorativeness' score which was, on average, highest for the natural environment group and was positively correlated (r=0·22) with the proof-reading score.

The other two studies used a new measure that was theoretically derived specifically to test the effect of restoration on directed attention. This measure is based on the Necker cube, a wire frame drawing whose perceived orientation in depth appears to reverse over time. Necker cube fluctuation is an individual difference measure of long standing. A common interpretation of the apparent reversals is the satiation of the representation of a given perspective, thus allowing the alternative perspective to dominate (Orbach *et al.*, 1963; Cornwell, 1976). This interpretation suggests a direct parallel to situations requiring directed attention, namely the potential cessation of a given mental activity due to competition from some other mental activity. If this interpretation is correct, then by intentionally focusing on the cube as it appears at a given moment, its apparent change to the other possible orientation should be delayed. In other words, it should be possible to slow the rate of reversals through exertion of directed attention. Further, the more fatigued the directed attention, the less effective such an effort should be. Thus a high 'Necker Cube Pattern Control' score (the degree to which the rate is slowed relative to the individual's base line) should provide an indication of the strength of this inhibitory capacity.

Cimprich's (1992, 1993) clinical study of recovering cancer patients also supported the link between the restorative experience and enhanced effectiveness. Cancer patients are generally instructed in necessary self-care following discharge from the hospital. They frequently have difficulty in remembering such information, thus seriously jeopardizing attaining optimal treatment outcomes and quality of life. It has also been observed that following cancer treatment patients with a clean bill of health from a medical perspective nonetheless experience persistent and diverse coping problems, including difficulties in interpersonal relationships and limitations in returning to former activities.

Feeling that these clinical observations suggested serious problems of directed attention fatigue, Cimprich studied recovering breast cancer patients at four time points during the 3 months after surgery, using a wide range of attentional and other measures. Participants were randomly assigned to either the experimental intervention or usual care control group. The former involved having each person sign a contract agreeing to participate in three restorative activities (of at least 20 minutes each) per week. While the notion of restorative activities

was explained in broad terms with numerous examples, participants in the experimental group generally selected nature-based activities such as walking in nature and gardening to fulfil their contracted time. The control group received no information about the proposed attention-restoring activities until after the study was completed; however, to ensure that they received equal attention, time was spent in discussing the importance of usual self-care activities, such as frequent rest periods and monitoring of untoward symptoms.

Cimprich reported that the participants in both groups showed severe attentional deficits after surgery before the intervention was initiated. The experimental (restorative) group showed significant improvement in attentional performance over the four times they were measured; the control group did not. The Necker Cube Pattern Control measure was particularly sensitive to attentional changes such that the restorative group showed improvement in the capacity to limit pattern reversals, while the control group showed a significant decline in this capacity by the end of the 3-month study period. Mood scores, however, did not show a significant relationship with the measures of attentional capacity.

The intervention also appeared to have an impact on life patterns. In the restorative group, participants went back to work and were more likely to return full time. Another striking difference was the inclination of members of the restorative group to start new projects (such as losing weight, music lessons, and volunteer work). No new projects were reported by the control group participants. And finally, experimental group members showed significantly greater gains on quality of life ratings by the end of the study period.

What is particularly remarkable about this study is the effect of a very modest intervention (three activities of at least 20 minutes a week) on a problem that, according to the literature in the area, can undermine the capacity to deal with and to adjust to the effects of a serious illness such as cancer and its treatment.

Finally, Tennessen, C. & Cimprich, G. (in press) studied the possible restorative benefits of a natural view from a college dormitory window using a battery of attentional and other measures. Dormitory views ranged from all natural to all built views. Controlling for the geographic location of the buildings, undergraduates with more nature in their dormitory view scored significantly higher on the Necker Cube Pattern Control measure and the Symbol Digit Modalities Test. Those with more natural views also tended to rate themselves as functioning more effectively in daily life activities requiring directed attention than those with more built views. The observed differences in attentional performance were not related to age, gender, or year in school. Finally, there were no differences in mood state based on type of dormitory view.

Taken together these studies make it reasonable to suspect that there is a link between the restorative experience and directed attention. Further, the majority of these findings were obtained without corresponding influences on mood. Since mood enhancement is a frequent goal of stress reduction procedures (presumably to reduce the aversiveness of the stress inducing situation), this finding is suggestive of a distinctive effect of restorative experiences on directed attention.

Toward an Integration

It is time to turn to the synthesis of the stress-oriented and the attention-oriented theories of restorative experiences that Hartig and Evans (1993) encouraged. Since the stress-oriented position put forward by Ulrich *et al.* (1991) does not permit a significant role for attention, the challenge can be defined as developing an integrated theory of stress that permits such a role. Ulrich and his colleagues emphasize attentional decline (and performance decline in general) as a consequence of stress. The integration proposed here, which focuses on the various factors that lead to stress, creates a quite different perspective on the role of attentional decline.

The causes of stress

A distinction is often made between physiological and psychological theories of stress (Evans, 1982). The former concerns the autonomic nervous system reaction to harm or to a threat of harm. The latter, following Lazarus (1966), tends to focus on a cognitive appraisal of whether the individual has the resources necessary to deal with a given challenge. Fisher *et al.* (1984, p. 77), however, make the useful point that 'physiological and psychological stress reactions are interrelated, and do not occur alone'. Furthermore, they distinguish between stimuli 'aversive enough in themselves' to evoke a stress response and those requiring more information processing before a stress response occurs. The integration I propose follows the lead of Fisher *et al.* with respect to both these points. It differs in plac-

ing greater emphasis on the factors *leading* to a stress response, and particularly in the central role of resource inadequacy as a causal factor.

Let us begin with the generally accepted notion that the stress response is an organism's adaptive mobilization to deal with a potentially negative situation. The schematic organization of the factors that I propose as leading to this adaptive mobilization, depicted in Table 1, is based on two major categories, harm and resource inadequacy.

Harm can be direct, as when one is injured (either physically or psychologically). Alternatively, it can be signalled by a perceptual pattern. The latter case is in the spirit of Zajonc's (1980) 'preferences need no inferences' theme. In other words, certain patterns, like something suddenly looming in one's face, automatically indicate the threat of impending harm.

'Resource inadequacy', focuses on whether one has the resources necessary to deal with the situation one is facing (or anticipates facing at some point in the future). It is divided into three subcategories. The first, following Lazarus (1966), emphasizes the *appraisal* by which the individual determines that the available resources are insufficient. This implies a deliberative process by which a conclusion is reached.

The second subcategory also involves information processing but of a variety so much faster and so unlikely to be conscious that the term 'appraisal' would not be an appropriate description. Rather 'intuition' or even 'pre-attentive process', following Neisser (1967) would be more appropriate.

An example is provided by the mechanism by which an individual begins the process of making sense out of a scene or visual array. A crucial first step is the segmentation of a scene into 5±2 objects or regions (Lesperance, 1990). This simple but powerful process, which is believed to depend on a primitive brainstem structure (Bruce *et al.*, 1986), is essential to the process of understanding and dealing with the visual environment. As a highly adapted mechanism, it is usually successful. This is not, however, always the case. While some scenes parse readily, others resist attempts to organize them. It is hypothesized that in such cases an immediate sense of discomfort will occur. One is suddenly faced with a situation of potential confusion, a situation in which one cannot be sure one has what it takes to resolve it.

TABLE 1
Factors leading to stress

Harm	Resource inadequacy
Direct	Determined via appraisal
Perceptual pattern or signal	Determined via intuition
	Occurring through gradual depletion

These two types of resource inadequacy mark ends of a continuum. While the degree of consciousness and the speed of processing might seem to be parametric issues not worthy of major theoretical distinctions, it is, as we have seen, at the heart of an unfortunate misunderstanding of the role of information processing in stress and restoration. Ulrich *et al.* (1991) appear to avoid allowing cognition to play a role in the stress process, due to the same misconception that led them to deny the relevance of the (presumably cognitive) compatibility concept in restoration. Once again, definitional issues aside, there is overwhelming evidence that information processing can occur rapidly and without consciousness.

The third type of resource inadequacy involves neither assessment nor appraisal. Rather, it concerns circumstances in which a task, either neutral or even pleasant, gradually draws down some basic resource, leading to a stress reaction. Unlike the other members of this category, where the resource inadequacy is either predicted or anticipated, in this case there is a reaction to the actual depletion of the resource. This type of resource inadequacy is closely akin to that described by Hancock and Warm (1989), which is a central part of their model relating vigilance or sustained attention to stress.

Regardless of the type one is considering, the resource inadequacy category inevitably raises the question of what sort of resources might be involved. Sometimes resources external to the organism such as money or friends in high places are undoubtedly crucial. At other times the physical strength of the individual may be the key resource at issue. But much of the time it is likely that *psychological* resources are the crucial limiting factor. How to conceptualize such resources is, then, our next task.

A possible alternative to consider would be that there are a large number of resources that play this role. One might wonder, for example, if one had the needed empathy to handle a situation, or the needed insight, or the needed patience. The problem with this alternative is that such a list would be endless, and the time required to come to a conclusion would be prohibitive. Thus, on adaptive grounds, it seems more reasonable that there would be some basic underlying resource. This is consistent with people's behavior; when someone states that they just don't have what it takes to deal with

some forthcoming challenge, they speak as if referring to a broad, global concept.

What would the requirements be of such a resource? It would have to be important to the individual's functioning, and pervasive in its influence. It would also have to function like a resource; in other words, it would have to be subject to depletion and to subsequent inadequacy. It is perhaps hardly surprising at this point in the discussion to discover that directed attention fits these requirements remarkably well. Directed attention is important because of the central role of selectivity in human information processing, and because of the significance of inhibition in managing behavior. It is also important for the very reason that it is fragile, that it is susceptible to fatigue. As the weak link in the chain, it is a highly likely cause of incompetent or inappropriate behavior.

A potential drawback in this argument is that attention has only rarely been treated as a resource (Simon, 1978). Furthermore inhibitory attention is rarely discussed, and the fatigue of this mechanism is essentially not considered. Perhaps it is for these reasons that Ulrich *et al.* (1991) favor the 'more mainstream terms' relating to stress. In fact, there is more support than this would imply, although the conflicting uses of the term 'stress' are part of the difficulty. Hancock and Warms (1989) provide an interesting example of this. Attention, which they consider equivalent to 'psychological adaptability', is in fact the key psychological resource in their model. They characterize this attentional resource as being reduced by task demand (which they refer to, following their distinctive terminology, as 'input stress'). The loss of attentional resources in turn elicits a physiological response, which other investigators refer to as stress.[2]

(As Lazarus (1966) pointed out long ago, the original meaning of stress in the engineering context was the force or pressure directed at an object. Selye (1956) reversed the meaning of the term, using it to refer to a reaction to a pressure rather than to the pressure itself. Others, however, including Hancock and Warm, retain the original engineering usage, referring to environmental pressure as 'input stress', or, at times, simply as 'stress'.)

Thus the integration proposed here and the model proposed by Hancock and Warm have several remarkable similarities, despite the fact that the conclusions have been reached by quite different routes. In the model proposed here, as in theirs, insufficient attentional resources will often be an antecedent of stress. The proposed model differs, however, in incorporating anticipated resource insufficiencies and non-resource issues into a framework that attempts to address a broader range of factors that lead to stress.

Implications for research, past and future

While the proposed integration is consistent with much of the theorizing in the stress domain, it is in direct conflict with a particular class of theories. It is important to recognize that theories of stress vary widely, ranging from the modest to the expansive. The latter can become so broad and diffuse as to cover everything and explain nothing.

One of the claims characteristic of the very broad theories of stress is that stress not only has physiological and experiential consequences, but that it has extensive impacts on performance as well. A number of studies have been cited as supporting one aspect or another of this very broad approach. However, one of the contributions of the integration proposed here is to indicate how challenging it is to carry out research that speaks to these issues in an unambiguous fashion. The central difficulty is that under a wide range of circumstances one would expect resource deficiencies and stress responses to occur together. Thus, although the contributions of directed attention and stress are distinct, the frequent co-occurrence could readily lead to the assumption that one concept subsumes the other.

Figure 1 illustrates three patterns that would tend to lead to the joint presence of resource deficiencies and stress responses. In Pattern A resource deficiency is a precursor of stress. In Pattern B, by contrast, stress is not resource-based (e.g. stress associated with pain and injury), but rather leads to resource deficiency. Pattern C includes those many circumstances (including manipulations popular in stress research) that simultaneously cause both stress and resource depletion. An interesting example of this pattern is provided by the work of Pennebaker (1991). He has shown that listening to a description of a traumatic experience is itself stressful. He also points out that people tend to avoid hearing about the traumas of others when they can avoid it. It follows that behaving in a socially (and humanely) appropriate way in such a situation (as opposed to running away) requires inhibitory control. Being stuck in a situation where one is exposed to a depiction of trauma (as occurs in studies such as that of Ulrich *et al.*) would thus be expected to be both fatiguing of the basic attentional resource and stressful at the same time. Comparably, the exhausting task used in the second study reported by Hartig *et al.* (1991) was very prob-

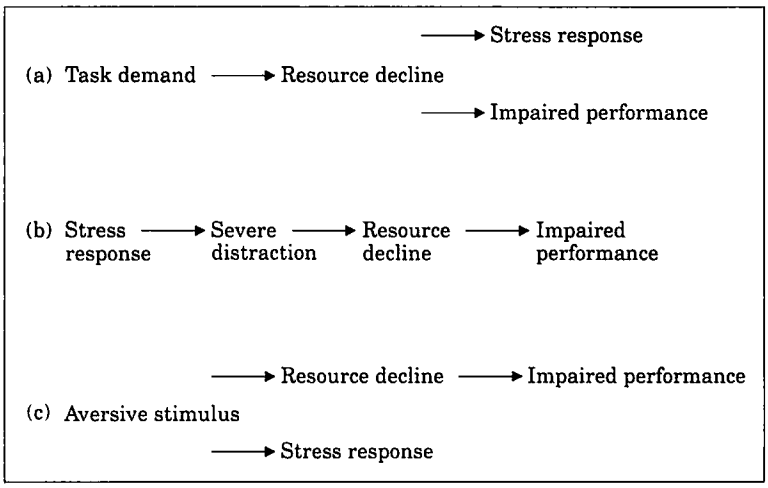

FIGURE 1. Causal linkages associated with impaired performance, illustrating the potential impacts of both the harm and resource inadequacy components of the proposed integration.

ably stressful as well as fatiguing. Clearly the confounding of these variables is a common property of much research in this area which has tended to stand in the way of an understanding of the causal relationships involved.

Given this confounding of stress and attention in so much research, the co-occurrence of stress and performance decline needs to be interpreted with caution. It is inappropriate to jump to the conclusion that stress is the cause of impairment in such cases. Fatigue of attention may well be the causal factor, for the very reason that selectivity and inhibitory control are so central to effective information processing.

The challenge facing research attempting to obtain unambiguous evidence in this area is illustrated by two studies which, although cited as supporting a broad stress theory, are entirely consistent with the expectations of the integrative framework proposed here.

Bohnen *et al.* (1990) studied the impact of continuous mental tasks (accompanied by noise) on stress and performance. Although performance was not impaired for the group as a whole, the participants with higher cortisol reactions (the stress measure used in this study) showed a greater attentional deficit. While the authors prefer the 'stress leads to impaired performance' interpretation, they openly acknowledge that the stress response may be 'a marker for ineffective coping with the demands of continuous tasks', or in other words, an outcome of resource depletion.

Another study suggestive of the effect of resource depletion utilized a pleasant (as rated by participants) learning task at a video display terminal as an independent variable (Lundberg *et al.*, 1993). Several physiological measures of stress were elevated following termination of the task. This study has been cited by proponents of broad stress theory as an example of stress occurring without an aversive stimulus. It would seem, however, that the resource depletion concept allows a more adequate explanation. Even tasks perceived as pleasant by participants can lead in time to resource depletion and ultimately to a stress response.

The fact that resource depletion takes time is part of a larger set of temporal issues that cry out for exploration. Attentional fatigue is slower to develop than is stress. It is also slower to recover. Hartig (1993) found that while stress recovery occurs more rapidly, it also dissipates more rapidly. Recovery from mental fatigue, while a slow process, may also be more durable. Clearly more information on these temporal parameters is urgently needed.

A second set of temporal issues has implications for the design of future studies in this area. As Fig. 1 suggests, a resource decline can lead to stress and a stress response can lead to a resource decline. Thus, even if care is taken to select manipulations that are relatively pure with respect to their impact on either directed attention fatigue or stress, the duration of the manipulation must be carefully chosen to keep the attentional fatigue from becoming stressful or vice versa.

Conclusion

The concept of stress is invoked in common usage under a wide assortment of circumstances. One is

'stressed out' when tired, pressured, anxious, exasperated. Feelings of stress can certainly lead to a sense of ineptitude and to being distraught. There are, however, both practical and theoretical reasons for being more analytic about the diverse situations that are so casually cast as 'stress'. The purpose of this paper has been to propose a framework that distinguishes between the stress-related and the attentional components that lead people to seek and benefit from restorative experiences. To earn its keep, the proposed framework should provide insight into matters not illuminated by previous theory. Here are four examples where this is the case:

(1) It explains how information-processing demands are related to attentional fatigue, and, under certain circumstances, to stress.

(2) It explains how one can enjoy what one is doing, be good at it, and confident of a positive outcome and still be exhausted from it.

(3) It explains why the two classes of experiences, one involving fatigue and the other, stress, can feel so different. Any theory that ignores these profound phenomenological differences is throwing away some important information.

(4) It explains how the same task can be stressful at one time and not at another. An individual already fatigued (experiencing resource inadequacy) could find a challenge overwhelming even though the same individual in a rested state might consider the same challenge to be minor. Individuals coming back from vacation sometimes find that a matter long avoided is experienced as relatively trivial given their rested state of mind.

In summary the proposed integration points to the existence of two distinct, albeit interacting, benefits of restorative experiences. Both of these benefits have an important role in an individual's life. Quite obviously anything that aids in the management of stress is desirable. At the same time, however, directed attention also plays a significant role. It is essential to a coherent life and to the identification and carrying out of worthwhile purposes. Looking back on a life of purpose and productivity, even if one experienced some stress along the way, might well be more satisfying than looking back on a stress-free life in which little was accomplished.

The proposed integration also makes a contribution to a larger theory of how humans relate to their environment. It points to the significant role that directed attention, a key psychological resource, plays in coping with challenges. In this perspective the role that natural environments play is a powerful one. Experience in natural environments can not only help mitigate stress; it can also prevent it through aiding in the recovery of this essential resource.

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Notes

(1) Ulrich *et al.* (1991, p. 206) state, 'However an assessment of the viability of a restoration explanation that emphasizes fascination should also take into account the fact that several scientific studies have shown that settings containing certain types of natural stimuli, such as snakes and spiders, do elicit strong "involuntary" attention or fascination, yet the effects are anything but restorative'. Although previous papers have discussed the four proposed components of a restorative experience, Ulrich and his colleagues have apparently misinterpreted the other three components as alternative sources of fascination.

(2) The Hancock and Warm (1989) model is in fact more complicated than this, depending upon an optimal task demand that can vary '... between extreme values of underload and overload. A zone of comfort is located at the central position of this continuum' (p. 527). Despite this complication, however, their basic model focuses on resource depletion. Task demands tax the individual's attentional resources, ultimately resulting in a stress response.

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